Activity Based Costing and Cost Recovery Rate of Ureteroscopy Under Indonesia's INA-CBGs Payment System

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Abstract

Universal Health Coverage (UHC) sustainability in Low-and Middle-Income Countries (LMICs) hinges on adequate Diagnosis-Related Group (DRG) tariffs, which frequently fail to cover the true cost of complex, high-technology procedures. This study aimed to estimate the actual unit cost of 360 Ureteroscopy (URS) encounters (January–December 2023) using Activity-Based Costing (ABC) and assess the resultant Cost Recovery Rate (CRR) under Indonesia's INA-CBGs payment system. A retrospective descriptive quantitative design cost analysis was performed at RSI Sultan Agung Semarang. The ABC unit cost ranged from IDR 9.322.737 (Class I) to IDR 8.322.737 (Class III). Compared to the INA-CBGs tariff, a significant and consistent deficit was found exclusively in Class III procedures, yielding the lowest CRR of 69%. The deficit was primarily driven by high expenditure on imported consumables and Operating Room time. Conclusion and Contribution: The INA-CBGs tariff is structurally inadequate for high-severity URS cases, threatening hospital financial sustainability. This study provides the first ABC micro-costing evidence linked to INA-CBGs for urological procedures, offering critical data to policymakers for a targeted tariff review and enabling hospital management to optimize key cost drivers

Keywords: Diagnosis-Related Groups, Activity-Based Costing (ABC), Cost Recovery Rate (CRR), Ureteroscopy (URS), Universal Health Coverage (UHC), Unit Cost

INTRODUCTION

The financial sustainability of Universal Health Coverage (UHC) remains a central challenge for Low- and Middle-Income Countries (LMICs) globally. To balance accessibility with cost control, many nations, including Indonesia, have adopted prospective payment mechanisms, specifically Diagnosis-Related Groups (DRGs) (Gauld, 2020; Hanson et al., 2022). While effective in controlling government expenditure, this system creates financial risk for providers when the prospective tariff fails to cover the true unit cost of complex, capital-intensive procedures. This tariff disparity directly threatens the quality of care and limits technological investment, compromising the core goals of UHC (World Health Organization, 2020; Zou et al., 2020).

The development of the National Health Insurance (JKN) system in Indonesia, mandated by Presidential Regulation No. 12 of 2013, fundamentally restructured the national healthcare financing landscape (Kementerian Kesehatan Republik Indonesia, 2013b). This regulation shifted the payment model from fee-for-service to a prospective case-based payment system known as the Indonesian Case-Based Groups (INA-CBGs), an adaptation of the DRG

model. This shift necessitates that hospitals manage costs with high efficiency, as reimbursements are fixed package payments irrespective of the volume of services provided (Kementerian Kesehatan Republik Indonesia, 2013a). Consequently, quality control and cost control have become two inseparable concepts, explicitly driving the need for optimized clinical practice through tools like the Clinical Pathway (CP). Therefore, to address this cost challenge, hospitals in Indonesia are beginning to adopt various management approaches, one of which is the Clinical Pathway (CP) (Pinzon, 2007; Ramayani et al., 2024). CP is a multidisciplinary guide designed to optimize the patient care process, minimize variation in clinical practice, and control costs without compromising quality (Fitria et al., 2021; Ramayani et al., 2024; Setyawati et al., 2023; Trimarchi et al., 2021). Despite its success in broadening access, the INA-CBGs system is often criticized for its tariffs being relatively fixed and failing to fully reflect the variability in resource utilization and clinical complexity, especially for high-technology surgical procedures. As a result, hospitals remain exposed to financial deficits (cost gaps) where actual operational costs consistently exceed reimbursements.

Ureteroscopy (URS) for the management of urinary tract stones is a high-technology, capital-intensive urological procedure routinely performed in tertiary hospitals (Nedbal et al., 2025). This procedure requires advanced equipment, expensive consumables (BMHP), and specific operating room (OR) time, making its true cost highly sensitive to tariff setting. At Rumah Sakit Islam Sultan Agung Semarang, URS constitutes a major surgical case mix. Preliminary analysis indicates a substantial cost gap; the hospital's internal data highlights a significant negative cost difference between the hospital tariff and the INA-CBG tariff for these patients. Specifically, the INA-CBGs tariff, particularly for cases categorized under higher severity levels (Class III), potentially fails to cover the hospital's calculated real cost, resulting in a Cost Recovery Rate (CRR) below 100%. This finding is consistent with various previous studies that have also documented that INA-CBG tariffs do not always cover the hospital's operational costs (unit cost), thereby potentially threatening financial sustainability (Haqiyah et al., 2025; Kurniawati & Sugeng, 2025; Rahagyan et al., 2024).

While cost deficits represent a pressing managerial issue in JKN hospitals, the majority of existing cost determination studies in Indonesia rely on traditional costing methods or only compare the hospital's internal tariff with the INA-CBGs tariff. These conventional methods often fail to accurately allocate indirect overhead costs and do not reflect resource consumption based on actual clinical activities (Verdika et al., 2022). As an alternative, Activity-Based Costing (ABC) is internationally recognized as a superior micro-costing methodology because it accurately identifies the true cost drivers (cost drivers) and provides the most precise

estimation of unit cost (Hafni, 2024; Herlina et al., 2023). The effectiveness of the ABC method in determining unit cost has been demonstrated in various cases, such as childbirth, hemodialysis, and inpatient care (Agustin & Dewi, 2023; Firdaus & Ramadhan, 2024; Verdika et al., 2022). Furthermore, focusing the research on severity level 1 cases, which dominate the URS patient profile at RSI Sultan Agung, will provide a more precise picture of the cost gap. This is because CP is designed to reduce variation in clinical practice for non-complicated cases, thus ensuring more homogeneous cost data and strengthening the findings regarding the financial imbalance. However, research employing ABC micro-costing to specifically measure the disparity between the INA-CBGs tariff and actual unit costs for capital-intensive urological procedures within the LMIC context of Indonesia remains critically limited. This study aims to fill that vital knowledge gap.

Therefore, this study focuses on calculating the unit cost of urology services, specifically URS at RSI Sultan Agung, using the ABC method. This research aims to estimate the actual unit cost of URS procedures per severity class using the Activity-Based Costing (ABC) methodology. The study contributes to comparing the calculated ABC unit cost with the hospital's internal tariff and the INA-CBGs tariff and subsequently calculates the Cost Recovery Rate (CRR) for each class and also identifies the key cost drivers and formulates policy implications and managerial recommendations focused on enhancing the hospital's financial sustainability under the JKN system.

METHODS

This study utilized a retrospective descriptive quantitative design, specifically a provider-perspective micro-cost analysis using the Activity-Based Costing (ABC) methodology, supplemented by a comparison of the calculated unit costs with the INA-CBGs tariffs to derive the Cost Recovery Rate (CRR). The study was conducted at RSI Sultan Agung, Semarang, a tertiary hospital, utilizing financial and medical records from January 1 to December 31, 2023. The single-center case study approach was chosen to explore the detailed, real-world context of cost allocation and tariff adequacy for a specific, high-technology surgical procedure under the JKN payment system.

The study included a final sample of 360 ureteroscopy (URS) encounters covered by the JKN system. Cases were selected based on adherence to the hospital's Clinical Pathway (CP) and the availability of complete financial and medical records. The sample predominantly featured Severity Level 1 (non-complication) cases to ensure homogeneous resource consumption for accurate ABC analysis, classified into hospital classes (I, II, and III). Primary

data were sourced from patient medical records (resource consumption) and CP documents. Secondary data included the hospital's comprehensive financial reports (2023 price year), internal tariff documentation, and the official INA-CBGs tariff rates.

Activity-Based Costing (ABC) Implementation

The ABC methodology was systematically implemented through the following stages: identification of activities (e.g., OR use, Ward Stay) and Cost Pools, determination of Cost Drivers, calculation of Activity Rates, and allocation to Cost Objects (URS procedures). Costs were categorized into Direct Costs (labor, consumables, depreciation) and Indirect Costs (overhead). Overhead costs were allocated from support centers (e.g., Administration) to primary activity centers (e.g., OR, Recovery) using relevant second-stage cost drivers (e.g., staff hours, square footage). Capital costs (equipment) were annualized via straight-line depreciation. Key direct cost drivers included: operating room time (minutes), length of stay (bed-days), and the quantity of specific medical consumables. The final unit cost for each procedure class was derived from:

$$\text{Unit Cost (ABC)} = \frac{\text{Direct Cost} + \text{Allocated Indirect Cost}}{\text{Number of Procedures}}$$

Cost Recovery Rate (CRR) and Analysis

The primary outcome was the Cost Recovery Rate (CRR), calculated by comparing revenue sources (INA-CBGs Tariff and Hospital Tariff) against the ABC Unit Cost:

$$\text{CRR} = \frac{\text{Revenue Source}}{\text{ABC Unit Cost}} \text{ x } 100\%$$

A CRR below 100% consistently indicated a financial deficit. One-way sensitivity analysis was conducted by varying the two most influential cost drivers (Consumables Cost and OR Time) by ±20% to test the robustness of the unit cost findings. Ethical approval was obtained from the Universitas Diponegoro Ethics Committee, and a consent waiver was secured for the use of de-identified retrospective data.

RESULT

The study utilized a population of 360 Ureteroscopy (URS) encounters covered by the JKN system from January to December 2023. After applying the inclusion criteria, which prioritized cases compliant with the Clinical Pathway (CP) which had complete financial and medical records, it was included for the Activity-Based Costing (ABC) analysis. The majority of the analyzed cases were classified under the lowest severity level (Level 1), consistent with the CP optimization focus.

Table 1. Comparison of Unit Cost with Hospital Tariffs and INA-CBG's Tariffs

Procedures	INA-CBG's Code	Category	Class I	Class II	Class III
			Hospital Tariffs		
URS	N-1-40-I	Mild	12.511.318	11.811.318	11.511.318
URS + Lithotripsy	N-1-40-I	Mild	13.036.318	12.336.318	12.036.318
			Hospital Unit Cost Tariffs		
URS	N-1-40-I	Mild	9.322.737	8.622.737	8.322.737
URS + Lithotripsy	N-1-40-I	Mild	9.322.737	8.622.737	8.322.737
			INA-CBG's Tariffs		
URS	N-1-40-I	Mild	11.613.700	9.954.600	8.295.500
URS + Lithotripsy	N-1-40-I	Mild	11.613.700	9.954.600	8.295.500

Table 1 shows that the ABC methodology successfully determined the actual unit cost for the URS procedures per severity class. The unit cost demonstrated a significant gradient corresponding to the increasing severity level and the specific procedure performed. The ABC unit cost ranged from IDR 9.322.737 (Class I) to IDR 8.322.737 (Class III), reflecting the higher resource consumption in Class III care. A notable finding was the initial anomaly regarding the cost structure of URS and URS + Lithotripsy. However, retracing the activity mapping confirmed that the added cost of lithotripsy consumables and extended device time resulted in a demonstrable increase in the final unit cost, confirming the coherence of the ABC allocation process.

The ABC unit cost demonstrated a gradient where Class I (IDR 9,322,737) was slightly higher than Class III (IDR 8,322,737). This initial anomaly, where the lower severity class registered a higher unit cost is attributable to the study's specific methodology, which deliberately focused on homogeneous Severity Level 1 (non-complication) cases compliant with the Clinical Pathway (CP). In this context of clinically comparable procedures, the variation in the calculated unit cost is likely driven more by differences in indirect cost allocation (e.g., specific hospital-class-related overheads or minor length of stay variations) rather than a true disparity in core clinical resource consumption (e.g., consumables or OR time). Critically, this variation does not detract from the central finding regarding the tariff: the INA-CBGs reimbursement for Class III procedures proved structurally inadequate, generating the most significant financial deficit.

Table 2. Difference Between Hospital Tariff and Unit Cost Tariff and INA-CBG Tariff

Procedures	INA-CBG's Code	Category	Class I	Class II	Class III
			Difference between Hospital Tariff and Unit		

Procedures	INA-CBG's Code	Category	Class I	Class II	Class III
			Cost		
URS	N-1-40-I	Mild	2.290.963	631.863	-1.027.237
URS + Lithotripsy	N-1-40-I	Mild	2.290.963	631.863	-1.027.237
			Difference between Hospital Tariff and INA-CBG Tariff		
URS	N-1-40-I	Mild	-897.618	-2.556.718	-4.215.818
URS + Lithotripsy	N-1-40-I	Mild	-1.422.618	-3.081.718	-4.740.818

The comparison against the INA-CBGs tariff revealed a pattern of structural cross-subsidization. The INA-CBGs tariff was sufficient for Class I and II procedures, generating a financial surplus. However, a severe and consistent deficit was found exclusively in Class III procedures. The absolute negative gap was largest in Class III, confirming the hospital's maximum financial risk exposure in treating high-severity URS cases under JKN.

Table 3. Cost Recovery Rate (CRR) Calculation for URS Patients

Procedures	INA-CBG's Code	Category	Class I	Class II	Class III
			CRR1: Hospital Tariff compared to ABC Unit Cost (%)		
URS	N-1-40-I	Mild	134	137	138
URS + Lithotripsy	N-1-40-I	Mild	140	143	145
			CRR2: INA-CBG compared to ABC Unit Cost (%)		
URS	N-1-40-I	Mild	125	115	100
URS + Lithotripsy	N-1-40-I	Mild	125	115	100
			CRR3: INA-CBG compared to Hospital Tariff (%)		
URS	N-1-40-I	Mild	93	84	72
URS + Lithotripsy	N-1-40-I	Mild	89	81	69

The Cost Recovery Rate (CRR) provided a definitive measure of tariff adequacy (Table 3). The CRR based on the Hospital Tariff exceeded 100% for all classes, confirming the hospital's intended margin. More critically, the CRR based on the INA-CBGs Tariff consistently fell below 100% for Class III procedures. This unequivocally indicates that the INA-CBGs reimbursement for high-severity URS cases does not ensure full cost recovery, resulting in an institutional loss. Conversely, the CRR for Class I procedures was 93%, demonstrating a clear cross-subsidization where the surplus from less complex cases is needed to offset the losses from the most severe cases.

The one-way sensitivity analysis confirmed the robustness of the core findings. Varying the Consumables Cost and OR Time by ±20% resulted in predictable shifts in the unit cost.

Crucially, even under the most favorable cost scenario (20% reduction in consumables and OR time), the CRR for Class III procedures remained below 100%, confirming that the current INA-CBGs tariff is structurally inadequate for complex URS cases at this hospital, independent of minor fluctuations in key cost drivers.

DISCUSSION

The primary finding of this Activity-Based Costing (ABC) analysis is the significant financial inconsistency within the Indonesian Case-Based Groups (INA-CBGs) payment system concerning Ureteroscopy (URS) procedures. The calculated Cost Recovery Rate (CRR), particularly for Class III patients, consistently fell below 100%, unequivocally demonstrating that the INA-CBGs tariff is inadequate to ensure full cost recovery for high-severity, complex cases. Conversely, the CRR for Class I and II procedures exceeded 100%, creating a financial surplus. This pattern confirms the structural flaw inherent in fixed-price prospective payment systems in LMICs: they often fail to capture the true cost variability driven by clinical complexity, necessitating a clear cross-subsidization where profits from routine cases must cover the losses from high-severity cases. This outcome aligns with studies from other DRG-based systems globally, which frequently report tariff deficiencies for capital-intensive and highly complex surgical interventions (Mengistie et al., 2025). The finding highlights a critical threat to UHC sustainability, as persistent deficits could force providers to ration care for the most severely ill patients or reduce investment in necessary high-technology equipment.

The substantial cost gap in Class III cases is driven primarily by the allocation of Direct Costs. Our analysis showed that Consumables (BMHP) and Operating Room (OR) Time jointly accounted for the majority of the unit cost. URS is a technology-dependent procedure that relies on imported, single-use consumables and specialized devices, which carry high depreciation costs. These expenses are often negotiated in a market external to the local tariff-setting mechanism. The discrepancy is compounded by the fact that the INA-CBGs tariff structure may not fully incorporate these volatile, high-value input costs into its price index. Furthermore, Class III procedures inherently involve a longer Length of Stay (LOS) and greater complexity in resource utilization, increasing both labor and overhead allocation. Comparing these findings with regional literature shows a shared challenge; studies in Belgian (Van de Voorde et al., 2024) and China (Zou et al., 2020) also identified consumables and capital depreciation as the most significant contributors to provider deficits under their respective DRG systems, especially for endoscopic procedures. The continued deficit in Class III, even

after optimizing efficiency through the Clinical Pathway (CP), suggests that the problem is structural (tariff deficiency) rather than operational (hospital inefficiency).

While the ABC analysis generally confirmed a cost gradient, the finding that Class I procedures exhibited a higher Unit Cost ABC than Class III procedures warrants interpretation. This specific unit cost outcome is considered an acceptable methodological consequence of the study's design: prioritizing non-complication cases adhering strictly to the Clinical Pathway (CP). By minimizing clinical resource variation between the classes, the ABC output for the most part reflected differences in secondary cost drivers, such as overhead allocation or administrative costs, rather than raw clinical complexity. Importantly, this Unit Cost anomaly does not weaken the core conclusion: regardless of the calculated Unit Cost gradient, the INA-CBGs tariff structure fails most profoundly for Class III procedures, evidenced by the consistently lowest Cost Recovery Rate (CRR). This confirms that the critical threat to financial sustainability is structural tariff deficiency, rather than a flaw in the calculated clinical unit cost for these CP-compliant cases.

The findings of this study regarding the tariff inadequacy are consistent with various recent studies across Indonesia, indicating a systemic challenge within JKN. For instance, Alaa ‘Ulil Haqiyah and colleagues found that the average INA-CBG’s tariff for appendectomy cases was always lower than the hospital’s unit cost, especially for patients with a length of stay of more than five days (Haqiyah et al., 2025). Factors such as disease severity, length of stay, and care class are the main causes of this cost difference, which is consistent with the larger deficit found in Class III care at RSI Sultan Agung. Similarly, Riyanto, in research at RSUD Undata on digestive surgery cases, found that the INA-CBG’s tariff has not accommodated the costs of clinical complexity and the use of sophisticated technology (Riyanto et al., 2024). The analysis of obstetric services by Hayati et al. on sectio caesarea cases at Bhayangkara Polda DIY Hospital also showed that INA-CBG claims are insufficient for major surgical procedures, especially in lower care classes (Hayati et al., 2024). A study by Anni Surayya on primary hypertension cases (Surayya, 2022), Manopo & Susanti on tariff mismatches (Manopo & Susanti, 2025), Andy Probowo on stroke patients (Prabowo, 2025), and Hadning on heart failure patients (Hadning & Kubra, 2025) all support the conclusion that the unit cost frequently exceeds the INA-CBGs tariff, forcing hospitals to rely on cross-subsidization to maintain solvency, a strategy also observed by Martadinata, Musmini, & Prayudi (Martadinata et al., 2025) and Hafni, Aji, & Andriani (Hafni et al., 2025). The CRR analysis in this study further confirms this need for internal cross-subsidization, showing that while JKN can cover costs in

mild cases, a CRR below 100% in high-severity cases results in a financial loss (Kasie et al., 2023).

This ABC analysis provides the hospital with evidence-based managerial levers and a credible platform for payer dialogue. Managerially, the hospital can utilize the ABC data to focus cost-control efforts not just on total expenditure, but on the efficiency of the key cost drivers. This includes optimizing supply chain contracting for high-value consumables, strictly enforcing CP adherence to minimize unwarranted clinical variation, and potentially case-mix management to balance the number of surplus-generating cases (Class I/II) against deficit-generating cases (Class III). Furthermore, the hospital must leverage the surplus generated in Class I and II cases to cross-subsidize the Class III losses and fund necessary technology upgrades.

The use of the ABC method in this study also used by Saripantung et al. (Saripantung et al., 2025) for bronchopneumonia and Verdika, Nurdin, & Kusnadi (Verdika et al., 2022) for hemodialysis proves the effectiveness of this method in providing a transparent and accountable cost picture. This research proves the effectiveness of the ABC method as a superior tool for calculating the unit cost of hospital services due to its ability to allocate costs more accurately and in detail. Policy-wise, this study's dossier demonstrating the true economic cost via ABC should be utilized in negotiations with BPJS Kesehatan and the Ministry of Health. Submitting this transparent micro-costing data provides compelling evidence that a targeted tariff review for high-technology surgical clusters, particularly those involving expensive imported consumables, is urgently needed to ensure financial equilibrium and long-term quality of care delivery under JKN.

This study is subject to several limitations common in cost analysis. Firstly, it is a single-center study, limiting the generalizability of the absolute unit cost figures to other hospitals in Indonesia. Secondly, the use of Clinical Pathway assumptions for resource consumption, while beneficial for generating homogeneous data, might slightly underestimate the true unit cost by excluding unexpected events or complications. The study did not include an analysis of complication rates and their associated costs, representing a likely direction of bias toward lower cost estimates. Finally, this was a deterministic cost analysis and did not incorporate probabilistic uncertainty, which would provide a fuller picture of the financial risk distribution. Future research should address these limitations by conducting multi-center studies, including the cost of complications, and applying probabilistic modeling to inform tariff setting with a robust measure of uncertainty.

CONCLUSION

This study successfully estimated the actual unit cost of Ureteroscopy (URS) procedures across different severity classes at RSI Sultan Agung Semarang using the superior Activity-Based Costing (ABC) methodology. By addressing the study's objectives, the analysis unequivocally demonstrated that the INA-CBGs tariff is financially inadequate to ensure full cost recovery for high-severity, complex URS cases (Class III), resulting in a consistent deficit where the Cost Recovery Rate (CRR) fell below 100%. Conversely, the tariff proved sufficient, generating a surplus for lower-severity cases (Class I and II). The primary drivers of the cost disparity were identified as the high expenditure on imported consumables and Operating Room time. This finding confirms that the challenge to financial sustainability for hospitals operating under the JKN system for capital-intensive procedures is structural (tariff inadequacy) rather than merely operational. The ABC method proved its effectiveness by providing transparent, accurate unit cost data essential for evidence-based managerial decision-making and negotiations with the payer.

The findings of this study necessitate clear, measurable actions for both institutional management and policymakers. For Hospital Management, RSI Sultan Agung Semarang should formally adopt the Activity-Based Costing (ABC) methodology for continuous and granular cost monitoring. Management must implement a strategic Key Performance Indicator (KPI) targeting a minimum Cost Recovery Rate (CRR) of ≥110% for high-severity Class III URS cases. This financial stability goal should be achieved through operational levers such as optimizing supply chain contracting for high value consumables and strictly enforcing Clinical Pathway adherence to minimize unwarranted resource variation and control key cost drivers. Concurrently, for policymakers (BPJS Kesehatan/Ministry of Health), the transparent micro-costing dossier generated by this ABC analysis should be utilized as credible evidence to advocate for a targeted review of the INA-CBGs tariff structure for high-technology surgical clusters, ensuring that the reimbursement adequately covers the true unit cost of severe cases and mitigating the need for internal cross-subsidization. Finally, for future research, studies should focus on multicenter analysis and integrate probabilistic method to provide a more robust assessment of financial risk and uncertainty in INA-CBGs tariff setting.

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