

Cost of a routine (planned) cardiac by-pass surgery at the National Hospital of Sri Lanka

KANLK Arachchi^{1*}, MCM Maranthota², WK Wickremasinghe³

¹Postgraduate Institute of Medicine, University of Colombo

²Base Hospital, Balangoda

³National Hospital of Sri Lanka, Colombo

*Correspondence: nkarasinghe@gmail.com

 <https://orcid.org/0009-0001-3879-039X>

Abstract

Background: Non-communicable disease (NCD) has become a major challenge in Sri Lanka. Over the last 40 years, ischemic heart disease (IHD) has been identified as one of the leading causes of NCD deaths in Sri Lanka. Coronary artery bypass graft (CABG) is a revascularization procedure that has been identified as an effective method for managing a patient with IHD. Therefore, estimating the approximate cost of CABG surgery in a public hospital would help in economic evaluations and managerial decision-making in public sector investments.

Objective: To estimate the approximate cost of an uncomplicated routine (planned) cardiac bypass surgery at the National Hospital of Sri Lanka (NHSL), Colombo.

Methods: This study was primarily based on secondary data. The data required for costing the procedure was extracted from 52 BHTs of patients who underwent CABG surgery at the NHSL during the last three months of the year 2019. Extracted data was used to determine the costing elements of each cost center. Direct and indirect cost centers were identified, and the cost of each center was determined by apportioning the available cost data by the step-down method using a weighted factor where applicable.

Results: The approximate cost of an uncomplicated CABG was Rs. 1.3 million per patient. Out of the total cost, 89% (Rs. 1.16 million) was expended on direct labor as salaries of different categories of staff. A major portion of it (56%) was spent on ICU care (Rs. 0.654 million) followed by post-surgical care at the ward settings (33.9%, Rs. 0.393 million). The highest cost of the material was recorded at the theatre which was 6% of the total cost (Rs. 78,960.00). The cost of total overheads was Rs. 29,517.00 which was about 2.2% of the total.

Conclusion: Although the approximate cost of a routine uncomplicated CABG surgery was Rs.1.3 million (\$ 7,027) as of December 2019 at the National Hospital of Sri Lanka, compared to more developed countries this is a fairly low cost. However, when the differences between health system organization and per capita health expenditure are concerned, this is quite evident to claim that the Sri Lankan health system has low-cost but effective models of delivering its care to people.

Key Words: Costing, CABG, National Hospital of Sri Lanka

Introduction

Managerial cost accounting is about obtaining information in support of internal management processes often in terms of monetary values. Therefore, managerial decision-making of such functions as resource allocation, mobilization, and pricing of a product or service can be done based on systematic evidence [1]. This is particularly important in such services as coronary artery bypass grafting (CABG) because of its vitality and demand.

CABG is a revascularization procedure used in patients with cardiovascular disease (CVD). In this surgery, a healthy artery or vein is connected to a blocked artery to bypass the blocked segment. The aims of the surgery are to improve the quality of life by reducing the symptoms and improving survival by reducing the risk of further infarction in those patients who suffer from CVDs. CABG was identified as a cost-effective option for treating multivessel coronary disease in a study that was done for cost-effectiveness analysis of cardiovascular disease treatment in Japan [2].

Sri Lanka adopted a free health policy after its independence (1951). Therefore, the state sector healthcare is publicly funded (tax-based) and delivered free at the point of care [3]. The evolution of advanced medical technology amidst increasing demand for such care has amplified the cost of healthcare warranting raising cost awareness among policymakers, healthcare professionals as well as the general public [4]. The coronary artery bypass graft is one of the most expensive operative procedures in healthcare having considerable variations among countries, hospitals, and even among surgeons due to differences in its supply chain and practices [5].

Non-communicable diseases (NCD) have shown a sharp increase in prevalence contributing to the disease burden in the country over the last few decades. During the last 40 years, CVD has been identified as one of the leading causes of death in Sri Lanka. Compared to the other

countries in the region and the developed world, the contribution of CVD to NCD mortality is much higher in Sri Lanka [6]. A study that was done to estimate the risk of cardiovascular diseases in Sri Lanka has found that 25.4% of the population is at a higher risk of developing CVD [7].

The National Hospital of Sri Lanka performs about 550 CABG surgeries per annum [8]. Five cardiothoracic surgeons, three senior registrars, eleven designated medical officers, two dedicated operating theatres, five cardiothoracic wards, and an assigned staff of nurses and other support staff are currently involved in the above performance. However, there is a yearlong waiting for cardiac surgeries due to the escalated demand for the service.

Cost accounting is defined as the collection, assignment, and interpretation of cost-related data for managerial decision-making [1]. It is used for pricing, evaluating, and implementing cost-minimizing interventions as well as to compare different investment strategies. While there are several methods of costing that have been developed by various scholars, the ideal approach to capturing cost is dependent on what exactly is being produced.

When costing a service, some of the methods that can be utilized are activity-based costing, job costing and process costing [1]. Among them, activity-based costing, and job costing require a great deal of precision in data for a better estimate. However, it might often be difficult to assign specific costs to each unit because of the complexity of the operational activities and the nature of available data. To deal with these limitations, the accountants might prefer the method of process costing over the others [1].

Although a greater proportion (nearly 90%) of inpatient care is covered by the state sector, the approximate cost of individual procedures has not been estimated much. The aim of this study was to estimate the approximate cost of an

uncomplicated routine (planned) cardiac bypass surgery at the National Hospital of Sri Lanka.

Methodology

The data for costing the procedure was primarily extracted from 52 BHTs of patients who underwent CABG surgeries at the NHSL Colombo during the last three months of the year 2019. Extracted data was used to determine the costing elements of each cost center.

Average salary details of the consultants, medical officers, nursing officers, health assistants, and staff of the other supportive services were obtained from the salary branch of the NHSL. The average number of staff involved in each procedure was determined based on their duty rosters while their labor was determined and weighted based on an estimated average time spent on a patient.

After reviewing the BHTs, a set of commonly performed investigations for an uncomplicated CABG was recorded. Costs of laboratory and other investigations were estimated and apportioned accordingly. However, the cost of the land and buildings were not included in the estimation.

Details of water, electricity, and communication bills and dietary expenses were collected from the supply branch of the hospital and apportioned according to an estimated weighted factor based on the number of beds available in the respective units.

It was assumed that the cost per patient on consultation and other services was directly proportional to the number of patient days that each patient had. Hence, it was weighted as per the time exposed for the consultation of the medical officers including the consultants. Finally, only the quantifiable cost elements were considered. Neither the opportunity cost nor the costs of qualitative elements (morbidity and quality-related costs) were taken into account.

According to the nature of the financial data available at the accounts department of the NHSL, it was not possible to assign costs to the identified

centers with confidence because of the bulk nature of paying utility bills. Therefore, this costing exercise used an estimated cost in those steps based on an average at each step. For instance, water consumption per patient was estimated per patient bed by dividing the total monthly expenditure on water by the number of total patient beds in the hospital. It was assumed that water consumption in each ward or unit was directly proportional to the number of patient beds that it had. It was also assumed that the capacity to hold any activity that utilizes water (including the activities of the staff, bystanders, and visitors) was dependent on the number of beds. In this context, cost per patient bed at any given step seemed to be the most appropriate method of apportioning a bulk cost in the given conditions of retrieving data.

Process costing is a methodology that allocates total costs of production to homogenous units produced via a continuous process involving multiple steps or departments [1]. For simplification, the average cost at each center was estimated utilizing the costs of direct labor, direct material, and overheads. In fact, this type of costing is characteristic of activity-based costing as well. Therefore, the approach of this costing exercise adopted a mixed method that utilized both process and activity-based costing concepts combined with the step-down method of cost allocation.

Administrative clearance

The administrative clearance was obtained from the Deputy Director General of the NHSL. Privacy and confidentiality were ensured. None of the authors were involved in patient management at the wards.

Identifying the Cost Centers

Considering the inward patient care, four cost centers were identified to which the cost could be assigned with reasonable assumptions. Nevertheless, they were all consistent with the care path of a patient who undergoes a routine surgery of CABG. Figure 1 illustrates the identification of those cost centers along the care path of a patient

who ends up with an uncomplicated outcome.

Once a patient was admitted to the hospital as planned, pre-surgical care was considered as “Cost center 1”, followed by the surgical care at the theatre, as “Cost center 2”. Mandatory post-surgical ICU care was considered as “Cost center 3” and mandatory post-surgical ward management as “Cost center 4”. Pre-assumptions were made that all the required pre-admission investigations were completed, and a management plan was available by the time of admission.

Results

The total estimated labor cost through the entire care path was Rs.9,152,400 whereas the total labor cost per patient was Rs.1,166,162. The direct material cost per patient was Rs.101,160 while, the sum of estimated overheads was Rs.29,517. Therefore, the estimated cost of a routine CABG surgery was Rs.1,296,839 which was approximated to Rs.1.3 million. The results of the costing exercise with all the assumptions are summarized in Table 1. The percentage distribution of the total cost by the cost centers is illustrated in Figure 2.

Discussion

The cost of any clinical intervention can be estimated in terms of direct costs (labor and material costs that are directly attributable), indirect costs (labor and material costs that are not directly attributable), and overhead costs (indirect costs that are not directly attributable to patient care such as administrative costs). Although the above have definitive accounting terms inherent to them, it is quite challenging to break the available data into them due to such complexities as overlapping and the inability to disintegrate the bulk form of costs. Therefore, cost accounting is not without limitations which warrant making reasonable assumptions to make outputs more rational and appropriate.

Out of the total cost of a CABG (Rs.1.3 million), 89% (Rs.1.16 million) was expended on direct labor. It primarily comprised salaries of different categories of

the staff. A major portion of it (56%) was spent on ICU care (Rs.0.654 million) followed by post-surgical care at the wards (33.9%, Rs.0.393 million). The highest cost of the material was recorded at the theatre which was 6% of the total cost (Rs.78,960.00). The total overhead cost was about 2.2% (Rs.29,517.00) of the total cost.

Economic analysis of surgical and interventional treatments for patients with complex coronary artery disease in China revealed that the average cost of a CABG surgery is \$ 13,842 [9]. It has also revealed that CABG bears a higher cost than primary coronary interventions (PCIs). However, since CABG has better clinical outcomes compared to PCI, they warranted the economic and health benefits of the CABG over the PCI [9].

United States of America bears a higher cost per CABG surgery which is around \$ 1,23,000. In South Korea the cost is around \$ 26,000 while in Singapore it is around \$ 17,200 [10]. Whilst the results of this study (\$ 7,027) cannot be compared with them side by side, it indicates that the total cost of a CABG in Sri Lanka is comparatively low. Although there are considerable differences between health system organization and per capita health expenditure in developed countries, it is quite evident to claim that Sri Lankan healthcare delivery is cost-effective. In fact, Sri Lanka has many health indices above the averages of regional countries and has acquired a much comparable status to developed countries.

This costing exercise was severely constrained by the inability to retrieve financial data appropriately. It was also limited to a selected cardiothoracic ward, a selected theatre, and a selected ICU at the NHSL. Since the analysis of this study was based on the apportioned costs devised from aggregates of financial data that were available, the best approach to interpret the estimate would be to compare it with the other estimates available in the literature. However, the availability of such literature in the Sri Lankan context is limited.

Conclusion

CABG is a complex but vital surgical intervention needed to save lives in critical clinical events like ischemic heart disease. It attempts to deliver tailor-made care for each patient. Therefore, the overall management of the condition tends to differ from one patient to another causing a significant variation in the utilization of resources including time. This diversity is reflected in the path of patient care and therefore in the cost as well. The availability of expenditure data in bulk forms (as aggregates) makes it extremely difficult

to apportion the cost elements appropriately unless one would have rational assumptions and the best possible guesses. However, having at least an approximation of the costs of vital clinical interventions at hand is imperative to make fair decisions in terms of allocating resources and future investments. This costing study concludes that decision-makers can assume that a routine uncomplicated cardiac bypass surgery approximately costs Rs. 1.3 million (\$ 7,027) per patient in Sri Lanka at a public sector hospital like the National Hospital of Sri Lanka.

Author declaration

Author contributions: All authors contributed to conceptualizing, designing, and carrying out the study.

Conflicts of interest: The authors declare no conflicts of interest concerning the research, authorship, and/or publication of this article.

Ethics approval: Ethics approval was not sought as the entire study was based on secondary data and no violation of ethics was observed by the design of the study.

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References

- [1] Walther LM, Skousen CJ. Managerial and Cost Accounting [Internet]. Ventus Publishing ApS; 2009 [cited 2019 Dec 29]. Available from: <https://cool4ed.calstate.edu/bitstream/handle/10211.3/180408/managerial-and-cost-accounting.pdf?sequence=1>
- [2] Koder S, Kiyosue A, Ando J, Akazawa H, Morita H, Watanabe M, et al. Cost-Effectiveness Analysis of Cardiovascular Disease Treatment in Japan. *International Heart Journal*. 2017;58(6):847–52.
- [3] Kumar R. Public–private partnerships for universal health coverage? The future of “free health” in Sri Lanka. *Globalization and Health* [Internet]. 2019 Nov;15(S1). Available from: <https://globalizationandhealth.biomedcentral.com/articles/10.1186/s12992-019-0522-6>
- [4] Walter PJ. Return to Work After Coronary Artery Bypass Surgery. Springer Science & Business Media; 2012.
- [5] Saha SP, Hill KS. Cost management of coronary artery bypass surgery. *The Journal of the Kentucky Medical Association* [Internet]. 2005 Aug 1 [cited 2023 Jun 10];103(8):355–60. Available from: <https://pubmed.ncbi.nlm.nih.gov/16134429/>
- [6] World Health Organization. Country Office for Sri Lanka. Status, determinants and interventions on cardiovascular disease & diabetes in Sri Lanka: desk review of research 2000–2018 [Internet]. apps.who.int. World Health Organization. Regional Office for South-East Asia; 2019. Available from: <https://apps.who.int/>

int/iris/handle/10665/329430

- [7] Ranawaka UK, Wijekoon CN, Pathmeswaran A, Kasturiratne A, Gunasekera D, Chackrewarthy S, et al. Risk estimates of cardiovascular diseases in a Sri Lankan community. Ceylon Medical Journal. 2016 Mar 21;61(1):11.
- [8] National Hospital of Sri Lanka. Annual Hospital Statistical Bulletin. 2018.
- [9] Zhao Y, Meng S, Liu T, Dong R. Economic Analysis of Surgical and Interventional Treatments for Patients with Complex Coronary Artery Disease: Insights from a One-Year Single-Center Study. Medical Science Monitor : International Medical Journal of Experimental and Clinical Research [Internet]. 2020 Feb 25 [cited 2021 Apr 19];26:e919374-1e919374-10. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7059453/#>
- [10] Heart bypass costs select countries 2019 [Internet]. Statista. [cited 2020 Aug 12]. Available from: <https://www.statista.com/statistics/189966/cost-of-a-heart-bypass-in-various-countries>

Table 1: Cost estimation of an uncomplicated coronary artery bypass surgery at the NHSL

Cost center		Pre-surgical wards care		Surgical care at the theater		ICU care		Post-surgical wards care	
Direct labor (wages)		Rs. '000		Rs. '000		Rs. '000		Rs. '000	
Consultants									
Anesthetists	03*	732	03*	732	02*	488	--	--	
Weighted factor**		0.2		0.3		0.5			
Estimated cost		146.4		219.6		244			
Cardiothoracic surgeons	05*	1220	05*	1220	03*	732	01*	244	
Weighted factor**		0.2		0.5		0.2		0.1	
Estimated cost		244		610		146.4		24.4	
Cardiologists	02*	484		1176	03*	784	01*	244	
Weighted factor**		0.1		0.6		0.1		0.2	
Estimated cost		48.4		705.6		78.4		48.8	
Medical officers	16*	3136	06*	864	04*	864	04*	784	
Weighted factor**		0.2		0.4		1.0		0.4	
Estimated cost		627.2		345.6		864		313.6	
Nursing officers	24*	1728	12*	864	12*	864	09*	648	
Weighted factor**		0.5		1.0		1.0		0.5	
Estimated cost		864		864		864		324	
Other health staff									
Attendants	05*	305	--	--	--	--	01*	61	
Health assistants	12*	516	06*	258	06*	258	04*	172	
A. Direct labor cost per day		Rs. 2,751,000		Rs. 3,002,800		Rs. 2,454,800		Rs. 943,800	
B. Number of patients cared per month		160		45		45		12	
C. Cost per patient per day		Rs. 17,194		Rs. 66,730		Rs. 54,550		Rs. 78,650	
D. ALOS as per the sample		3 days		1 day		12 days		5 days	
E. Total labor cost per patient		Rs. 51,582		Rs. 66,730		Rs. 6,54,600		Rs. 3,93,250	
Direct material costs									
Drugs & IV fluids									
- Indoor pharmacy									
- Local purchasing									
Medical gases									
Surgical & dressing materials									
- Surgical									
- Dressing									
		Rs. 3,250		Rs. 78,960		Rs. 12,680		Rs. 6,270	
F. Direct material cost per patient		Rs. 3,250		Rs. 78,960		Rs. 12,680		Rs. 6,270	
Indirect costs & Overheads									
Indirect labor									
- Radiography									
- Radiographers									
- MLTs									
- ECG technicians									
- Physiotherapists									
- Other staff									
Indirect materials									
- Materials for radiological investigations									Rs. 1,920
- Materials for laboratory investigations									Rs. 5,090
Diet									Rs. 5,250
Water									Rs. 4,170
Electricity									Rs. 13,050
Communication									Rs. ,037
Administrative costs**									
G. The sum of overheads per patient								Rs. 29,517	
Estimation of the cost of CABG (Routine & uncomplicated)									
Total direct labor cost		(51,582+66,730+6,54,600+3,93,250)				Rs.		1,166,162	
Total direct material cost		(3,250+78,960+12,680+6,270)				Rs.		101,160	
Estimated overhead costs		(1,920+5,090+5,250+4,170+13,050+37)				Rs.		29,517	
The estimated cost of a CABG surgery								Rs. 1,296,839	
								Approx. Rs. 1.3 million	

* Weighting was based on the estimated share of time per patient at each cost center. The average number of staff in each unit was estimated based on the duty-roster information received from each unit. A caution was made to include only those who exclusively engaged with the care of CABG patients. ** The weighted factor indicates the proportion of the contribution of care by individual professionals. # The cost of direct materials was estimated based on randomly selected ten BHTs out of those referred ones (n=52).

Process map of routine by-pass surgery at the cardiology unit of the NHSL

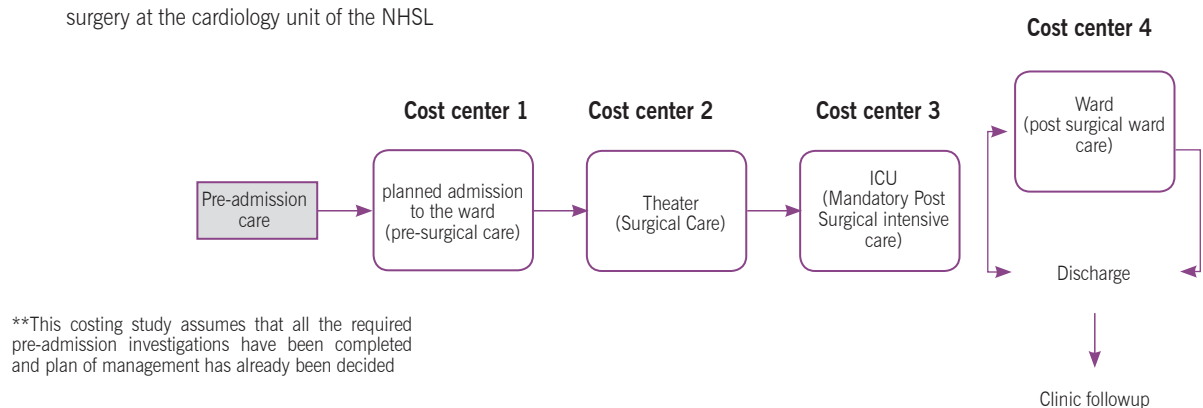


Figure 1: Care path and the identification of cost centers for an uncomplicated coronary artery bypass surgery

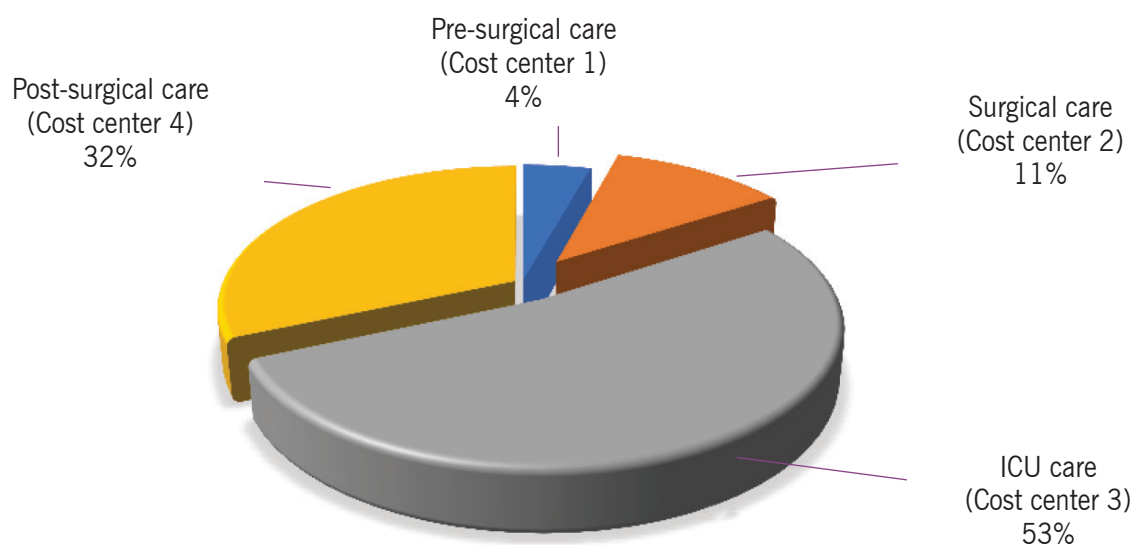


Figure 2: Percentage distribution of the cost among the cost centers