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Analysis of Hemodialysis Unit Costs Using the Double Distribution Approach to Enhance Hospital Profitability: A Case Study at YARSI Hospital in Jakarta, Indonesia

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ABSTRACT Chronic Kidney Disease (CKD) represents a major and growing health challenge globally and in Indonesia, with the number of patients requiring hemodialysis increasing sharply in recent years. This surge in demand places significant financial pressure on healthcare institutions, necessitating precise cost management to maintain service quality and hospital sustainability. This study aims to calculate the actual unit cost of hemodialysis at YARSI Hospital using the Double Distribution (DD) method, which provides a transparent allocation of both direct and indirect costs. Employing a quantitative descriptive case study design, data were collected from hospital financial records and service documentation for 16,789 hemodialysis sessions conducted during 2024. The DD method was applied in two stages: distributing overhead costs to intermediate cost centers, and subsequently distributing intermediate costs such as those related to pharmacy, laboratory, and medical personnel to final service centers. The analysis revealed that the unit cost of Single-Use hemodialysis was IDR 1,927,643, while Re-Use hemodialysis was IDR 1,956,284. The minimal difference between the two systems indicates that high utilization volume significantly influences cost efficiency. These findings confirm that the DD method enables hospitals to obtain a more accurate understanding of cost structures, thereby supporting evidence-based decision-making in pricing and resource management. In conclusion, implementing the Double Distribution approach can enhance cost transparency, optimize efficiency, and guide hospitals in establishing rational service rates without compromising care quality. Future research should involve multi-hospital comparisons to strengthen the generalizability of cost-efficiency models in hemodialysis services.

INDEX TERMS Chronic Kidney Disease, Hemodialysis, Double Distribution, Unit Cost Analysis, Hospital Profitability

I. INTRODUCTION

Chronic Kidney Disease (CKD) has emerged as a growing public health concern globally, with a steady increase in its prevalence due to lifestyle changes, aging populations, and rising rates of diabetes and hypertension [1]–[3]. CKD imposes significant clinical and economic burdens, particularly in low- and middle-income countries such as Indonesia, where healthcare financing systems are under strain [4], [5]. The Indonesian Ministry of Health projected that by 2024, approximately 1.5 million individuals will suffer from CKD, and more than 134,000 of them will require regular hemodialysis treatment [6]. This dramatic growth not only challenges hospital capacity but also demands efficient cost management to ensure the sustainability and quality of care.

Hemodialysis is an essential renal replacement therapy that removes metabolic waste and excess fluids from the blood when kidney function declines. However, it is among the most resource-intensive procedures in modern hospitals [7]. The high operational costs arise from the need for specialized equipment, consumable supplies, skilled personnel, and strict infection control measures [8], [9]. Hospitals must therefore balance between providing accessible, high-quality hemodialysis services and maintaining financial sustainability under Indonesia's National Health Insurance (JKN) reimbursement system [10]. Inaccurate cost estimation can lead to suboptimal pricing strategies, misallocation of resources, and long-term financial deficits [11].

The accurate determination of unit costs is fundamental to effective hospital financial management. Conventional costing approaches, such as Activity-Based Costing (ABC) and Step-Down methods, have been widely applied to healthcare services [12], [13]. However, these models often oversimplify the allocation of indirect costs, leading to distorted cost structures [14]. The **Double Distribution (DD) method** has recently gained attention as a more comprehensive and transparent approach. It distributes

overhead costs first to intermediate centers (e.g., pharmacy, laboratory) and subsequently from these centers to final service units (e.g., hemodialysis) [15]. This two-stage process provides more accurate and replicable cost allocations compared to traditional models [16], [17]. Several studies in Indonesia and other developing countries have demonstrated that DD offers superior accuracy in cost allocation and supports evidence-based decision-making for hospital tariff setting [18]–[21].

Despite the method's potential, research applying the Double Distribution approach to hemodialysis cost analysis in Indonesia remains scarce. Most local studies have focused on Activity-Based or Step-Down costing, overlooking indirect and overhead allocations that significantly influence real service costs [22], [23]. Moreover, few studies have compared **Single-Use** and **Re-Use** dialysis systems within the same institutional context, limiting understanding of cost efficiency across utilization scales [24]. Hence, there is a pressing need to employ the Double Distribution method in hospital cost analysis to improve accuracy, transparency, and financial decision-making.

This study aims to analyze the **unit cost of hemodialysis services** at YARSI Hospital using the **Double Distribution approach**. Specifically, it seeks to (1) calculate real unit costs for Single-Use and Re-Use hemodialysis procedures, (2) assess the impact of overhead and intermediate cost allocations on total service costs, and (3) provide strategic insights to enhance hospital profitability while maintaining service quality.

The main contributions of this research are threefold. First, it offers a **comprehensive cost analysis framework** that incorporates all relevant cost components, including overhead and intermediate allocations. Second, it provides **empirical evidence** of the financial implications of different hemodialysis modalities within an Indonesian hospital setting. Third, it delivers **practical recommendations** for hospital administrators to improve cost efficiency and pricing transparency through DD-based budgeting models.

II. METHOD

A. STUDY DESIGN

This research employed a quantitative descriptive case study design focusing on YARSI Hospital in Jakarta, Indonesia, as a single institutional setting. The study aimed to calculate and analyze the unit cost of hemodialysis services using the Double Distribution (DD) method. This approach was selected for its systematic and transparent cost allocation process, which allows hospitals to identify the contribution of overhead and intermediate costs to the final unit cost of medical procedures. The research design is retrospective, utilizing existing financial and operational records from the fiscal year January–December 2024. This design enabled a comprehensive evaluation of cost elements without influencing ongoing clinical operations [28], [29].

B. STUDY SITE AND POPULATION

The study site, YARSI Hospital, is a private, sharia-compliant tertiary healthcare facility located in Jakarta. It operates a fully equipped Hemodialysis Unit managed by nephrology specialists, general practitioners certified in hemodialysis, and trained dialysis nurses. The hospital provides both Single-Use and Re-Use hemodialysis systems, allowing for comparative cost evaluation within the same clinical environment. The study population consisted of all hemodialysis sessions performed during 2024. A total of 16,789 dialysis procedures were included, comprising both Single-Use and Re-Use modalities. No randomization was applied, as this was a non-experimental, observational study based entirely on secondary administrative and financial data.

C. DATA TYPE AND SOURCE

All data were validated by cross-referencing between multiple departments to ensure accuracy and consistency. Missing data were resolved through triangulation using comparable reports from Pharmacy, Laboratory, and Finance units [30]. Data collection relied exclusively on secondary data obtained from the hospital's official records. The primary data sources included:

1. **Financial reports** from the Accounting and Cost Control Unit;
2. **Operational and service records** from the Hemodialysis Installation;
3. **Supporting department records**, including Pharmacy, Laboratory, Radiology, and Maintenance units;
4. **Administrative documents**, such as staffing lists, utility bills, and maintenance logs; and
5. **Electronic Medical Record (EMR)** summaries related to dialysis service volume and frequency.

D. COST CLASSIFICATION FRAMEWORK

This structured framework allows for systematic allocation of costs from general and supporting departments to direct patient care centers [31]. The total cost of hemodialysis services was categorized into three cost centers, consistent with the Double Distribution cost allocation model:

1. Overhead Cost Centers (General Services): These included administration, facility maintenance, security, utilities, and hospital information systems.
2. Intermediate Cost Centers (Supporting Medical Services): Comprising departments indirectly supporting clinical operations, such as Pharmacy, Laboratory, Radiology, and Central Sterile Supply Department (CSSD).
3. Final Cost Centers (Direct Medical Services): Representing clinical units directly providing patient services, including the Hemodialysis Unit.

E. DOUBLE DISTRIBUTION (DD) METHOD

Following these distributions, the final unit cost was computed by dividing the total allocated costs for each dialysis modality (Single-Use or Re-Use) by the total number of corresponding dialysis sessions performed during 2024. The Double Distribution method was implemented in two sequential stages to allocate costs transparently:

1. **Stage 1 – Overhead Cost Distribution**: Overhead costs were distributed proportionally to both intermediate and final cost centers using allocation bases such as number of staff, hospital floor area, number of patient days, and total service utilization. For instance, electricity and facility

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maintenance were distributed based on floor area, while administrative and training costs were allocated based on staff numbers [32].

2. **Stage 2 – Intermediate Cost Distribution**: In the second phase, costs accumulated in intermediate centers (e.g., Pharmacy, Laboratory) were redistributed to the final service centers including the Hemodialysis Unit according to utilization metrics. Allocation keys included the number of laboratory tests per dialysis session, drug usage frequency, and radiology referrals per patient [33].

F. DATA ANALYSIS PROCEDURES

Currency conversions were maintained in Indonesian Rupiah (IDR), reflecting 2024 fiscal conditions. All financial data were compiled and analyzed using Microsoft Excel 365 for preliminary tabulation and validation, followed by IBM SPSS Statistics v26 for descriptive and cost-per-unit computations. The analysis involved:

1. Summation of total real costs per cost center;
2. Sequential allocation through DD stages;
3. Computation of total and unit costs for Single-Use and Re-Use modalities;
4. Comparative analysis to assess differences and identify cost drivers.

G. QUALITY CONTROL AND VALIDATION

Data confidentiality was maintained under the hospital's ethical data use policy. Since the study did not involve human subjects or interventions, ethical clearance was not required; however, the research was conducted with formal permission from YARSI Hospital management. To ensure data reliability and validity, several verification steps were conducted:

1. Cross-departmental review among accounting, finance, and hemodialysis units;
2. Reconciliation of overhead and intermediate cost totals after each distribution stage;
3. Sensitivity analysis to verify the impact of potential cost allocation changes (±10% variation).

H. STUDY LIMITATIONS AND REPLICABILITY STATEMENT

While comprehensive, the study was limited by its single-hospital scope and retrospective design, which may restrict generalizability to other institutions with different operational models or resource utilization patterns. Future research should incorporate multi-hospital datasets to validate findings and evaluate regional cost variations. All costing steps, allocation bases, and calculation formulas were documented and archived. Any hospital with similar departmental structures can replicate this analysis by substituting local financial data into the same Double Distribution model, ensuring methodological reproducibility [34].

III. RESULTS

This study aims to analyze the unit cost of hemodialysis using the Double Distribution method at YARSI Hospital. This approach was chosen because of its ability to accurately distribute indirect costs to relevant cost centers, thus providing a clearer picture of the costs incurred to carry out hemodialysis procedures. The results obtained provide a comprehensive picture of the costs involved in providing hemodialysis services at this hospital in 202. The more complete and accurate data is the key to the success of the size of the Hemodialysis unit cost. The data collection required in the unit cost calculation activity is to add up real cost data into groups: General Cost Center (Overhead Cost Center), Medical Support Cost Center (Intermediate Cost Center) and Medical Service Cost Center (Final Cost Center) [6].

The Double Distribution method is carried out in two stages of distribution. The first stage involves the distribution of overhead costs (such as administrative costs and facility maintenance) to various relevant cost centers, while the second stage involves the distribution of intermediate costs (such as medical personnel costs) to hemodialysis procedures [7].

TABLE 1
Overhead Cost

No	Cost Center	Cost 2024
1	Pharmacy	20.966.878.693
2	Radiology	8.443.953.369
3	Laboratory	9.263.381.968
4	Medical Rehabilitation	1.649.550.890
5	Psychosocial Rehabilitation / Occupational Rehabilitation	-
6	Intensive Care Unit (ICU) / ICCU / HCU	11.673.565.572
7	NICU & PICU	3.909.824.755
8	Stroke Unit	1.576.586.869
9	Central Surgical Installation	13.417.030.381
10	ER	3.926.620.322
11	Medical Care	292.724.621
12	Hemodialysis	11.174.176.480
13	Blood Bank	446.706.131
14	Tissue Bank	-
15	Others	-
16	**Total**	**86.741.000.049**

Based on TABLE 1 are calculated based on the allocation base used, such as the number of staff or the floor space of the hospital facility. Using this allocation base, the relevant costs are distributed proportionally to each cost center.

Based on TABLE 2, intermediate costs directly related to medical services, such as medical personnel and medical equipment costs, are allocated to more specific cost centers, such as hemodialysis procedures [9].

Based on TABLE 3 carried out using the Double Distribution method, the total cost of hemodialysis at YARSI Hospital for 2024 was calculated by combining direct and indirect costs. The following is a calculation of the total costs incurred for hemodialysis services [8].

Using this calculation, YARSI Hospital can see the total costs of performing hemodialysis procedures and compare this to the revenue generated from the fees charged to patients.

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This information is crucial for helping the hospital design more efficient cost management strategies.

This is the distribution of cost allocations resulting from the first distribution from the general administration group to the medical support and medical services groups. This stage will yield the values from the second distribution stage. This study aims to calculate the real unit cost of single-use hemodialysis and the actual cost of single-use hemodialysis.

TABLE 2
Allocation Factor from Overhead

No	Cost Centers	Allocation Basis
1	Administration	Number of Staff
2	Hospital Facilities Maintenance	Floor Area
3	Power & Service Subscription Fees	Floor Area
4	Telephone, Internet, and Fax	Number of Staff
5	Cleaning Services	Floor Area
6	Security	Number of Staff
7	Consumables	Number of Staff
8	Hospital Information System	Number of Staff
9	Library	Number of Staff
10	Taxes and Insurance	Number of Staff
11	CSSD	Number of Hospital Days
12	Nutrition	Number of Hospital Days
13	Medical Records	Number of Patients
14	Laundry and Linen	Number of Hospital Days
15	Training	Number of Staff

TABLE 3
Double distribution Stage I

No	Medical Support Cost Center (Intermediate)	Real Cost	Distribution I
18	Pharmacy	Rp20.966.878.693	Rp25.172.694.123
19	Radiology	Rp8.443.953.369	Rp10.527.421.377
20	Laboratory	Rp9.263.381.968	Rp13.011.362.071
21	Medical Rehabilitation	Rp1.649.550.890	Rp3.527.426.425
22	Psychosocial Rehabilitation / Occupational Rehabilitation	-	-
23	Intensive Care Unit (ICU) / ICCU / HCU	Rp11.673.565.572	Rp17.901.517.520
24	NICU & PICU	Rp3.909.824.755	Rp5.311.506.205
25	Stroke Unit	Rp1.576.586.869	Rp2.075.086.808
26	Central Surgical Installation	Rp13.417.030.381	Rp19.669.162.519
27	ER	Rp3.926.620.322	Rp7.346.957.509
28	Medical Embalming	Rp292.724.621	Rp694.962.366
29	Hemodialysis	Rp11.174.176.480	Rp18.920.981.321
30	Blood Bank	Rp446.706.131	Rp983.223.072
31	Tissue Bank	-	-
32	Others	-	-

From TABLE 4, the distribution of stage I for hemodialysis burden / total cost is Rp / 15,044,639,491 for Re use and Rp. 15,525 / 634 for single use. The Double Distribution approach provided a detailed view of costs by integrating direct, indirect, and overhead allocations. Key findings:

1. The unit cost for Single-Use hemodialysis was Rp. 1,927,643.
2. The unit cost for Re-Use hemodialysis was Rp. 1,956,284.
3. The small difference between the two is largely due to the high procedure volume (16,789 sessions in 2024).

Tables summarizing overhead and intermediate allocations strengthen the reliability of these calculations. The narrative highlights that despite cost similarities, efficiency opportunities remain in overhead reduction and better resource utilization.

TABLE 4
Double Distribution Stage II

No	Center Cost	Distribution Cost I	Real Cost	Total Cost I I
1	Hemodialisa Re Use	Rp3.570.463.011	Rp11.174.176.480	Rp14.744.639.491
2	Hemodialisa Single Use	Rp3.505.867.198	Rp12.019.626.436	Rp15.525.493.634

IV. DISCUSSION

A. INTERPRETATION OF FINDINGS

The results of this study revealed that the unit costs for hemodialysis at YARSI Hospital were IDR 1,927,643 for the Single-Use system and IDR 1,956,284 for the Re-Use system. The relatively small difference of approximately 1.5% indicates that both methods produce comparable financial outcomes under conditions of high procedure volume. This finding underscores the importance of capacity utilization as a determinant of per-session cost efficiency in hemodialysis operations [38].

The Double Distribution (DD) method used in this study provided a comprehensive picture of total costs by integrating overhead and intermediate cost allocations into the final cost calculation. Through its two-stage allocation framework, DD effectively captured costs that are often overlooked in conventional costing methods, such as administrative overhead, maintenance, and indirect medical support [39]. The transparency achieved through this approach enabled YARSI Hospital to identify key cost drivers, including utility usage, facility maintenance, and human resource distribution.

The minimal cost difference between Single-Use and Re-Use dialysis is largely attributable to high utilization rates, which dilute fixed overhead costs across a greater number of sessions. This relationship supports the economic principle of economies of scale, where increasing operational volume results in lower unit costs. Moreover, the similar cost structure between the two modalities suggests that the Re-Use system though requiring sterilization and monitoring does not necessarily guarantee significant cost savings when performed at large volumes [40].

The findings also indicate that indirect and overhead costs constitute a significant portion of total service costs, often exceeding 60% of total expenditure. This aligns with previous literature emphasizing that in hospital-based dialysis services, fixed operational costs such as utilities, human resources, and maintenance dominate over consumables [41]. Therefore, cost management strategies should prioritize optimizing overhead

efficiency rather than focusing solely on reducing material use.

B. COMPARISON WITH SIMILAR STUDIES

The outcomes of this study are consistent with several national and international investigations analyzing dialysis cost structures. Agada-Amade et al. (2024) in Nigeria found that overhead costs represented nearly 65% of total dialysis expenditures, emphasizing that staff salaries and utilities are the primary cost drivers [42]. Similarly, Jiménez-Ramírez et al. (2023) reported in the Dominican Republic that the mean cost per hemodialysis session was USD 137.5, where indirect costs accounted for the majority of expenditures. These findings reinforce the observation that cost efficiency in dialysis is more closely linked to hospital-level management than to material usage.

In the Indonesian context, Nurmansyah et al. (2025) applied the Double Distribution model to basic hospital pricing and observed that indirect costs could contribute up to 70% of total service expenses [43]. Their conclusion aligns with this study, confirming the method's accuracy in providing a realistic financial picture and enabling hospitals to make rational pricing decisions. Furthermore, Vinawaty et al. (2022) and Bahaswan & Pribadi (2022) also demonstrated that the DD approach provided superior precision compared to Activity-Based Costing (ABC), which tends to underestimate overhead allocations in hospital settings [44], [45].

While the similarity between Single-Use and Re-Use costs found in this study may seem counterintuitive, it is comparable with results from a Sri Lankan multi-center study, which showed that cost differences between modalities diminish when hospitals operate at high capacity [46]. In contrast, smaller institutions with lower patient volumes tend to experience greater cost disparities between Single-Use and Re-Use systems due to inefficient overhead allocation [47]. These comparisons affirm that the financial viability of Re-Use dialysis depends heavily on operational scale, quality assurance systems, and sterilization management efficiency.

However, some differences also emerge when comparing this study to research from developed economies. For example, a Japanese cost-effectiveness study found that Single-Use dialysis was significantly more expensive than Re-Use, primarily due to stricter infection control regulations and higher labor costs [48]. This contrast suggests that contextual factors such as national health policies, wage structures, and infrastructure availability greatly influence cost outcomes. Thus, results derived from one health system cannot be generalized without considering local operational and regulatory contexts.

The application of the DD method in this study also aligns with international trends emphasizing data-driven hospital financial management. Recent literature supports the adoption of multi-stage cost allocation models for complex medical services to improve cost transparency and accountability [49]. Compared with conventional methods like Step-Down Allocation, DD captures reciprocal relationships among cost centers, thereby reducing estimation bias and enhancing precision in hospital budgeting [50]. Consequently, the findings from this study confirm that the DD approach is both theoretically robust and practically applicable for developing countries aiming to modernize their hospital cost accounting systems.

C. LIMITATIONS, WEAKNESS, AND IMPLICATIONS

Despite its comprehensive nature, this study presents several limitations. First, it is confined to a single hospital and based on data from a one-year period (2024). Thus, the findings may not be generalizable to other hospitals with different organizational structures, staffing patterns, or resource utilization levels. Second, the study relies exclusively on secondary data, which may contain inconsistencies in documentation or recording practices. Although cross-departmental validation and triangulation were conducted, minor inaccuracies may persist. Third, the study did not incorporate patient outcome metrics, such as satisfaction, infection rates, or quality-of-life measures, which could enhance the interpretation of cost-effectiveness beyond financial dimensions [51].

Nevertheless, the study holds several practical implications. First, it demonstrates the feasibility of using the Double Distribution method for precise cost accounting in complex hospital environments. This method allows hospital administrators to identify cost inefficiencies across overhead, intermediate, and final service centers, thus enabling targeted interventions such as resource reallocation or process redesign [52]. Second, the findings provide empirical evidence to support tariff adjustments that reflect actual costs while maintaining affordability for patients under the National Health Insurance (JKN) system. Rational pricing based on accurate cost data can strengthen financial sustainability and minimize cross-subsidization among departments [53].

Third, the study highlights that optimizing capacity utilization is a key determinant of dialysis cost efficiency. Hospitals performing large volumes of hemodialysis sessions can achieve lower unit costs due to economies of scale. Conversely, underutilization of dialysis machines can inflate costs per session and erode profitability. Hence, hospital management should continuously monitor utilization rates, schedule optimization, and preventive maintenance to maintain high operational efficiency [54].

From a policy perspective, the findings underscore the need for standardized costing methodologies across hospitals. The absence of uniform cost accounting practices often leads to discrepancies in tariff structures and reimbursement rates, undermining fairness within the national healthcare system. The adoption of DD as a standard framework could enhance transparency and enable policymakers to make more equitable funding allocations [55].

Moreover, in terms of future research, integrating cost data with patient safety and clinical outcomes would offer a more holistic view of hemodialysis service performance. Future multi-center studies should compare different cost allocation models such as DD, ABC, and Time-Driven Activity-Based Costing (TDABC) to determine the most efficient approach under diverse healthcare settings. Additionally, digital health tools and hospital information systems can be leveraged to

automate cost tracking and improve real-time decision-making accuracy [56].

In summary, the results from this study affirm that the Double Distribution method provides an effective and replicable framework for calculating hospital service costs with high precision. The near-equivalence of Single-Use and Re-Use hemodialysis unit costs highlights the dominant influence of overhead and intermediate expenses, particularly under high-volume conditions. By improving transparency in cost allocation and facilitating rational tariff setting, the DD method can significantly contribute to both hospital profitability and the sustainability of national healthcare systems.

V. CONCLUSION

This study aimed to determine the real unit cost of hemodialysis services at YARSI Hospital using the **Double Distribution (DD)** method as a strategic approach to enhance cost transparency and hospital profitability. The analysis covered both **Single-Use and Re-Use dialysis systems**, integrating direct, indirect, and overhead cost components from fiscal year 2024. The results revealed that the **unit cost for Single-Use hemodialysis was IDR 1,927,643**, while the **Re-Use system cost IDR 1,956,284**, showing a minimal difference of approximately 1.5%. This small variation suggests that both systems yield comparable financial outcomes, largely driven by high utilization volumes totaling **16,789 sessions in 2024** which effectively diluted fixed overhead costs. The DD method proved advantageous in producing accurate and replicable cost estimates by systematically allocating overhead to intermediate and final cost centers, offering hospitals a more precise understanding of their cost structure. The findings indicate that indirect and overhead expenses represent the largest share of total hemodialysis costs, emphasizing the need for managerial focus on optimizing these elements rather than solely reducing consumable usage. Moreover, the study highlights the strategic importance of efficient resource utilization, facility management, and rational tariff setting to sustain hospital operations under the National Health Insurance (JKN) reimbursement scheme. Future work should expand this research to a **multi-hospital comparative study**, integrating **patient outcome indicators** such as quality of life, infection control, and satisfaction measures, to assess not only the financial but also the clinical efficiency of hemodialysis services. Additionally, applying digitalized costing systems and exploring advanced cost models such as **Time-Driven Activity-Based Costing (TDABC)** may further enhance accuracy and operational decision-making in healthcare financial management.

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DATA AVAILABILITY

No datasets were generated or analyzed during the current study.

AUTHOR CONTRIBUTION

All authors contributed substantially to the conception, design, and execution of this study. **Wendi Pradiyatmoko** formulated the research concept, designed the study methodology, and led the overall analysis and manuscript preparation. **Hulmansyah** and **Laura Mayanda** were responsible for data acquisition, cost classification, and financial analysis, ensuring data accuracy and completeness. **Dicky Budiman** contributed to the theoretical framework, comparative literature review, and integration of international perspectives related to cost management. **Misbahul Munir** provided critical oversight for data validation and statistical processing to ensure methodological rigor. **Danial Rasyid** supervised the project administration, coordinated institutional collaboration, and reviewed the final manuscript for intellectual and academic coherence. All authors discussed the results, contributed to the interpretation of findings, and approved the final version of the manuscript for publication.

DECLARATIONS

ETHICAL APPROVAL

This study did not involve human participants, patient data, or any form of clinical intervention. Therefore, ethical approval and informed consent were not required. However, the study was conducted with permission from YARSI Hospital management, and all institutional data were handled confidentially and in accordance with hospital data protection policies.

CONSENT FOR PUBLICATION PARTICIPANTS.

All authors have read and approved the final version of this manuscript and consent to its publication in the *International Journal of Advanced Health Science and Technology (IJAHST).*

COMPETING INTERESTS

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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