The burden of ischemic heart disease at a major cardiac center in Central Saudi Arabia

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ABSTRACT

الأهداف : تقدير التكلفة الإجمالية للرعاية الصحية المرتبطة بأمراض انسداد شرايين القلب في مركز الأمير سلطان لأمراض القلب كمثال لتكلفة هذه الرعاية الصحية بالمملكة العربية السعودية .

الطريقة : أُجريت هذه الدراسة الاستطلاعية القائمة على انتشار المرض خلال الفترة من إبريل إلى يونيو 2009م وذلك لتحديد العبء المادي لأمراض انسداد شرايين القلب بمركز الأمير سلطان لأمراض القلب بالرياض، المملكة العربية السعودية. شملت الدراسة جميع المرضى الذين تم تشخيصهم أو يُشتبه في وجود أمراض انسداد شرايين القلب لديهم. ثم تمت متابعتهم بعد ذلك من لحظة دخول المستشفى حتى الخروج أو إجراء عملية استبدال شريان القلب التاجي أو تغيير التشخيص. وقد قمنا أيضاً باسترجاع البيانات من ملفات المرضى ونظام الحاسب الآلي للمركز، وحُسبت التكاليف الطبية المباشرة منها .

النتائج : لقد تمت متابعة 205 مريض خلال هذه الدراسة. شُخص 47.8% منهم بالذبحة الصدرية المستقرة، و24.4% بالذبحة الصدرية غير المستقرة، و19.5% باحتشاء عضلة القلب الناتج عن ارتفاع جزء من ST، و8.3% باحتشاء عضلة القلب غير الناتج عن ارتفاع جزء من ST. لقد كانت غالبية المرضى من الذكور السعوديين وفي الفئة العمرية ما بين 40 إلى 75 عاماً. وعانى 87% من المرضى من مرضين مصاحبين أو أكثر، كما أن نسبة السمنة كانت 32%. لقد كان متوسط العبء المادي للمريض 40,164 ريال سعودي (10,710 دولار أمريكي). مثلت الأدوية أقل مساهمة في العبء المادي (3.2%). وكانت الأعباء المادية المصاحبة للذبحة الصدرية المستقرة و غير المستقرة واحتشاء عضلة القلب الناتج وغير الناتج عن ارتفاع جزء من ST على التوالي 33,991 و35,107 و46,585 و58,877 ريال للمريض الواحد من كل حالة. كما أن أقل متوسط فترة مكوث لمريض كانت 6.5 أيام صاحبت مرضى الذبحة الصدرية المستقرة. كما ارتفع متوسط المكوث بالمستشفى كلما زاد عدد الأمراض الأخرى المصاحبة من 5.67 أيام (عدم وجود أمراض مصاحبة) إلى 11.25 يوم (في وجود 6 أمراض مصاحبة) .

خاتمة : تبين هذه الدراسة أن تكلفة علاج أمراض انسداد شرايين القلب هي ذات عبء اقتصادي مرتفع في المملكة العربية السعودية . ومن بين الأربعة أنواع لأمراض انسداد شرايين القلب التي تمت دراستها كان استهلاك الموارد المرتبطة باحتشاء عضلة القلب الناتج عن ارتفاع جزء من ST أعلى من حيث التكاليف وطول مكوث المريض بالمستشفى. كما أدت الأمراض المصاحبة إلى زيادة فترة المكوث بالمستشفى .

Objectives: To estimate the direct medical costs associated with ischemic heart disease (IHD) at Prince Sultan Cardiac Center (PSCC) in Riyadh, Saudi Arabia.

Methods: This is a prevalence-based prospective observational cost of illness study conducted in PSCC, Riyadh, Kingdom of Saudi Arabia between April and June 2009. All patients diagnosed or suspected of having IHD at admission were included. They were followed up until discharge, or performing coronary artery bypass graft (CABG), or changing diagnosis. Clinical data were extracted from the patients' computerized database, and combined with the unit cost of services to calculate costs.

Results: A total of 205 patients were recruited and diagnosed with stable angina (SA, 47.8%), unstable angina (USA, 24.4%), ST-segment elevation myocardial infarction (STEMI, 19.5%), and non-ST-segment elevation myocardial infarction (NSTEMI, 8.3%). Most of the patients were Saudi males, aged between 40-75 years. Eighty-seven percent of patients had 2 or more co-morbidities, and 32% of the patients were obese. The average cost was 40,164 Saudi Riyals (SAR)/patient (US\$10,710). Medication contributed the lowest in the costs (3.2%). A cost associated with SA was SAR33,991, USA was SAR35,107, NSTEMI was SAR46,585, and STEMI was SAR58,877 per patient. The lowest mean hospital length of stay was 6.5 days with SA. The average length of stay increased with the number of co-morbidities from 5.67 days (no co-morbidity) to 11.25 days (6 co-morbidities).

Conclusion: The IHD is of high economic burden in the country. Among IHD types studied, the resource consumption associated to STEMI was the highest in terms of costs, and hospital length of stay.

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Ischemic heart disease (IHD) (also called coronary artery disease [CAD]) is now the leading cause of death worldwide, responsible for more than 7 million deaths annually worldwide.[1] It is also the major cause of death in the Kingdom of Saudi Arabia (KSA), according to data published by the Saudi Ministry of Health.[2,3] In KSA, cardiovascular diseases (CVD) accounted for approximately 20% in 2005, 22% in 2006, and 19% in 2007of the total death.[2] Annual mortality report 2005 indicated that acute myocardial infarction (MI) was one of the leading causes of death (2494/8070, 30.9%) among CVD followed by cerebrovascular strokes (15.8%), essential hypertension (14.6%), and chronic IHD (7.1%).[3] Choi et al,[4] in their review on IHD "current treatments and future", described IHD as "the insufficient status of oxygen within the cardiac muscles due to an imbalance between oxygen supply and demand, and a cardiac disease that occurs as a result of coronary artery stenosis". This includes both acute coronary syndrome, which includes unstable angina (USA), ST-segment elevation myocardial infarction (STEMI), and non-ST-segment elevation myocardial infarction (NSTEMI), and chronic coronary syndrome (that is, stable angina [SA]). In a 2004 published study,[5] the prevalence of IHD among Saudis was 5.5% (approximately 858,000 patients), increasing more in males, and in urban areas. With atherosclerotic risk factors on the rise, CAD, and ischemic cardiomyopathy will become more prevalent.[5] This was probably the only national study that touched this issue and did not report any cost figures. The related economic burden of IHD can be evaluated by measuring the costs associated with IHD in cost of illness (COI) studies.[6] The major contribution of COI studies is to help decision makers in prioritizing disease management.[7] Cost of IHD is a general concern for all nations; studies coming from UK,[8] Thailand,[9] India,[10] China,[11] and several other countries[5,12-14] discussed this issue either exclusively, or as part from the general view of the disease burden. For example, the estimated direct and indirect cost of CAD in the United States for 2010 was $177.1 billion.[15] Total cost of illness associated with CAD in 2004 in the UK was £8.47 billion per year (US$15.52 billion, average exchange rate for year 2004 was 1.8326);[16] the total health care costs of coronary heart disease represented 40.7%. The major costs were those used for hospital inpatient care, which accounted for 70% of the total health care cost and drug treatment, which accounted

to 18% of the total health care cost.[8] Such studies and cost data are missing in Saudi Arabia. The aim of this study was to estimate the hospital health care cost associated with IHD at Prince Sultan Cardiac Center (PSCC), a major cardiac referral center in the country, and to identify cost patterns in IHD for future studies, budget, and administration planning.

Methods. This is a prevalence-based, 2.5 months prospective cohort observational cost of illness study conducted from the perspective of PSCC, Riyadh, KSA. The study period was from April to June 2009. The study was started after acceptance from the ethical committee at PSCC, and conducted according to the principles of Helsinki Declaration. All adult inpatients (≥18 years of age) who were diagnosed, or suffered from IHD (according to patient file) between April to June 2009 were followed up until discharge, or referred to surgery, specifically coronary artery bypass graft (CABG), or changed diagnosis. The IHD were stratified into 4 types: SA; USA; STEMI; and NSTEMI depending on physician's diagnosis. Patients who are less than 18 years old, or suffered from other heart diseases (not including IHD), or were just admitted to perform heart surgery (for example, CABG), or diagnosis were not confirmed, or for routine check up were excluded from the study. Exclusion of CABG patients was that, the operation usually is not carried out on the same admission, and that post operation costs sometimes may not directly relate to IHD. There was no sample size calculation since all patients meeting the eligibility criteria were included consecutively.

Data were collected by a team of trained pharmacist. Clinical data were extracted from patient information sources (paper files and computerized system) after gaining the Institution Review Board approval. Collection was carried out using a special sheet, which was filed by the collector, one sheet for every patient on admission, then updated with recent relevant information until the end point is reached. Combining this information, the resource consumed were generated. Then, the resource consumption data were combined with the unit cost of services provided by the hospital (medication, procedures, bed utilization) to calculate direct medical costs. We used Predictive Analytics SoftWare (PASW) version 18, licensed to King Saud University for all statistical analysis and calculations.

Results. A total of 205 individuals were identified with diagnosis of different types of IHD. The study population was predominantly 40-75 years old (90%) with a mean age of 61.4 years (59.88-62.92 95%

confidence interval). Almost 50% of patients were equal to or younger than 63 years old (**Table 1**). Approximately 80% of the study population were male and 32% were obese and overweight. The SA was the most frequent type, occurring in 47.8% of the cases, followed by MI (27.8%) with ST or non ST segment elevation (STEMI and NSTEMI) (**Table 2**). Approximately 87% of the study population had 2 or more co-morbidities. Co-morbidities followed were diabetes mellitus, hypertension, hyperlipidemia, previous IHD, previous heart surgery, and others (for example, asthma, chronic obstructive pulmonary disease, hypo- or hyper- thyroidism). Total cost of all medical care was SAR8,233,531 (US$2,195,608) (SAR1 is equal to US$3.75) during the period of the study. The average cost of care per patient was SAR40,164 (95% confidence interval: 35,617 - 44,711) , or SAR16,066 (US$4,284.3) per patient per month (**Table 3**). Calculation of the median patients cost for the 2.5 month period resulted into SAR30,140 (US$8,037.3). If the results were extrapolated to the whole year, it is estimated that IHD will cost PSCC a total of SAR39,520,949 (US$10,538,920). More than SAR3.3 million (40.4% of total costs) were spent on care for SA, the average cost of care for SA was SAR33,991 (US$9,064.3) per patient, or SAR13,596.4 (US$3,625.7) per patient per month. An additional SAR2.3 million (28.6%) were spent on care for STEMI, which is equal to SAR58,877 (US$15,700) per patient, or SAR23,550 (US$6,280.2) per patient per month. SAR1.7 million (21.3%) were spent on care for USA, which is on average SAR35,107 (US$9,361.9) per patient, or SAR14,042.8 (US$3,744.8) per patient per month, and SAR791,945 (9.6%) were spent on care for non NSTEMI, in other words, SAR46,585 (US$12,422.7) per patient, or SAR18,634 (US$4,969.1) per patient per month. Medications accounted for SAR261,220 (US$69,658.7), or 3.2% of the total expenditure, valuing 1577 medication prescriptions. These costs included a wide variety of medication categories including oral antiplatelets (prescription percentage was 38%, total cost SAR48,122), beta blockers (BBs) (14%, SAR10,660), lipid lowering drugs (13%, SAR56,642),

Table 1 - Population distribution by age and gender (n=205).

Age (years)	Gender		Total (%)	
	Male	Female		
<40	2	0	2	(0.9)
40-55	55	13	68	(33.2)
56-65	43	15	58	(28.3)
66-75	49	9	58	(28.3)
76+	16	3	19	(9.3)

Table 2 - Direct medical cost in Saudi Riyals (SAR), and length of stay (LOS) for all ischemic heart disease categories in Prince Sultan Cardiac Center, Riyadh, Kingdom of Saudi Arabia.

Diagnosis	n	(%)	Direct medical cost (SAR)			Total direct medical cost (SAR)	Average direct medical cost/ patient	Sum LOS, days	Average LOS/ patient
			Medication	Hospital bed use	Procedure				
Stable angina	98	(47.8)	93,606.31	2,014,500	1,223,052.19	3,331,158	33,991.4	637	6.5
Unstable angina	50	(24.4)	67,762.28	1,079,000	608,595.65	1,755,358	35,107.2	365	7.3
Non ST elevated myocardial infarction	17	(8.3)	27,488.16	562,000	202,457.83	791,946	46,585.1	145	8.5
ST elevated myocardial infarction	40	(29.5)	72,363.29	1,605,500	677,205.48	2,355,069	58,876.7	392	9.8
Total	**205**	**(100.0)**	**261,220.0**	**5,261,000**	**2,711,311.0**	**8,233,531**	**40,164.0**	**1539**	**7.5**

Table 3 - Average direct medical cost and average length of stay (LOS) per diagnosis and associated co-morbidities in Prince Sultan Cardiac Center, Riyadh, Kingdom of Saudi Arabia.

| Diagnosis		Number of associated co-morbidities						
		0	1	2	3	4	5	6
Stable angina	LOS	4.2	5.7	4.1	6.9	6.8	8.5	8.7
	Cost	29,812	45,027	26,315	36,604	30,755	41,915	32,185
Unstable angina	LOS	8.7	9.5	7.8	7.1	6.2	9	6
	Cost	27,028	41,996	37,400	40,253	30,129	31,519	15,431
Non ST elevated myocardial infarction	LOS	0	5.5	7	10	8.7	12.3	8
	Cost	0	31,036	45,893	53,768	48,140	56,191	33,989
ST elevated myocardial infarction	LOS	4	5.3	11.9	7.3	12.7	6.5	23
	Cost	55,430	29,586	66,284	49,827	80,356	28,231	130,132
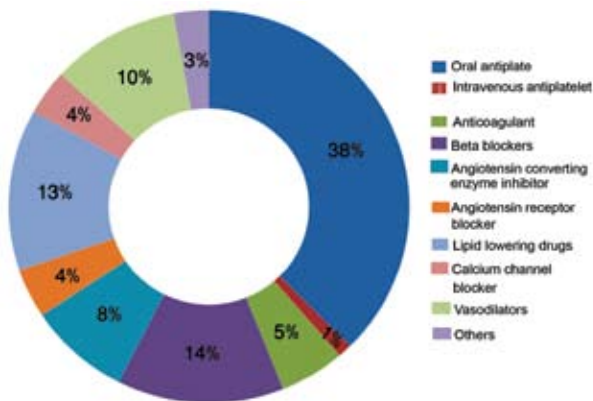
Figure 1 - Frequency of dispensing medication calculated as a percentage of the total prescriptions in 205 patients.

angiotensin converting enzyme inhibitor (ACEI) (8%, SAR13,968), angiotensin receptor blockers (ARBs) (4%, SAR8,434), and other medications (for example, IV antiplatelets, anticoagulants, calcium channel blockers and vasodilators) (23%, SAR125,394) (**Figure 1**). The contribution of ARBs were only 0.10%, BBs 0.13%, and ACEI 0.17%; to the total cost. For the study population, the average monthly medication cost was SAR509.7 (US$135.9) and the estimated average yearly medication cost was SAR6,116.4 (US$1,631). Hospitalization or hospital bed use cost accounted for more than SAR5.2 million (more than US$1.4 million), or 63.9% of the total expenditure. Cardiac care unit admission (31%) accounted for 58% of total hospital cost, while inpatient admission (49%) accounted for 40% of expenditures. Having any diagnostic and/or surgical procedure had an important effect on cost. The procedure cost accounted for SAR2.7 million (US$723 thousand), or 32.9% of the total expenditure during the study period. Cardiac catheterization accounted for 67%, while diagnostic imaging accounted for 26% of total procedure cost. Among the diagnoses, SA had 45% of total cost of procedure. Regarding the length of stay (LOS) in days, results are shown in **Table 3**, SA cases showed the lowest confinement. Both STEMI and NSTMI, and USA required on average, the longest LOS. The mean LOS for an IHD patient was 7.47 days (95% CI: 6.67-8.27), however, half of the patients stayed 6 days or less. Among the study population, approximately 196 (95%) patients had one or more co-morbidities along with IHD, which was expected to affect the length of hospital stay. The average LOS increased with the number of co-morbidities from 5.67 days (no co-morbidities) to 11.25 (6 co-morbidities) (**Table 3**).

Discussion. The IHD remains the first cause of death worldwide including KSA. The demographics

from this study concluded that IHD is still mainly a male prevalent disease in KSA, and this may be contributed to the high smoking percentages of males compared to females. Comparing age distribution for IHD it was found to be the same with age groups as in other countries.[5,9,17,18]

The estimated annual total cost of IHD care in PSCC was SAR39,520,949 (US$10,538,920). This number is hard to be compared directly to other studies due to different perspectives, inclusion criteria, and costs accounted. On the other hand, cost breakdowns can be compared. Etemad and McCollam[17] reported a 12-month study in a single health plan, that newly onset acute coronary syndrome total costs were more than US$300 million, and the cost breakdown was distributed as 93% medical and 7% pharmacy, which is somewhat similar to our findings (96.8% medical, calculated as hospitalization and procedures costs, and 3.2% medications). Continuing the comparison, hospitalization was the largest cost contributor by 71% of the total cost in the previous study, and relative results were reported here (63.9% of the total expenditure).[17] The least contribution in IHD direct cost was medications, with annual per patient estimation of SAR6,116.4 (US$1,631). Knowing that medical supply in KSA is free for all Saudi patients, and that the GDP per capita in 2009 as per official numbers is SAR52,853, the annual cost of IHD patient medications will represent 11.6% of the GDP per capita.[19] This represents a relatively low burden on the governmental expenditure. Comparing this number with an estimation from other institute, reporting an estimation of US$2,076, and US$2,643.72 annual medication expenditure per patient,[17,18] makes this expenditure reasonable and acceptable.

Each IHD patient cost US$4,284.3 per month in average, which is higher than what was reported in similar studies.[17] A 7.47 days as average LOS, was found to be higher than what usually reported in the literature (4.9 days).[17] A possible explanation could be that most of patients stay over the weekends, where there is no active procedures carried out to patients. Recommendations to reduce this number will impact largely on the total cost, and will further improve resource management of the institute.

Care for SA had the lowest overall mean cost during the study period, while care for STEMI, NSTEMI, and USA had substantially higher costs. Also as expected, disease severity and/or number of co-morbidities/risk factors played an important role in increasing both the cost and hospitalization. Here, we can provide a proven role by pharmacists, as well as other health professionals, to support reducing this burden by providing patient

education regarding the importance of having a healthy diet, performing suitable amount of physical activities, and assuring patient compliance; which can have a great impact on cost. Moreover, emphasizing the hazards of smoking and other risk factors will put the patient on the right track for treating risk factors for IHD, or prevent worsening of the situation, which will decrease the recurrence of hospitalization, and thus affect the cost of IHD. This was proven in studies regarding drugs affecting IHD.[20,21]

Perfection was our aim but limitations were presented in the form of only studying the direct medical cost. Other costs, for example, direct non-medical, intangible and indirect costs were not included due to either shortage of time, or difficulty in getting patients cooperation. The second issue is the focus on a single center for a short period of time, which makes it hard to be extrapolated to the general population, but gives a picture on the expenditure of a specialized site in the country. Another issue is the difficulty in comparing our results to commonly national available studies. However, this study is the first COI study regarding IHD in KSA, which gives a rough understanding of the current situation, and future planning, as well as a model for extensive national and/or future cost effectiveness study.

In conclusion, this study provides a reasonable indication of the economic consequences of IHD. It shows that IHD is of high economic burden in KSA. Among the 4 types of IHD studied, the resource consumption associated to STEMI was the highest in terms of costs, and patient hospital LOS. Medications were the cheapest between all processes, for example ACEI, which contributed only to 0.17% of the total cost. Decreasing the length of hospital stay is a key factor for reducing IHD cost, since it was the highest contributor in the total cost. And also co-morbidities increased the hospital LOS, and thus the cost. At the end, it is thought that this is the first study to look exclusively at the cost of IHD in a specialized center in KSA, which needs to go national in the next step along with performing other pharmacoeconomic studies to compare treatments and medications. Then, after having a good foundation in the field of IHD, the same studies will be applied to other high burden diseases.

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