Cost analysis of management of cardiovascular disease comorbidities in Turkey

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Abstract

Objectives  The strongest muscle of human body, the heart, is susceptible to a range of diseases. These diseases involve deterioration of the blood vessels, muscles of heart, malformation of cardiovascular structures, tumour formations, formation of clots, rupturing of vessels and others. Therefore, taking into consideration the direct and indirect burdens of cardiovascular diseases around the globe, the present study was designed to perform a direct cost analysis of managing comorbidities of cardiovascular diseases with reimbursement authority perspective.

Methods  The cost analysis study conducted in the present article was conducted in three phases. The first phase involved filling of survey questionnaire by five experts practicing in the field of cardiology in Turkey. The second phase comprised of expert panel wherein three out of five experts reviewed the forms filled by all the experts. This was followed by third phase wherein the three experts attending the panel re-filled the questionnaire as per the daily clinical practice.

Key Findings  The findings showed total annual costs for cardiovascular diseases (CVDs) exhibiting myocardial infarction comorbidities for both acute and maintenance treatment as 5622.95 and 1245.04 TL respectively. The total costs for major bleeding events were found to be 1211.95 TL, whereas for minor bleeding events the costs were 496.26 TL. The total cost for intracranial bleeding was 1761.53, and 3595.62 TL for stroke, which followed myocardial infarction.

Conclusion  The study findings helped gain an insight into the most prominent comorbidities associated with CVDs in the perspective of reimbursement institution including direct costs. Further studies are needed to understand the real cost for reimbursement institution.

Keywords  health economics; health services research; outcomes research

Introduction

The strongest muscle of human body, the heart, is susceptible to a range of diseases. These diseases involve deterioration of the blood vessels, muscle of heart, malformation of cardiovascular structure, tumour formations, formation of clots, rupturing of vessels and others.[1] These conditions are not always limited to the affected organ, rather give rise to multitude of comorbidities, which severely impairs the quality of life of the patient. This noncommunicable disease has lately evolved into one of the leading causes of early death, thereby overburdening the public healthcare infrastructure worldwide.[2] Keeping in view the escalating cost of illness associated with cardiovascular diseases (CVDs), the intelligent disease management is essential.

Cardiovascular disease clinical management

The ongoing trend of disease prevalence has led to prediction of rise in the mortality from 17.5 to 22.2 million by 2030. The most common heart conditions resulting in mortality are heart attacks and stroke, which could often be avoided, by practicing relevant lifestyle interventions and drug treatment WHO designed the HEART package which is for to put forward interventions for ensuring access to continuous, standardised,
high-quality care for people with high-risk CVDs. By integrating the tools necessary for management of CVDs in primary health care, the package emphasises upon essential training of patients, effective governance, clinical tools and protocols, medical products, health information systems, healthcare workers and service delivery.[3]

**Comorbidities of cardiovascular diseases**

The occurrence of multiple diseases in a single individual at the same time is referred to as comorbidity. The patients suffering from CVDs often report comorbid conditions, which share the risk factors with CVDs, such as diabetes and chronic kidney diseases. The cooccurrence often occurs due to indirect and direct causal relationships between the diseases.[4] A wide range of comorbidities are associated with cardiovascular diseases such as respiratory comorbidities, renal dysfunctions, anaemia, arthritis, depression and cognitive dysfunctions (Table 1).[5] The table given below mentions some studies which have studied the cardiovascular comorbidities in clinical settings (Table 2).[6-9]. The study by Tusek-Bunc & Petek[6] presented the impact of CVDs on quality of life of the patients. Findings showed a statistical significant reduction in quality of life of patients with CVD who reported frequent physician office visit with heart failure, anxiety and depression being the primary reasons. Rushton & Kadani[7] present the prevalence scores for association of chest pain and shortness of breath associated with the respective comorbidities. The complex nature of risk factors and outcomes associated with these diseases makes disease management a challenge, demanding comprehensive strategies for the same.

**Cost of managing cardiovascular diseases**

As CVDs has achieved number one position for causing mortality around the world, its burden on social and economic spheres continues to grow for both the developing and developed regions. The increased instances of CVDs in the developing regions have been attributed to rapid modernisation and modern epidemiological transition. The patients exhibiting development of CVDs belong to young age group, thereby creating a deficit in the availability of workforce and damaging the economies at both local and global scales. This also poses significant economic challenges on the world economies, especially for the developing economies.[10] The statistics have shown devotion of 2–3% of South Africa’s gross national income towards CVDs treatment. Another international survey conducting to understand the loss of years with covering five developing nations, namely Brazil, India, China, South Africa and Mexico. Findings indicated that there is a loss of 21 million years of future productive life annually due to CVDs in given countries.[11]

**Objectives of the study**

The mentioned facts emphasise not only on the rising prevalence of cardiovascular diseases, but also their complex relationship with comorbidities. Therefore, taking into consideration the direct and indirect burdens of cardiovascular diseases around the globe, the present study was designed to perform a direct cost analysis of managing comorbidities of cardiovascular diseases from reimbursement authority perspective.

**Methods**

Researchers cannot reach the real-world data that are collected by Social Security Institution or Ministry of Health, even anonymously. Depending on that, there are two potential methodologies for cost calculation. First approach is to make a registry system across country for collecting the real-world data which needs to involve physicians from clinics. Second approach is to conduct expert opinion surveys. Expert opinion survey has been selected for the study.

To fulfil the designated objective, the following methodology was adopted:

**Expert opinion design**

The cost analysis study conducted in the present article was conducted in three phases. The first phase involved filling of survey questionnaire by five experts practicing in the field of cardiology in Turkey. The second phase comprised of expert panel wherein three out of five experts reviewed the forms filled by all the experts. This was followed by third phase where in the three experts attending the panel re-filled the questionnaire as per the daily clinical practice.

**Selected comorbidities**

Major bleeding, minor bleeding, intracranial bleeding, stroke and myocardial infarction which are mostly co-occurring with CVDs have been selected as common comorbidities for cardiovascular diseases under expert opinion. Cognitive dysfunctions and depression did not selected for cost calculation either. Acute cost defined as cost associated with 0–3 months has been calculated for major bleeding, minor bleeding, intracranial bleeding, stroke and myocardial infarction. Chronic maintenance cost as cost associated 12 months after acute cost has been calculated for intracranial bleeding, stroke and myocardial infarction.

**Reference guidelines**

The guidelines formulated by American College of Cardiology (ACC)/American Heart Association (AHA)/European

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**Table 1** Comorbidities associated with cardiovascular diseases[5]

| Associated comorbidities     |
|------------------------------|
| Anaemia                      |
| Arthritis                    |
| Cognitive dysfunctions       |
| Depression                   |
| Renal dysfunctions           |
| Respiratory diseases         |
Society of Cardiology (ESC) and the daily clinical practice were followed by experts while filling the questionnaires. These reference guidelines form the basis of classification and evidence-based recommendations for the management of cardiovascular disease morbidities such major and minor bleedings, intracranial bleeding, stroke, and myocardial infarction (Table 1).

Cost analysis
The cost analysis involved calculating the total medical costs comprising of treatment, utilised healthcare resources, diagnostic testing and cost of consultations. For the purpose of calculating the drug costs, the updated price and discount lists as obtained from Social Security Institution (SSI) for 2017 was taken into account. The nonmedicine costs, costs for

### Table 2 Clinical studies regarding comorbidities in cardiovascular diseases

| Author (year)                        | Place                      | Sample population                                                                 | Results                                                                 |
|--------------------------------------|----------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------|
| Robbins et al. (2005) [8]            | Philadelphia               | Outpatient data of 10 095 patients from Philadelphia Health Care Centers           | Cerebrovascular disease – 3.1%                                         |
|                                      |                            |                                                                                   | Hypertension – More than 77%                                           |
|                                      |                            |                                                                                   | Myocardial infarction – 1.4%                                           |
|                                      |                            |                                                                                   | Congestive heart failure – 4.8%                                        |
| Slater et al. (2011) [9]             | Canada                     | 115 915 from 2005 Canadian Community Health Survey 3.1                             | Prevalence ratio arthritis – 1.60                                      |
| Rushton & Kadam (2014) [7]           | England                    | 5426 patients from family practices                                                | Prevalence ratio back problem – 1.46                                   |
| Tušek-Bunc & Petek (2016) [6]        | Slovenia                   | 423 Coronary heart disease patients                                                | Hypertension: CP: –14.7, SOB: –9.2                                     |
|                                      |                            |                                                                                   | Ischaemic heart disease: CP: –5.5, SOB: –6.4                           |
|                                      |                            |                                                                                   | Heart failure: CP: –22.1, SOB: –8.8                                    |
|                                      |                            |                                                                                   | EQ-VAS score was 58.6 ± SD 19.9                                        |

CP, chest pain; EQ-VAS, European Quality of Life Visual Analogue Scale; SOB, shortness of breath.

### Table 3 Cost analysis for acute treatment (0–3 months) of different cardiovascular diseases comorbidities

| Diagnosis | Total cost, TL | Diagnosis cost, TL | Long-term secondary prevention cost, TL | Nonmedicine treatment cost, TL | Medicine treatment cost, TL |
|-----------|----------------|--------------------|----------------------------------------|-----------------------------|------------------------------|
| Major bleeding | 1211.95 | 388.62 | 516.00 | 198.37 | 108.96 |
| Minor bleeding | 496.26 | 219.38 | 206.00 | 70.66 | 0.21 |
| Intracranial bleeding | 1761.53 | 283.32 | 558.61 | 272.82 | 646.78 |
| Stroke | 3595.62 | 431.08 | 2433.15 | 445.03 | 286.36 |
| Myocardial infarction | 5622.95 | 298.10 | 3463.00 | 1810.23 | 51.62 |

Society of Cardiology (ESC) and the daily clinical practice were followed by experts while filling the questionnaires. These reference guidelines form the basis of classification and evidence-based recommendations for the management of cardiovascular disease morbidities such major and minor bleedings, intracranial bleeding, stroke, and myocardial infarction (Table 1).
diagnostic tests, hospitalisations and consultations were calculated utilising the Health Implementation Notification by SSI.

**Statistical analysis**

The statistical analysis for undertaking the cost analysis, for gaining an insight into disease management, was performed using SPSS (version 13.0), SPSS Inc. Chicago, IL, USA. The mean direct costs were taken into consideration to obtain a better outlook regarding the disease burden. The direct cost model equation was as follows:

\[
\text{Cost} = \sum (\text{Frequency}) \times (\text{Unit price})
\]

**Results**

The statistical analysis of the collected data generated the results as shown in Tables 2 and 3. Table 2 shows the costs for acute treatment in case of no events and with different comorbidities. It was highest for myocardial infarction, 5622.95 TL, as seen from Figure 1. The average cost for diagnosis was highest for stroke, 431.08 TL, followed by major bleeding events 388.62 TL. The pharmacological treatment costs were the highest for intracranial bleeding, 646.78 TL, whereas it was surprisingly low for minor bleeding events. However, the nonpharmacological costs were highest for myocardial infarction, 1810.23 TL, with highest maintenance cost of 3463.00 TL. Also, it was surprising to observe that the pharmacological and nonpharmacological costs for minor bleeding events were lowest, even in comparison with scenario reporting no event (Tables 3 and 4).

The maintenance costs were calculated for three comorbidities, as shown in Table 3. The maintenance treatment costs showed that myocardial infarction comorbidity reported the high costs for diagnosis, 168.15 TL, and medicines, 823.13 TL. However, the nonmedicine treatment costs were high for intracranial bleeding, 754.50 TL, and stroke, 670.50 TL. With respect to the total average costs, myocardial infarctions reported the highest expenditure, 1245.04 TL, whereas it was the lowest for intracranial bleeding. Also, the maintenance cost for the respective comorbidities was found to be low with respect to the costs for acute treatment (Figures 1 and 2).

**Discussions**

The present study results indicated towards high cost of acute and maintenance treatment of myocardial infarction. The similar high costs incur in myocardial infarction comorbidity has also been indicated by previous studies.

![Figure 2](image-url)  
**Figure 2** Cost analysis for long-term secondary prevention cost of different cardiovascular diseases co-morbidities.
While performing the cost analysis for patients hospitalised for percutaneous coronary intervention for acute myocardial infarction, the increase in costs over the course of period from 2004 to 2009 was recorded. Amongst the 265 531 patients who received the treatment, the costs increased from $15 889 ($12 057–$21 204) in 2001 to $19 349 ($14 660–$26 282).[12] Myocardial infarction and percutaneous coronary interventions were also reported to be one of the most expensive and frequent cardiovascular events, accounting for more than 75% of fatal cardiovascular events.[13] Myocardial infarction was also regarded as the primary reason for admission diagnosis, contributing to higher costs of treatment. The patients who received percutaneous coronary interventions were reported to have annual expenditure of $52 673, with high costs of disability, $9221 and absenteeism, $9460.

Therefore, the study results were found to be in alignment with the results from previous researches. Myocardial infarction continues to be one of the leading comorbidities associated with CVDs, and the treatment costs are high. Taking into view the pathophysiology of the disease, relevant management strategies have been devised, for acute and long-term management. The acute management strategies involve timed cardiac protection, postconditioning, remote ischaemic conditioning and reperfusion strategies.[14] Other contemporary strategies suggested in studies involve revascularisation and long-term secondary prevention, besides administering adjunctive treatments such as clopidogrel, aspirin, direct thrombin inhibitors and others.[15]

**Limitations**

The present study suffered from the limitations of time and cost, due to which the questionnaire could be administered to only 5 experts. Also, a host of other conditions could present as comorbidities of CVDs. Due to aforementioned limitations, the scope of investigations was also limited, which could be expanded to include other comorbidities as well.

**Conclusions**

**Conclusion**

The cost analysis study emphasised upon the additional economic burden faced by the patients suffering from comorbid conditions of cardiovascular diseases. Amongst the different conditions under consideration, myocardial infarction was observed to inflict the highest burden. Therefore, it is necessary to have a clear and concise view of the diseased state of the patient, epidemiology and the history of illness, so as to facilitate the appropriate allocation of resources for treatment. Also, prior knowledge of the relevant conditions which could accompany the underlying CVDs could also help in defining better treatment measures, so as to avoid any possibility of comorbidities, thereby reducing the possibilities of additional economic burden on the patients.

**Future scope**

The findings from the present study pave way for future researches, as the possible range of comorbidities associated with CVDs is large in number. The future research could study the spatial distribution of the diseased conditions, in accordance with the lifestyle and surrounding conditions of patients. This could help in linking the geography of comorbidities and the costs incurred in treating these conditions. Through this, the relevant authorities could formulate better healthcare policies, and the patients could possibly avoid the additional economic burdens.

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**Authors’ contributions**

Dr Guvenc Kockaya & Dr. Gulpembe Ergin Oğuzhan lead the research and calculate the cost of comorbidities. Prof. Dr. Bulent Ozin, Dr. Kerem Can Yılmaz and Dr. Orçun Çiftçi made contribution as the experts for cardiovascular diseases. Filiz Cavus, Dr. Amir Sharaf, Dr. Nazım Büyuktuna, Tansu Buyukisik and Dr. Mete Saylan has been conducted the literature search and gave inputs for preparing the article.

**Data availability statement**

The data supporting this cost analysis are from previously reported studies and data sets, which have been cited. The expert opinion data used to support the findings of this study are available from the corresponding author upon request.

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