

COST ANALYSIS OF PHACOEMULSIFICATION ACTION USING THE ACTIVITY-BASED COSTING METHOD BASED ON THE CLINICAL PATHWAY AT MATA PRIMA VISION SPECIAL HOSPITAL, MEDAN

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Abstract

Phacoemulsification is the main surgical procedure for cataract treatment, but its resource requirements require accurate cost calculation to support hospital financial sustainability and service efficiency. This study aimed to analyze the unit cost of a standard phacoemulsification episode based on the clinical pathway using the Activity-Based Costing (ABC) method and to compare the resulting cost with hospital billing and INA-CBG's tariffs at Prima Vision Eye Hospital, Medan. A quantitative comparative study with a retrospective approach was conducted using hospital clinical pathway, financial, operational, pharmaceutical, and service documents for the January–November 2025 period. Cost extraction sheets were used to identify activities, direct and indirect costs, and relevant cost drivers. The analysis was descriptive and comparative using nominal differences, percentages, and Cost Recovery Rate (CRR). A total of 1,194 phacoemulsification cases were identified. The ABC unit cost for one standard episode was IDR 5,979,694, consisting of 91.5% direct costs and 8.5% indirect costs. The average hospital billing was IDR 11,960,057, while the INA-CBG's tariff was IDR 7,351,600. The INA-CBG's tariff exceeded the ABC unit cost by IDR 1,371,906 (22.9%), with a CRR of 122.9%. ABC-based costing combined with clinical pathway provides a more detailed basis for cost control and rational tariff management.

Keywords: Activity-Based Costing; cataract; clinical pathway; phacoemulsification; unit cost.

INTRODUCTION

Cataract remains one of the major causes of blindness and visual impairment worldwide. Global estimates indicate that cataract continues to contribute substantially to the burden of blindness despite improvements in cataract surgery services (Hashemi, 2020; Pesudovs, 2024). In Indonesia, the Rapid Assessment of Avoidable Blindness has also demonstrated a substantial burden of cataract-related blindness, indicating that cataract management remains an important public health priority (Rif'Ati, 2021). The burden is particularly relevant for health facilities providing cataract surgery because increasing demand for surgical treatment must be accompanied by efficient utilization of health resources.

Phacoemulsification has become the dominant modern cataract surgery technique because it uses a small incision, provides favorable visual outcomes, and generally enables relatively rapid recovery (AlRyalat, 2022). The development of phacoemulsification has transformed cataract surgery from conventional procedures requiring relatively large incisions into a minimally invasive procedure using ultrasonic energy to fragment the cloudy lens (Awad et al., 2024; Leffler, 2020). However, the clinical advantages of phacoemulsification are accompanied by substantial resource requirements, including specialist medical services, intraocular lenses, pharmaceutical products, medical consumables, surgical instruments, operating rooms, and specialized equipment.

The increasing demand for cataract surgery creates an important challenge for hospital management, particularly in the context of the National Health Insurance system. Hospitals must maintain service quality while controlling operational costs and ensuring that reimbursement mechanisms remain adequate to cover the resources consumed. Previous research has demonstrated that hospital unit costs can differ considerably according to the

costing method, resource utilization, service characteristics, and institutional context (Hammad, 2022; Palakawong Na Ayutthaya et al., 2020).

One of the challenges in hospital cost management is the use of traditional costing systems. Traditional approaches may allocate indirect costs using relatively broad allocation bases and therefore may not adequately reflect the actual consumption of resources by individual services. Activity-Based Costing (ABC) provides an alternative by assigning costs according to activities and cost drivers associated with resource consumption (Alsayegh, 2020; Javid, 2016). ABC can therefore provide more detailed information regarding the actual cost structure of health services and support managerial decision-making.

Previous studies have demonstrated the usefulness of ABC in hospital services. Ashari and Ridwan (2021), for example, found differences between hospital tariffs and tariffs calculated using ABC for Caesarean section services. Similarly, Priyono et al. (2021) demonstrated the application of ABC to inpatient service tariffs, while (Lopatkin et al., 2021) applied ABC in combination with a clinical pathway to calculate treatment costs for ischemic stroke, further demonstrated that ABC could be used to compare unit costs with hospital tariffs and INA-CBG's tariffs and to calculate the Cost Recovery Rate (CRR).

The clinical pathway is also important because it provides a structured framework for standardizing the sequence of clinical activities, resources, and responsibilities involved in patient care. Clinical pathways can reduce unnecessary variation and support quality and efficiency in hospital services (Firmansyah & Gunawan, 2022; Julianti et al., 2022). Evidence from clinical pathway research indicates that standardized care pathways may contribute to improved resource management and cost control (Fitria, 2021). Thus, integrating clinical pathways with ABC provides an opportunity to connect clinical processes with their associated resource consumption.

The context of Rumah Sakit Khusus Mata Prima Vision, Medan, is particularly relevant. Based on the preliminary assessment reported in the thesis, 1,194 phacoemulsification cases were recorded during January–November 2025, while the hospital had not previously calculated the unit cost of phacoemulsification using ABC. The existing tariff determination was more strongly influenced by estimates, reasonableness, and comparison with similar hospitals. This situation creates a need for a systematic cost analysis based on actual activities and resource utilization.

Therefore, this study aimed to analyze the unit cost of a standard phacoemulsification episode based on the hospital clinical pathway using the ABC method, identify the activities and cost drivers involved, and compare the resulting unit cost with hospital billing and INA-CBG's tariffs. The study is expected to provide useful information for hospital management in developing rational tariffs, controlling costs, and maintaining the balance between service quality and financial sustainability.

LITERATURE REVIEW

Cataract and Phacoemulsification

Cataract is characterized by progressive opacification of the eye lens that interferes with the transmission of light to the retina. Age-related cataract represents a major component of the global burden of visual impairment (Hashemi, 2020; Pesudovs, 2024). The Indonesian RAAB data similarly demonstrate that untreated cataract remains an important cause of blindness in Indonesia (Rif'Ati, 2021).

Phacoemulsification is a modern cataract surgery technique that uses ultrasonic energy to fragment the cloudy lens, which is subsequently aspirated through a small corneal incision. The procedure is generally associated with favorable visual outcomes and relatively rapid recovery (AlRyalat, 2022). Compared with conventional manual cataract surgery, phacoemulsification may provide advantages in terms of visual outcomes and certain postoperative complications.

From a hospital management perspective, however, phacoemulsification involves multiple activities and resources. These include registration, specialist consultation, diagnostic examination, anesthesia, surgical procedures, intraocular lens implantation, sterilization, postoperative medication, and follow-up. The diversity of activities makes accurate costing important.

Clinical Pathway

A clinical pathway is a structured approach that translates evidence-based clinical recommendations into an organized sequence of care activities. It provides information concerning clinical interventions, timing, responsibilities, and resource utilization. Clinical pathways can support standardization, quality improvement, patient safety, and resource efficiency (Firmansyah & Gunawan, 2022; Luo et al., 2021). Demonstrated that clinical pathways can influence patient-related outcomes in hospital settings. Meanwhile, Julianti et al. (2022) emphasized

the importance of implementation strategies when clinical pathways are introduced in hospital services. Fitria et al. (2021) specifically demonstrated the potential of clinical pathways as instruments for controlling service costs under the INA-CBG payment system. Clinical pathways are therefore relevant to cost analysis because they define the standard sequence of activities forming one episode of care. In the present study, the clinical pathway is used as the basis for determining the standard phacoemulsification episode before assigning costs to activities.

Activity-Based Costing in Health Services

Activity-Based Costing is a costing method that assigns resource costs to activities and subsequently assigns activity costs to cost objects based on relevant cost drivers. Unlike simple traditional costing, ABC attempts to establish a more direct relationship between resource consumption and the service being analyzed (Alsayegh, 2020; Javid, 2016). The theoretical foundation of ABC emphasizes that costs should be traced according to the activities responsible for consuming resources. Quesado and Silva (2021) describe ABC as a system that can provide more detailed information about resource consumption and support managerial decision-making. Putuhena and Kamarudin (2024) similarly emphasize the usefulness of ABC for improving the accuracy of cost information.

In healthcare organizations, ABC is particularly relevant because hospital services involve multiple activities and different patterns of resource consumption. Javid et al. (2016) demonstrated the application of ABC for hospital unit-cost calculation, while Palakawong Na Ayutthaya et al. (2020) highlighted the importance of unit-cost analysis for both operational and academic purposes.

Clinical Pathway-Based ABC and Cost Control

Combining ABC with clinical pathways provides two complementary perspectives. The clinical pathway identifies what activities should occur, while ABC determines how much each activity consumes in terms of resources. This combination can therefore produce a more transparent estimate of the cost of a standardized episode. Purnamasari and Nuryadi (2020) demonstrated this approach in ischemic stroke care by calculating treatment costs based on clinical pathways and ABC. Similarly, Fitria et al. (2021) demonstrated the role of clinical pathways in controlling costs in patients undergoing Caesarean section under INA-CBG payment arrangements.

The use of ABC should nevertheless be interpreted carefully because its accuracy depends on the quality of cost-driver selection and availability of reliable operational data. Meyer and Schmidt (2025) emphasize that the design of costing systems and cost hierarchies influences the usefulness of ABC information. Consequently, the selected cost drivers in this study were matched with the characteristics of resource consumption in the phacoemulsification episode.

Research Gap

Previous studies have examined ABC in various hospital services, including inpatient care, Caesarean section, ischemic stroke, debridement, and hemodialysis (Ashari & Ridwan, 2021; Purnamasari & Nuryadi, 2020; Verdika et al., 2022; Zakaria & Nadjib, 2024). However, evidence regarding ABC-based costing specifically for standard phacoemulsification episodes using a hospital clinical pathway remains limited. The present study addresses this gap by identifying the activities and cost drivers of phacoemulsification and comparing the resulting standard episode unit cost with both hospital billing and INA-CBG's reimbursement.

METHOD

Research Design

This study used a quantitative comparative design with a retrospective approach. The main analytical object was one standard episode of phacoemulsification based on the clinical pathway of Rumah Sakit Khusus Mata Prima Vision, Medan. The study design and analytical framework were explicitly established in the thesis as a quantitative comparative retrospective study. The analysis was conducted from the hospital/provider perspective. Therefore, the calculation included costs incurred by the hospital in providing the service and did not include costs directly borne by patients, such as transportation or productivity losses.

Study Setting and Period

The study was conducted at Rumah Sakit Khusus Mata Prima Vision, Medan, using data for the period January–November 2025. The hospital is a specialized eye hospital providing cataract surgery and was a partner of BPJS Kesehatan during the study period.

Population and Cost Object

The study identified 1,194 phacoemulsification cases recorded during January–November 2025. The cost object was defined as one standard phacoemulsification episode for one eye, consisting of activities and resources specified in the clinical pathway, using a standard intraocular lens and excluding additional procedures, complications, or conversion of surgical technique. Thus, the resulting ABC unit cost represents the cost of a standard episode, rather than the average actual cost of all individual cases.

Data Sources and Instruments

Data were obtained through document review and limited clarification interviews. The documents included:

1. hospital clinical pathway;
2. operational data;
3. medical consumable and pharmaceutical usage;
4. direct and indirect cost reports;
5. human resource and asset information;
6. financial reports;
7. hospital billing data; and
8. INA-CBG's and JKN claim data.

A cost extraction sheet was used to systematically record direct and indirect costs, quantities, unit prices, activities, and sources of cost information. The thesis states that document analysis was complemented by limited interviews with medical and management personnel to clarify the consistency and accuracy of documentary information.

Activity-Based Costing Procedure

The costing process consisted of:

1. identification of activities based on the clinical pathway;
2. identification of direct and indirect costs;
3. establishment of relevant cost pools;
4. selection of cost drivers;
5. allocation of resource costs to activities;
6. calculation of the cost of one standard episode; and
7. calculation of the final ABC unit cost.

Direct costs were allocated using activity-specific consumption, including quantities of materials and medicines. Depreciation of equipment and operating rooms was allocated using minutes of utilization, while indirect costs were allocated using the number of episodes as the resource driver. This approach is consistent with the ABC principle of tracing resources to activities and then to cost objects according to resource consumption (Quesado & Silva, 2021).

Comparative Analysis

The ABC unit cost was compared with hospital billing using:

$$\begin{aligned}\text{Difference} &= \text{Hospital Billing} - \text{ABC Unit Cost} \\ \text{Difference (\%)} &= \frac{\text{Difference}}{\text{ABC Unit Cost}} \times 100\end{aligned}$$

The ABC unit cost was also compared with the INA-CBG's tariff:

$$\begin{aligned}\text{Difference} &= \text{INA-CBG's Tariff} - \text{ABC Unit Cost} \\ \text{CRR} &= \frac{\text{INA-CBG's Tariff}}{\text{ABC Unit Cost}} \times 100\end{aligned}$$

A CRR above 100% indicates that the reimbursement tariff exceeds the estimated standard episode cost, whereas a value below 100% indicates that the tariff does not fully cover the estimated cost.

Because ABC unit cost is a deterministic calculation based on the complete cost data rather than repeated measurements across independent observations, the study used descriptive comparison rather than statistical hypothesis testing.

RESULTS AND DISCUSSION

Identification of Activities Based on Clinical Pathway

The clinical pathway enabled the researchers to identify the sequence of activities involved in the standard phacoemulsification episode. The cost components included outpatient services, CSSD and sterilization, surgical professional services, depreciation of equipment and operating rooms, medical supplies, medications, and supporting operational costs.

The use of the clinical pathway as the starting point of costing is important because it establishes a consistent definition of the standard episode. This approach is consistent with previous research showing that clinical pathways can standardize care and facilitate cost management (Fitria, 2021; Long et al., 2021; Trimarchi, 2021).

ABC Unit Cost

The total ABC unit cost for one standard phacoemulsification episode was Rp5.979.694. Direct costs accounted for Rp5.473.705 (91.5%), while indirect costs amounted to Rp505.989 (8.5%).

Table 1. ABC Unit Cost of a Standard Phacoemulsification Episode

Cost component	Value (IDR)	Contribution
Direct costs	5,473,705	91.5%
Indirect costs	505,989	8.5%
Total ABC unit cost	5,979,694	100.0%

The predominance of direct costs indicates that phacoemulsification is highly dependent on resources directly associated with the clinical procedure. The largest components included surgical professional fees of Rp1.800.000 and Medical Supp Phaco of Rp1.761.197. This finding is consistent with the principle of ABC that costs should be traced according to the activities and resources actually consumed (Alsayegh, 2020; Javid, 2016). In a surgical procedure, professional services, specialized medical supplies, and surgical equipment may constitute major cost drivers. Therefore, managerial efforts to improve efficiency should focus on the dominant components rather than concentrating exclusively on relatively small indirect costs. The finding also corresponds with previous studies showing that ABC can reveal differences in the composition of unit costs that may be obscured by traditional costing methods (Ashari & Ridwan, 2021; Priyono et al., 2021; Putuhena & Kamarudin, 2024).

Hospital Billing

During January–November 2025, the hospital recorded 1,194 phacoemulsification cases with total billing of Rp14.280.308.442. The average billing was therefore Rp11.960.057 per case.

Table 2. Comparison of ABC Unit Cost and Hospital Billing

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Table 2. Comparison of ABC Unit Cost and Hospital Billing

Indicator	Value (IDR)
ABC unit cost	5,979,694
Average hospital billing	11,960,057
Difference	5,980,363
Difference (%)	100.0%

The average hospital billing was approximately twice the ABC unit cost. However, this difference should not automatically be interpreted as hospital profit. The billing value reflects the revenue generated from the actual services recorded for individual cases, including variations in intraocular lens type, medications, and additional procedures. In contrast, the ABC calculation represents the cost of a predefined standard episode based on the clinical pathway. The thesis explicitly emphasizes this distinction. This distinction is important for managerial interpretation.

Comparing standard episode cost with actual billing is useful for understanding revenue variation, but it should not be treated as a comparison between two alternative costing methods.

Comparison with INA-CBG's Tariff

The INA-CBG's tariff applicable to the study cases was Rp7.351.600, consisting of the INA-CBG's component and Special CMG component for phacoemulsification. The thesis identifies the applicable code as H-2-36-0 with Special CMG YY-10-III.

Table 3. Comparison of ABC Unit Cost and INA-CBG's Tarif

Indicator	Value (IDR)
ABC unit cost	5,979,694
INA-CBG's tariff	7,351,600
Difference	1,371,906
Difference (%)	22.9%
CRR	122.9%

The INA-CBG's tariff exceeded the ABC unit cost by Rp1.371.906 or 22.9%, producing a CRR of 122.9%. This means that, for the defined standard episode, the reimbursement tariff exceeded the estimated cost by 22.9%. The finding is comparable with research by Verdika et al. (2022), which also used ABC, hospital tariffs, INA-CBG's tariffs, and CRR to assess the adequacy of reimbursement relative to service costs. The result demonstrates the practical value of ABC in evaluating whether standardized reimbursement is sufficient to cover resource consumption. However, the result should be interpreted within the defined scope of the cost object. It applies to a standard phacoemulsification episode and should not automatically be generalized to cases involving non-standard intraocular lenses, additional procedures, complications, or different clinical pathways.

Implications for Hospital Cost Management

The study demonstrates the importance of integrating clinical information with financial information. The clinical pathway establishes the standard sequence of activities, while ABC translates those activities into monetary values. This provides management with more detailed information for identifying major cost drivers. The results suggest that cost-control strategies should focus primarily on surgical professional fees and Medical Supp Phaco, because these components accounted for more than half of the direct cost. The relatively small proportion of indirect costs suggests that reducing administrative or facility-related overhead alone would have a limited effect on the total unit cost. The results also provide a basis for evaluating the hospital's tariff structure. The difference between billing and ABC unit cost indicates substantial variation in actual services delivered, whereas the positive CRR indicates that the current INA-CBG's tariff is above the estimated cost of the standard episode.

These findings support previous evidence that ABC can provide more detailed information for strategic cost management than traditional costing systems (Javid, 2016; Quesado & Silva, 2021). The results are also consistent with studies applying ABC to surgical and hospital services (Ashari & Ridwan, 2021; Purnamasari & Nuryadi, 2020; Zakaria & Nadjib, 2024).

CONCLUSION

The Activity-Based Costing method combined with a clinical pathway produced a standard phacoemulsification unit cost of Rp5.979.694 per episode at Rumah Sakit Khusus Mata Prima Vision, Medan, for the January–November 2025 period. Direct costs contributed 91.5%, while indirect costs contributed 8.5% of the total unit cost. The dominant cost components were surgical professional fees and Medical Supp Phaco. The average hospital billing was Rp11.960.057 per case, which was Rp5.980.363 or 100.0% higher than the ABC unit cost. This difference reflects the fact that billing represents actual revenue and may include variations in intraocular lenses, medications, and additional procedures, whereas ABC represents the cost of a predefined standard episode.

The INA-CBG's tariff was Rp7.351.600, exceeding the ABC unit cost by Rp1.371.906 or 22.9%, with a Cost Recovery Rate of 122.9%. Thus, for the standard clinical pathway episode, the INA-CBG's tariff was sufficient to cover the estimated ABC unit cost. The findings indicate that the integration of clinical pathway and Activity-Based Costing can provide a more transparent basis for hospital cost control, evaluation of reimbursement adequacy, and rational tariff management. Hospital management should consider implementing ABC periodically and using the standard clinical pathway as a reference for monitoring resource utilization, while separately monitoring non-standard components such as intraocular lenses, medications, additional procedures, and complications.

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