

Original Article

Economic Implications of Coronary Arterial Revascularization from Bangladesh Perspective

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Abstract:

Key Words :
CABG, PCI,
Health
economics,
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Background: There has been a radical improvement lately both for coronary artery bypass graft (CABG) and percutaneous coronary intervention (PCI) in Bangladesh. Besides the clinical goals, the economic impact of these procedures is very important as well. Out of pocket spending is the major payment strategy for healthcare in Bangladesh. It is estimated that the poverty headcount increased by 3.5% due to out of pocket healthcare payments.

Methods: Data on patients' expenditure for CABG and PCI in seven Bangladeshi hospitals were collected between 16th and 30th August, 2020. Several models were created, where the cost of CABG was compared with that of PCI in each of these hospital settings.

Results: In the two public hospitals CABG is much cheaper than PCI. However, in mid-level expensive hospitals the cost of PCI with 2 stents is comparable with that of CABG, but with 3 or more stents, PCI becomes more expensive. In the big corporate hospitals, CABG tends to be relatively more expensive. The basic treatment expenditure of a patient suffering from triple vessel ischemic heart diseases may range from Taka 50000 to Taka 415000.

Conclusion: In Bangladesh CABG is much cheaper than multi-stent PCI in the public and medium range private hospitals. CABG in corporate hospitals may be equal or even more expensive than PCI. IHD may contribute to national poverty as it may turn into a catastrophic health event for the patient's family.

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Introduction:

In the recent years, Bangladesh experienced an epidemiological transition from communicable disease to non-communicable disease (NCD). Among NCDs, one of the most growing concern has been the burden of coronary artery disease (CAD). Bangladesh probably has one of the highest rates of CAD in this region. Lifestyle related factors, including tobacco consumption, poor dietary habits, excess saturated and trans-fat, high salt intake, and low-level physical activity as well as some novel risk factors, including hypovitaminosis D, arsenic contamination in water and food-stuff, particulate matter air pollution has been identified as some of the main contributing factors to this phenomenon.¹

There has been a radical improvement in the treatment for ischemic heart disease (IHD) in Bangladesh from the beginning of the new millennium. This improvement involves both ends of the spectrum, namely coronary artery bypass graft (CABG) and percutaneous coronary intervention (PCI). These two are the most common revascularization procedures for patients with multivessel CAD (MVCAD). Clinical outcomes of the CABG and PCI over long-term follow-up have been compared in several studies on developed countries and have demonstrated that the CABG and PCI provided a similar degree of protection against death and myocardial infarction,^{2,3} although most of them also have shown that

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patients who underwent PCI are much more likely to require repeat procedures.⁴ PCI and CABG both are clinically time tested, but these procedures are expensive and difficult to bear for the vast majority of Bangladeshi population.

The main goals of coronary revascularization are to increase life expectancy and improve the quality of life. But the economic impact of these procedures is another very important issue particularly because out of pocket (OOP) spending, which is directly paid by a patient during service use and not reimbursed by any insurance coverage, is the most prevalent payment strategy for healthcare in Bangladesh. According to World Bank, 74 percent of current health expenditure in Bangladesh is OOP, which is much higher than the global average OOP spending of 18 percent and that of many neighboring countries such as India (62 percent), Nepal (58 percent) and Sri Lanka (50 percent). On the other hand, average cost of either procedure is more than the per capita gross domestic product (GDP) of Bangladesh. These numbers are alarmingly contrasting, and inevitably large and unpredictable health payments due to severe cardiac ailment can expose households to substantial financial risk and, at their most extreme, can result in poverty. Catastrophic health expenditure (CHE) is one of the major reasons of poverty in Bangladesh. It is estimated that the poverty headcount increased by 3.5% (5.1 million individuals) due to OOP payments.⁶ This could mean immense financial burden on patients in Bangladesh as most patients rely on OOP expenditure. These all make the economic aspect an important matter of consideration in deciding the suitable treatment modality.

Classically, CABG was a recommended treatment path for patients with complex health conditions such as MVCAD while PCI was preferred in patients with single-vessel disease or acute myocardial infarction.⁷ With rapidly developing technological advancement in PCI, such as the introduction drug-eluting stents (DES) in the past decade, instigated an argument that PCI could be appropriate for patients with complex multivessel disease. This idea has led to several randomized clinical trials (RCTs) investigating the clinical and cost-effectiveness of CABG compared with PCI with DES.⁸ This RCT was examined across 85 health

centers in USA and Europe and concluded both a cardiac surgeon and interventional cardiologist should be consulted, along with the patient's SYNTAX score, to decide which treatment modality could be best suited for the patient's case. Moreover, some other trials studying PCI with DES versus PCI with bare-metal stents (BMS) revealed the later procedure entails significantly higher restenosis rates, higher initial procedural costs, small but significant risk of very late stent thrombosis, and similar mortality rates.⁹ In Bangladesh, all these procedures (CABG and PCI with DES or BMS) are available to patients. However, their direct (operative) and indirect (maintenance) costs vary and often the OOP expense factor plays a major deciding criterion for patients, along with medical advice, to choose among alternatives.

In this backdrop, the objective of this study is to compare the cost of CABG and PCI and to frame these against the economic reality of the country. The purpose is to draw attention of the stakeholders towards the economic implications of heavy OOP spending on a major NCD in Bangladesh.

Methods:

Data related to IHD in Bangladesh are often insufficient, suffer from statistical flaws and are not readily available. This article will heavily rely on observational data from cardiac units in public and private hospitals in Bangladesh and review of existing literature. This observational study was conducted between 16th and 30th August, 2020. Data on patients' expenditure for CABG and PCI in seven Bangladeshi hospitals were collected. These included two public sector hospitals, one hospital run by a non-profit organization and four private hospitals. The list of stents, as fixed by the Drug Administration Authority, Government of Bangladesh, was also collected. Several models were created, where the cost of CABG was compared with PCI involving 1, 2 and 3 or more stents in each of these hospital settings.

Results:

The list of stents for the PCI procedure approved by the Drug Administration authority of the Government of Bangladesh contains the names of 55 different stents supplied by 25 local

companies.¹⁰ The official price of these stents ranges from Bangladeshi Taka (BDT) 10,946 (CC Flex) to BDT 1,49,489 (Synergy). Price varies according to the nature of the stent, country of origin, suppliers' profit margin and other factors. With such diverse quality and price, it is difficult to estimate actual costing of PCI for individual patients. For practical purposes, we would consider an average price of implanted stents as Taka 75000. We also have contacted the cardiologists and surgeons of the concerned hospitals for crosschecking the estimated expenditure. We have provided the basic procedural costs of CABG and PCI in table 1 in 7 Bangladeshi hospitals.

It is noteworthy that both CABG and PCI may become complicated clinically and involve additional expenditure. For instance, a post-operative CABG case may incur more expenses in case it requires additional ICU days due to wound infection, unpredictable respiratory and renal failure, expensive antibiotics, use of Intra-Aortic Balloon Pump and so on. However, major post-operative complications are rare. In case of PCI,

additional charges may be imposed due to administration of medicines like integrillin or use of more complex or sophisticated devices like rotablator. All these may add unforeseen cost to the patient. But, inclusion of these factors would make the comparative calculation too much complicated and hence we would avoid these uncommon factors in our simple model.

The cost of CABG remains the same whatever be the nature of the lesion or the number of the grafts. However, the cost of PCI involves a basic price for the intervention procedure and after that the bill increases according to the number of stents implanted where the price of each stent is added individually. For the purpose of this study the average price of a stent has been considered as BDT 75,000 for convenience of calculation. It is interesting to note that in two prominent public hospitals, CABG is much cheaper procedure as compared to PCI. The cost of CABG is around BDT 50,000, whereas PCI with a single good quality DES would be BDT 85,000. As CABG is clinically indicated in multi-vessel disease, a PCI with 4

Table-I
Comparison of expenditure for CABG and PCI in different Bangladeshi Hospitals (in Bangladeshi Taka)

Hospital	CABG PCI	Basic 1 stent	PCI with 2 stents	PCI with 3 stents	PCI with 4 stents	PCI with 4 stents
Public hospital 1	80,000	7000	82,000	1,57,000	2,32,000	3,07,000
Non-Profit Hospital	2,10,000	65,000	1,40,000	2,15,000	2,90,000	3,65,000
Private hospital 1	4,00,000	1,10,000 to 1,60,000	1,85,000	2,60,000	3,35,000	4,10,000
Private hospital 2	3,75,000	75,000	1,50,000	2,25,000	3,00,000	3,75,000
Private hospital 3	2,60,000	85,000	1,60,000	2,35,000	3,10,000	3,85,000
Private hospital 4	3,00,000	90,000	1,65,000	2,40,000	3,15,000	3,90,000
Public hospital 2	50,000	10,000	85,000	1,60,000	2,35,000	3,10,000

Source: Authors' compilation from observational data.

Table-II
Comparison of estimated average cost of CABG, PCI and per capita GDP (in USD)

Country	CABG	3 stent PCI	Per capita GDP (2019)	CABG per capita GDP ratio	PCI per capita GDP ratio
Bangladesh	2500	3000	1855.74	1.35	1.62
India	5000	5500	2104.146	2.38	2.61
China	16963	11369	10261.68	1.65	1.11
USA	100000	80000	65118.36	1.54	1.23

Source: World Bank (2020) and authors' calculations

stents might be several times expensive than CABG, for example BDT 3,10,000 versus BDT 50,000 only.

The scenario tends to be different in the private hospitals. In the non-profit private hospital, the cost of PCI with 2 stents (BDT 2,15,000) is comparable with that of CABG (BDT 2,10,000), but with 3 or more stents, PCI becomes more expensive. In the third private hospital, 3 stents PCI (BDT 3,15,000) is little more expensive than CABG (BDT 3,00,000). Similarly, in the fourth private hospital, 3 stents PCI (BDT 3,10,000) is more expensive than CABG (BDT 2,60,000). However, in the big corporate hospitals, CABG tends to be relatively more expensive. In (Corporate) private hospital 2, CABG is almost equally expensive (BDT 3,75,000) as a 4 stent PCI (BDT 3,75,000). Likewise, in (Corporate) private hospital 1, the cost of CABG (BDT 4,00,000) is comparable to that of 4 stent PCI (BDT 4,10,000). So, the posher and more expensive the hospital is, the more PCI is economically comparable to CABG. There is a simple explanation for that. The Drug Administration has fixed the price of stents. This allows the hospital authority to increase only the basic intervention charge for PCI, which is a small portion of a 3 or 4 stent PCI. On the contrary, for a CABG procedure only the price of oxygenator, one of the disposables used in the surgery, is fixed by the Drug Administration. These oxygenators are also used only in On-Pump CABG and not on Off-Pump-CABG (OPCAB) and involves a small proportion of the total cost of CABG surgery. Therefore, not only a minor portion of a particular CABG costing (On-Pump) is regulated by Drug Administration but data also shows OPCABs outnumber On-Pump cases by a huge margin in Bangladesh. This inevitably allows the hospitals to set the bill of CABG flexibly keeping their profit margins intact. In this context, CABG thus becomes comparatively more expensive than PCI, especially in big corporate hospitals.

It is interesting to note that the basic treatment expenditure of a patient suffering from triple vessel IHD may range from BDT 50,000 to BDT 4,15,000 implying that the cost could be 8 folds different depending on the type of healthcare facilities providing the service. This minimum expenditure is mandatory regardless if the treatment plan

involves CABG or PCI. If additional or luxurious options are added, the cost may increase even further more. Unfortunately, price setting methods by most healthcare service providers may not consider the financial affordability of these services for low- and middle-income earners among the victims of IHD. Depending on the frequency and volume of the incidence of IHD among Bangladeshi people, the financial implications on the patients and their families could potentially transmit into social and economic crisis in the society.

Discussion:

Disease-specific disaggregated data are seldom adequately available in publicly accessible sources of Bangladesh. According to HIES, B (2019, 2010), approximately 7 percent of total population had suffered from chronic heart diseases in 2010 and 2015.^{11,12} The number of affected people had risen as there has been a 7 percent population increase within these six years. Within a period of 30 days, there were 61 percent more people suffering from the disease in the country in 2016 than in 2010.

The data from 2010 survey showed of the total affected people with chronic heart disease, 47 percent were male, and 53 percent were female. Moreover, there were a greater percentage of women in rural areas being affected than men and in the urban areas a greater proportion of men were sick. In the 2015 survey, however this proportions were opposite and a higher number of men were recorded impaired with chronic heart disease both in the rural and urban areas. Both surveys showed the age with highest affected number was 55 to 59-year-old males (4% of total male population) and 45 to 49-year-old females (5.7% of total female population). On average men in the urban areas suffered the longest, that is ninety-four months. Given the lengthy time of treatment plus recovery and strong prevalence of the ailment, IHD impose a significant emotional and financial anxiety on most affected people in the country, largely because most expenses are borne OOP as and when required. In terms of costing, we have shown there is significant asymmetry in prices depending on the scale of treatment required and the type of healthcare services providing the treatment. Table 2 provides some data to reveal the unrealistic burden of IHD treatment on individuals in Bangladesh as opposed

to the situation in other countries. We use per capita gross domestic product (GDP) to make cross country comparisons of CABG and PCI procedures.

Bangladesh has one of the lowest budgetary allocations to the health sector in South Asia, that is 4.9% of the national budget in the fiscal year 2019/20 and it is a mere 0.9 percent of the country's GDP.¹³ If we consider per capita GDP figures an indicator of average living standard and economic wellbeing in a country, table II alarmingly reveals the ratio of procedure cost to GDP per capita is greater than one in Bangladesh, India, China and USA. In Bangladesh and India, the ratio is marginally smaller for CABG procedure and in China and USA the ratio is smaller for PCI procedure. This implies the financial burden for CABG is lower than PCI for people living in Bangladesh than in India. Nevertheless, IHD does affect the economic wellbeing of affected individuals adversely.

With an alarming 24.3 percent unemployment rate prevailing in the economy, this expenditure burden falls primarily on the working age group of population, especially young people trying to support their elderly parents. In 2016, as much as 7 percent of the population were pushed below the poverty line and 4.5 percent increase in poverty gap due to out-of-pocket health care expenditure as per World Bank report. Therefore, an episode of ischemic cardiac ailment may turn into a catastrophic health event and potentially make a family bankrupt. Catastrophic health event is a major cause of poverty in Bangladesh. Many health care providers seem to behave indifferent to this vital issue. They tend to focus mainly on the apparent clinical issues ignoring the background essential economic concerns. These facts should be taken into consideration while choosing treatment modality. In our study it was found that CABG was more expensive than multi-vessel PCI in big corporate hospitals. Similar findings were found by Stroupe KT et al. at a multicenter study on 445 patients treated in 16 medical centers run by the Veteran Affairs in USA.¹⁴ There was similar finding in a study in China. Zhao et al. from Beijing reported that in the short-term, among the CAD patients with stable triple-vessel or left-main, costs and clinical outcomes are substantially higher for CABG than PCI. Costs of resources in Beijing Area are \$16,963 for CABG and \$11,369 for PCI.¹⁵

Limitations of our study include availability of disaggregated and timely collected data in Bangladesh. The hospitals are reluctant to provide clinical or financial data. The study period was short and further detailed investigation was not possible due to time constraint. For further research we would recommend to estimate health related quality of life (HRQoL) figures such as quality adjusted life years (QALYs) of either procedure to assess the cost-effectiveness. For now, the main objective of the study is to draw attention of the stakeholders towards the economic implications of expensive treatment methods of a persistently prevalent NCD in Bangladesh.

Conclusion:

Two most common treatment modalities of IHD have important economic implication as well. In Bangladesh CABG is much cheaper than multi-stent PCI in the public and medium range private hospitals. In big corporate hospitals, however CABG is relatively much more expensive. As a lower-middle-income country, Bangladesh has only limited financial capability to offer free healthcare to its citizens. An episode IHD may turn into a catastrophic health event for the family as out of pocket expenditure is often the only solution here and is a major contributing cause of poverty in Bangladesh. Strengthening of the regulatory body is necessary to control private health care providers' capacity to charge exorbitant prices as well as to monitor if public service providers are allocated adequate resources and efficiently utilized. Our study has just revealed a socioeconomic mismanagement. Further large and well-organized studies are recommended to highlight this important issue in future both for the health sector and overall economic wellbeing of the country.

Conflict of Interest - None.

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