ORIGINAL RESEARCH ARTICLE

Cost of Myocardial Infarction to the Australian Community
A Prospective, Multicentre Survey

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Abstract

Background: In order to evaluate the cost effectiveness of preventive strategies for myocardial infarction (MI), direct cost estimates are required. However, Australian-specific cost estimates for MI are not available.

Objective: The CosMIC (Cost of Myocardial Infarction to the Community) in Australia study was designed to determine the resource use and estimate the direct costs associated with MI in the Australian Health Care System. This information could subsequently be used in cost-effectiveness evaluations.

Methods: A prospective, multicentre survey was undertaken to investigate the costs associated with the initial hospitalization and the 12-month sequelae for patients with a first-ever MI. During the recruitment period 312 patients with MI from ten hospitals met the eligibility criteria. Of the 141 who consented to participate and were enrolled, three were withdrawn and 138 were included in the final analysis. Detailed data were collected for 12 months after the index hospitalization from several overlapping sources. All costs were considered from the point of view of total direct cost of care, i.e. regardless of who generated or paid for the service.

Results: The mean length of hospital stay for the initial acute episode was 7.4 days and the mean cost was $A10 934 (95% confidence interval [CI] 9588, 12 280) based on 2005 Australian dollars. There were 127 cardiac-related readmissions for 55 (40%) patients and the mean length of stay was 2.6 days. The mean total direct cost of an MI per patient was $A20 502 (95% CI 18 428, 22 576). The majority of the costs were for hospitalizations (initial and

readmissions), which accounted for 77% of the total 12-month costs, whilst hospitalization costs for the initial acute event accounted for 53% of all costs. During the 12-month follow-up period, out-of-hospital medical service costs (Medicare Benefits Schedule services) contributed to 7% of the total costs incurred, medications 6%, ambulance costs 3% and all other outpatient services and carer costs 7%.

Conclusion: The CosMIC study addresses the significant uncertainty associated with MI cost-of-illness data in Australia by providing an estimation of direct costs associated with MI in an Australian population. These direct costs can be used to determine the cost effectiveness of prevention strategies.

Introduction

Cardiovascular diseases (CVD) are recognized as one of Australia's leading health problems and the most expensive group of diseases.[1] Expenditure on CVD for 2004–5 was $A5.94 billion (11% of the total allocated healthcare expenditure) and increased by 18% between 2000–1 and 2004–5.[1] CVD contributes significantly to the mortality and disability of the Australian population, accounting for 18% of the total burden of disease in 2003. In 2006, 34% of all deaths were related to CVD, whilst coronary heart disease (acute myocardial infarction [AMI] and angina pectoris) accounted for 51.6% of the 45 670 CVD deaths in 2005.[1] To account for hospital discharges as a result of AMI admissions the Australian Institute of Health and Welfare (AIHW) data on hospital separations were utilized. There were 49 394 hospital separations for AMI (International Statistical Classification of Diseases and Related Health Problems 10th Revision [ICD-10], code I21) in 2004–5, of which 32% were for privately insured patients, with a mean length of stay of 5.5 days.[1] This significant burden of CVD highlights the importance of understanding the total cost of the disease per person, including both the hospitalization component and the costs involved after a patient is discharged from hospital.

Preventive strategies for CVD have the potential to significantly reduce morbidity, mortality and costs. To determine the cost effectiveness of these strategies, cost estimates of the CVD episode are required. Although there are many studies on the cost of MI hospitalization, few studies have examined the direct and indirect costs associated with MI.[2,3] After the initial episode of coronary heart disease there is frequently a subsequent series of events such as hospitalization for cardiac surgery, management of residual problems such as cardiac failure or the treatment of various complications of MI, all of which should also be taken into account. In the US the costs of treating a patient for 23 months following an MI (initial hospital costs and follow-up hospital and outpatient costs) were calculated to be $US39 707 (year of costing 1997).[2] The apparent disparity in the management of MI between countries and the wide range in cost estimates[4] necessitates the determination of Australian-specific cost estimates.

The aim of the CosMIC (Cost of Myocardial Infarction to the Community) study was to estimate the cost of an MI in Australia by following patients for 12 months from the initial hospital admission. In particular this study would provide a more accurate estimate of the direct costs of an MI in an Australian population by including MI-related costs incurred by patients.

Patients and Methods

Study Design

CosMIC was a prospective, multicentre cohort survey that investigated the resource use and

costs associated with illness in 'first-ever in a lifetime' MI patients during December 2000 to August 2001. The study was performed in accordance with the Guidelines for Good Clinical Research Practice (GCRP) in Australia, December 1991 and the protocol was approved by the Ethics and Research Committees of each participating hospital. Thirteen hospitals were approached and ten hospitals across the greater Melbourne metropolitan area agreed to participate in the study (nine public hospitals and one private hospital). These ten hospitals accounted for 73.4% of admissions for AMI (ICD-10: code I21) in metropolitan Melbourne and covered a broad geographical area.

Patients

A representative sample of patients with a first-ever MI event was identified from daily admission lists from the participating hospitals. Patients eligible for inclusion in the study were aged between 25 and 84 years, had experienced an MI according to the definition criteria (see below), and had a primary admission or discharge diagnosis from hospital of first-ever MI. Patients also had to reside within the Melbourne metropolitan area and provide informed consent. Only patients who survived the initial hospitalization and were discharged from the hospital to home or to a rehabilitation hospital were included in the study.

Patients were classified as having had an MI if they fulfilled two or more of the following criteria: characteristic ischaemic pain for ≥20 minutes; elevation of creatine kinase (CK) or CK-muscle and brain isoenzyme (CK-MB) to 2× the upper limit of laboratory normal; elevated serum troponin T levels to 3× the upper limit of laboratory normal; elevated serum troponin I levels to greater than or equal to the value considered diagnostic of MI by the laboratory performing the assay as part of the documentation of MI; development of new ≥40 ms Q waves in at least two adjacent ECG leads or development of a new dominant R wave in V1 (R ≥1 mm >S in V1); or non-Q wave MI designated on the basis of a history of prolonged ischaemic chest pain

and elevation of cardiac enzymes in the absence of the development of Q waves on serial ECGs.

Patients were categorized as public patients (admitted to a public hospital as a public patient), private patients (admitted to any hospital as a private patient) and Department of Veterans' Affairs (DVA) patients (claimed from the DVA during the 12-month study period).

Sample Size and Statistical Analysis

The sample size was based on cost variability estimates from three previous studies that considered either in-hospital and/or out-of-hospital direct costs.[3,5,6] With 140 MI cases there would have been sufficient precision to estimate mean direct costs with 95% confidence intervals (CIs) of ±16.9% assuming variability of costs.[3]

Descriptive data were produced for the utilization of different health services. Total costs were determined for each MI patient. These cost data were then used to determine the mean cost per first-ever MI, as well as the overall cost of first-ever MI, in Australia.

Data

Data were collected for all consented patients over 12 months (figure 1). In-hospital data were obtained by the study nurses from a 20-minute face-to-face interview in the hospital of clinically stable patients and a review of the patients' medical histories. Information collected included patient demographics; co-morbidities; use of ambulance services; tests and procedures performed and the results; and medication. Patients were provided with diaries to record all relevant MI-related information and out-of-pocket costs (e.g. health professional consultations, medications taken, transport for visits to health professionals and any community support). They were also asked to visit their pharmacy to obtain a list of all medications purchased. These medication lists were used to verify the information in the patient diaries. Standardized questionnaires adapted from NEMESIS (North East Melbourne Stroke Incidence Study)[7-9] were used to collect data during follow-up patient interviews at 3, 6
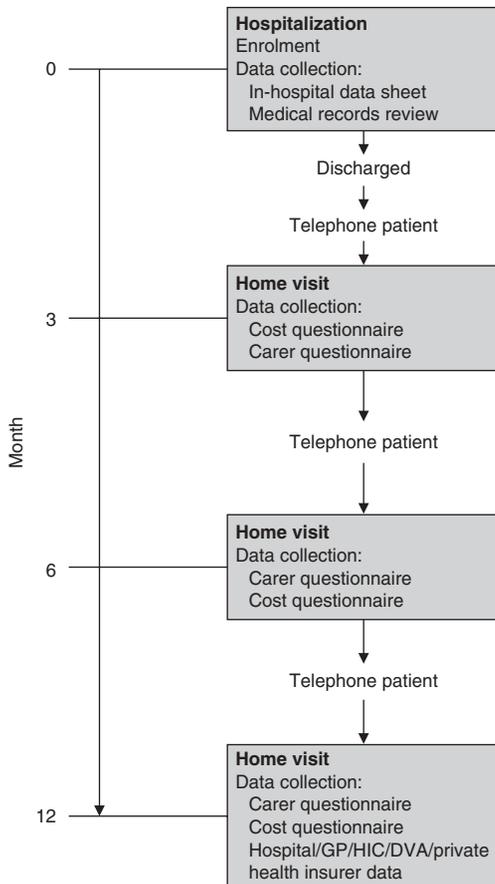
Fig. 1. Summary diagram of follow-up procedures. **DVA** = Department of Veterans' Affairs; **GP** = general practitioner; **HIC** = Health Insurance Commission (now Medicare Australia).

and 12 months (figure 1). Patient cost questionnaires and carer questionnaires were conducted face to face in patients' homes. These included questions on resource use and personal costs. Information on resource use is detailed in table I and included: subsequent hospitalization for MI-related problems or complications, emergency department attendances, ambulance services, rehabilitation hospital admissions, outpatient rehabilitation, specialist medical care, general practitioner care, allied health services, tests, medication (prescription and over the counter), transportation, specialist equipment or aids, home modifications, community services

and paid domestic assistance. All MI-related events that had occurred during the 12 months were followed up.

Costs

Funding in the Australian Health Care System is dependent on the service provided. Hospital services and community services are funded by the States; medication, allied healthcare services and other healthcare services utilized in the community are generally funded federally. Approximately 44% of Australians also have private health insurance. Veterans' healthcare costs are covered by the DVA and have a separate budget.

As a result of this complex funding model and to determine detailed costs, a 'bottom-up' methodology of actual costs incurred by patients with an MI was undertaken. The final cost of a first-ever MI was calculated using a variety of sources, which are presented in table I. The analysis was based on a societal perspective of direct costs. Every attempt was made to identify all costs incurred by society as a consequence of the MI and to only include costs that were MI-related.

Individual patient cost data were obtained from questionnaires and patients' diaries as well as hospitals, the Health Insurance Commission (HIC; now Medicare Australia), the DVA and private health insurers.

Patients were requested to keep a diary of their ongoing out-of-pocket medical and related costs. Hospitals provided cost data for the initial MI and any MI-related readmissions. Hospital cost data were based on a cost allocation model; however, there was some variation due to the clinical costing methodology used that may not have considered indirect costs (depreciation, electricity, etc.). The patient's Medicare number was used to obtain details of and costs of Medicare Benefit Schedule (MBS) services and Pharmaceutical Benefits Scheme (PBS) medications. Ambulance costs were incurred for the initial transfer to the hospital, between-hospital transfers and readmissions, and were estimated using standard rates supplied by Ambulance Victoria. All costs not related to the MI were separated from MI costs. Costs were categorized as

Table I. Resource use identification and source of costing data

Resource	Source of resource utilization	Source of costing information
Initial hospitalization	Hospital records	Hospital, HIC (MBS, PBS, RPBS), DVA, private health insurer
Subsequent MI-related hospitalizations	Patient diary and hospital records	Hospital, HIC (MBS, PBS, RPBS), DVA, private health insurer
Emergency department attendances	Patient diary and hospital records	Hospital, HIC, DVA, private health insurer
Ambulance services	Patient diary	Estimated using costing rates provided by the Ambulance Service
Rehabilitation hospital admissions	Patient diary	Estimated using the average cost of $A200 per day as per Rehabilitation Hospitals
Outpatient rehabilitation	Patient diary	Estimated using $A34.56 per session based on the Best Practice Guidelines for Cardiac Rehabilitation and Secondary Prevention
Specialist medical care	Patient diary, HIC (MBS)	HIC (MBS)
General practitioner care	Patient diary, HIC (MBS)	HIC (MBS)
Allied health services	Patient diary	Patient diary, private health insurer
Diagnostic tests	Patient diary, HIC (MBS)	HIC (MBS)
Prescription medication	Patient diary, HIC (PBS, RPBS)	HIC (PBS, RPBS)
Over-the-counter medication	Patient diary	Patient diary
RDNS	Patient diary	Estimated using the length of time of each visit and RDNS hourly rate of $A61.30. Patient contribution obtained from patient diary
Meals on Wheels	Patient diary	Estimated using $A15 for a delivered meal (based on costs provided by two Melbourne councils). Patient contribution obtained from patient diary
Home community services	Patient diary	Total cost estimated using $A35 for community services (based on costs provided by two Melbourne councils). Patient contribution obtained from patient diary
Home care	Patient diary	Total cost estimated using $A32 for home care services (based on costs provided by two Melbourne councils). Patient contribution obtained from patient diary
Special dietary requirements	Patient diary	Patient diary
Patient transportation	Patient diary	Patient diary
Specialist equipment or aids	Patient diary	Patient diary
Carer assistance	Patient diary	Patient diary
Home modifications	Patient diary	Patient diary
Other community services	Patient diary	Patient diary
Paid domestic assistance	Patient diary	Patient diary
Other direct financial costs	Patient diary	Patient diary

DVA = Department of Veterans' Affairs; **HIC** = Health Insurance Commission (now Medicare Australia); **MBS** = Medicare Benefits Schedule; **MI** = myocardial infarction; **PBS** = Pharmaceutical Benefits Scheme; **RDNS** = Royal District Nursing Service; **RPBS** = Repatriation PBS.

MI-related based on a review of the patients' medical records and diaries and from the details of services provided by the hospitals, HIC and the private health insurers. Costs were calculated in 2005 Australian dollars. Descriptive statistics (mean and 95% CI) were calculated using the data from the total number of patients in the study.

Results

Table II presents a summary of the study patient demographics. During the recruitment period 312 patients with MIs from ten hospitals met the eligibility criteria and, of these, 141 patients were recruited. Three patients were not

included in the final analysis (one patient had no enzyme rise and two patients had no data recorded). The final analysis therefore included a total of 138 patients (44.2%). During the 12-month period, 18 patients did not have follow-up information and, of these, three patients died. The patient population was predominantly male (78.3%). This was due to a higher refusal by female patients to participate in the study. The majority of patients were admitted as public patients (79%), with only a minority being admitted as private (15%) or DVA (6%) patients.

The total direct cost of the MIs experienced by the 138 patients was $A2.83 million over the 12-month period. The mean total direct cost per patient was $A20 502 (95% CI 18 428, 22 576) and the median $A17 610. The majority of costs incurred were for initial hospitalization and readmissions (77%). A summary of the mean costs is presented in table III.

The total cost of initial hospitalization for all 138 patients was $A1.5 million. The mean cost of initial hospitalization per patient was $A10 934 (95% CI 9588, 12 280) and the median $A9006, representing 53% of the overall cost of treating an MI over the 12-month period. Medication costs made up 6% of the total costs of an MI over the 12 months following the event, with the majority of the costs being for products dispensed under the PBS (98%). The remaining costs incurred during the 12 months following an MI were for out-of-hospital medical services provided under the MBS (7%), ambulance costs (3%) and carer and other outpatient services costs including rehabilitation, community services, Royal Dis-

trict Nursing Service assistance, home care, Meals on Wheels, patient transport and other general costs (7%).

The mean length of stay for the initial MI episode was 7.4 days (95% CI 6.4, 8.4), and the median 6 days. There were a total of 127 readmissions for 55 patients with a mean length of stay of 2.6 days (95% CI 1.8, 3.4), with some patients experiencing more than one readmission. Patients had a mean 5.7 rehabilitation sessions in the 12 months following discharge.

Given the mixed system of funding that exists in Australia the data examined the proportion of out-of-pocket expenses incurred by patients. Out-of-pocket expenses accounted for 8% of the total direct cost of a first-ever MI episode. Total post-hospital discharge costs represented 20% of the total direct cost of a first-ever MI (not including ambulance transfers), of which 35% of the costs were paid by patients as out-of-pocket expenses.

Often when conducting an economic evaluation there are insufficient data regarding patient resource utilization following hospital discharge. CosMIC provides some insight that may assist researchers in determining which services are utilized by patients following a first-ever MI episode. Figure 2 shows that a large proportion of such patients utilize services or resources such as medication (91.3%), outpatient medical services (89.1%) and rehabilitation (78.2%).

The total direct cost of AMI to the Australian Health Care System was estimated using the mean costs calculated from CosMIC and the total number of Australian hospital separations for AMI. In 2004–5 a total of 47 663 hospital separations for AMI were reported together with 55 676 hospital separations in the latest AIHW data (2007–8).[10] Initial hospitalizations would therefore have cost the Australian Health Care System $A521 million in 2004–5 and $A608 million in 2007–8, and the overall direct costs for the 12-month period including the AMI episode were estimated at $A1 billion and $A1.14 billion, respectively.

Discussion

The age distribution of patients in the Cos-MIC study is similar to that of the Australian

Table II. Patient demographics

Variable	Value
Total patients in analysis	138
Age, y, mean (SD) [range]	61.5 (13.8) [25.6–84.7]
Sex [no. (%)]	
males	108 (78.3)
females	30 (21.7)
Public patients [no. (%)]	109 (79)
Private health insurance patients [no. (%)]	21 (15)
DVA patients [no. (%)]	7 (6)
DVA = Department of Veterans' Affairs; **SD** = standard deviation.	

Table III. Total and mean direct costs of acute myocardial infarction (MI) in the study, by category of cost

Variable	Total direct cost ($A)	Mean ($A)	95% CI ($A)
Cost of hospitalization			
initial hospitalization	1 508 837	10 934	9588, 12 280
readmission	553 330	4010	2761, 5259
total in-hospital MBS	123 677	896	537, 1255
total hospital – initial and readmissions	2 185 845	15 839	13 977, 17 701
MBS			
total out-of-hospital	184 623	1 338	1165, 1511
Medication			
PBS	164 758	1 194	1053, 1335
non-PBS	3 471	25	15, 35
total medication	168 230	1 219	1077, 1361
All ambulance trips[a]	89 084	646	537, 755
Patient transportation	15 961	116	98, 134
Rehabilitation[b]	53 813	390	242, 538
RDNS	10 867	79	–33, 112
Meals on Wheels	9 397	68	–46, 182
Carer services	8 915	65	42, 88
Other services			
community/home assistance	3 806	28	15, 41
housing/equipment	9 467	69	20, 118
home care	15 552	113	49, 177
other community services	1 221	9	–1, 19
paid domestic assistance	4 951	36	17, 55
special diet	268	2	–1, 5
allied health services	2 574	19	–10, 48
other financial costs	64 685	469	104, 834
Total direct cost of first-ever MI	2 829 259	20 502	18 428, 22 576

a   Both initial use and between-hospital transfers.

b   In-hospital and post-discharge rehabilitation sessions.

MBS = Medicare Benefits Schedule; **PBS** = Pharmaceutical Benefits Scheme; **RDNS** = Royal District Nursing Service.

population with AMI. The AIHW provides national data on hospital separations, and these data provide an indication of AMI hospitalizations.[10] The majority of patients (89%) hospitalized with AMI were aged >50 years in the latest AIHW data (2007–8) and this proportion was similar to that found in previous years.[10-12] There are some variations between the CosMIC study population and the Australian population with AMI with respect to sex distribution. In the 2006–7 AIHW data for AMI hospital separations, 65.6% of patients were male,[10] a similar proportion to that found in previous years.[10-12] However, in the CosMIC study, 78.3% of patients were males. It is uncertain how this variation in sex distribution may impact on the generalizability of the CosMIC data. However, the data may not be directly comparable as the AIHW data do not distinguish between first, second or subsequent MI, whilst CosMIC focused only on the first-ever MI episode.

The overall direct cost in the 12-month period following an AMI episode estimated using the mean costs from CosMIC and the total number of hospital separations for 2004–5[10] ($A1 billion) was similar to the reported total of $A1.8 billion spent on coronary heart disease in Australia in 2004–5,[1] and to the $A1.2 billion estimated to
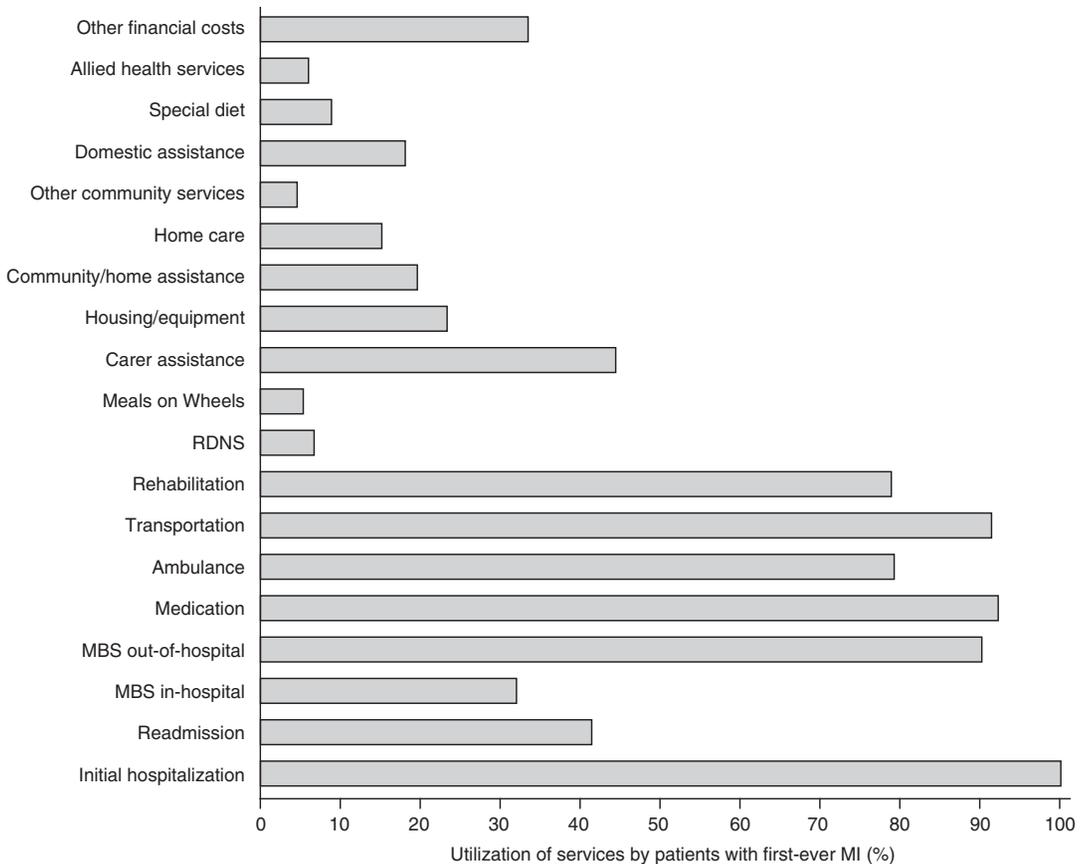
Fig. 2. Utilization of services by patients with first-ever MI. **MBS** = Medicare Benefits Schedule; **MI** = myocardial infarction; **RDNS** = Royal District Nursing Service.

have been spent on AMI in 2009 in a recent report.[13] This recently commissioned report projected that the number of hospitalizations and deaths due to acute coronary syndrome (ACS) in 2009 would be 87 526, with an associated total economic cost of $A17.9 billion, while MIs would be expected to cost around $A15.5 billion. Of this, direct healthcare system costs (primarily hospital stays and pharmaceuticals) were expected to account for around $A1.8 billion for ACS. Total direct healthcare system costs and indirect costs for MIs were expected to total around $A3.5 billion while the mean total cost per MI was estimated at $A281 000 and the cost per separation (direct costs only) was estimated to be $A25 000.[13]

There is some difference between the latest Australian report on the economic costs of MI and chest pain[13] and CosMIC in the distribution of costs. The latest Australian data show that the distribution of costs for AMI for 2009 was estimated to be approximately 64% on hospital-admitted patients, 18% on prescription pharmaceuticals and 14% on out-of-hospital medical services (out-of-hospital specialists, imaging and pathology, general practitioners and other professional services), with the remaining 4% on medical research and aged care.[13] This compares with approximately 77% on hospitalizations, 6% on medications and 7% for out-of-hospital services estimated from CosMIC. The CosMIC study focused on direct costs and

therefore no data were collected on medical research. The main differences are in pharmaceuticals and out-of-hospital medical services. This could be due to two factors; first, the utilization of a top-down approach in these studies and, secondly, the fact that 'out-of-hospital medical services' costs are underestimated in the latest Australian data, which focus on services funded by the State or Federal government and do not capture healthcare costs incurred by patients as a result of their MI. The CosMIC study may provide some insight into the extent of out-of-pocket healthcare costs incurred by MI patients.

A study from New South Wales in Australia reported the mean total cost per patient for an acute coronary event and the following 12 months as $A4937 (calculated in 1998 Australian dollars).[14] The study recruited and followed 113 patients with uncomplicated AMI or unstable angina for up to 12 months post-hospital discharge. Data were collected on medication, tests, physician consultations, rehabilitation and ambulance costs, and the cost of hospitalization was estimated using diagnosis-related groups (DRGs). The total costs ranged from $A4541 to &$A4937, with non-hospital costs representing just below 50% of the total cost.[14] The differences in the cost per patient between this study and the CosMIC study may be attributed to differences in patient populations (CosMIC included only first-ever MI patients and excluded those who died during the initial hospitalization), the costing methodology utilized, and the extent to which patient out-of-pocket expenses were considered. The CosMIC study utilized a 'bottom-up' approach based on actual costs incurred by patients, rather than DRG costs. Another potential difference is the extent to which patient out-of-pocket expenses were incorporated into the analysis.

A search of the literature revealed a range of studies that have examined the cost of MI.[2,4-6] However, the majority of these studies considered only the cost of hospitalization. An international study that evaluated the cost of MI in nine countries found that there were differences in the cost of hospitalization.[4] These differences most likely reflect variations in procedures and hospital length of stay.[4]

During the CosMIC study, coronary artery bypass grafts were performed on 18 patients, percutaneous transluminal coronary angioplasties on 44 patients, stents on 52 patients and angiograms on 64 patients. In recent years there has been a large increase in the use of more expensive procedures such as drug-eluting stents and an improvement in outcomes, including a decrease in mean length of hospital day and readmissions.[11,13] It is unclear what effect these changes will have had on costs.[13]

Limitations

There are several methodological difficulties experienced in conducting studies such as CosMIC. Obtaining patient consent for non-clinical non-intervention studies is an initial difficulty, given that patients are ill and do not want the added burden of participating in studies. If patient recruitment in the CosMIC study included fewer sicker patients, the resultant cost estimates may have underestimated the cost of MI. Secondly, the funding of the Australian Health Care System means that several funding sources need to be accessed to capture the various cost data. These various funding sources may use different costing systems, as was the case with the participating hospitals, and they may vary in the amount of detail they are able to provide on the costs. Every attempt was made to identify all costs related to MI and to minimize the risk of double counting. This included requesting individual patient-itemized data from the HIC on medical services and pharmaceuticals, obtaining similar patient-itemized data from private health insurers on insurance payments for hospital admissions and other services, and verifying self-reported data from patients. Thirdly, collecting self-reported costs from patients over a 12-month period presents its own difficulties, including potential recall bias. Measures taken to minimize recall bias included asking patients to keep a diary to record out-of-pocket ongoing medical and other related costs and requesting the records of individual patients from private health insurers, hospitals and the HIC. Another limitation was that the sample size did not permit a more

thorough investigation of the impact of factors such as age, sex, co-morbidities and patient type (i.e. public, private, DVA). Lastly, the exclusion of patients who had died during the initial hospitalization may limit the applicability of the costs data obtained from CosMIC to cost-effectiveness studies.

Despite these limitations, CosMIC examined for the first time the overall cost to society of a first-ever MI. It allows for a more accurate, 'bottom-up' calculation of the true costs of MI to the healthcare system and to patients. In terms of the data collected, it provides researchers and those conducting economic evaluations with valuable information that previously was not available, and it allows for decision making to be based on more accurate cost of illness data for a first-ever MI.

Conclusion

The CosMIC study addressed the significant uncertainty associated with MI cost-of-illness data in Australia by providing an accurate estimate of the direct costs associated with MI in an Australian population. Overall, the CosMIC study offers an insight into the true costs of an MI in Australia, and importantly provides a useful cost estimate for researchers and economists to access. These data will allow a more accurate determination of the cost effectiveness of preventive interventions and better inform test and treatment choices in clinical cardiovascular practice. Thus, optimal strategies can be determined for the prevention and treatment of coronary heart disease in Australia. From a policy perspective there is some evidence that the total mean cost of an MI is undervalued, given that the Australian Refined-Diagnosis Related Groups (AR-DRGs) cost for an MI in metropolitan hospitals in 2004–2005 ranged from $A3047 for AR-DRG F60B to $A9154 for AR-DRG I0Z.[15] In the Australian context, new procedures or medicines that are seeking reimbursement are guided by guidelines that generally request the use of DRGs to value episodes of care, where hospitalization is required. It could therefore be concluded that the DRG costs that

were utilized did not necessarily reflect the total cost of hospital care, let alone the total cost of an MI episode. Given that this study has shown that DRGs do not appropriately reflect the true value of an MI episode, it would appear that use of DRGs alone in an economic evaluation would undervalue the benefits of treatments or prevention measures designed to reduce the risk of MI. Further work in this area should be encouraged.

Acknowledgements

References

1. Australian Institute of Health and Welfare. Health care expenditure on cardiovascular diseases 2004–05. Cardiovascular Disease Series No. 30. Canberra (ACT), 2008. Cat. No. CVD 43 [online]. Available from URL: http://www.aihw.gov.au/publications/index.cfm/title/10641 [Accessed 2009 Apr 1]

2. Barnett PG, Chen S, Boden WE, et al. Cost-effectiveness of a conservative, ischemia-guided management strategy after non-Q-wave myocardial infarction: results of a randomized trial. Circulation 2002; 105: 680-4

3. Zethraeus N, Molin T, Henriksson P, et al. Costs of coronary heart disease and stroke: the case of Sweden. J Intern Med 1999; 246: 151-9

4. Kauf TL, Velazquez EJ, Crosslin DR, et al. The cost of acute myocardial infarction in the new millennium: evidence from a multinational registry. Am Heart J 2006; 151: 206-12

5. Krumholz HM, Chen J, Murillo JE, et al. Clinical correlates of in-hospital costs for acute myocardial infarction in patients 65 years of age and older. Am Heart J 1998; 135: 523-31

6. Caldwell MA, Sivarajan-Froelicher E, Drew BJ. Prehospital delay time in acute myocardial infarction: an exploratory study on relation to hospital outcomes and cost. Am Heart J 2000; 139: 788-96

7. Thrift AG, Dewey HM, Macdonell RAL, et al. Stroke incidence on the east coast of Australia: the North East Melbourne Stroke Incidence Study (NEMESIS). Stroke 2000; 31: 2087-92

8. Dewey HM, Thrift AG, Mihalopoulos C, et al. Cost of stroke in Australia from a societal perspective: results from

the North East Melbourne Stroke Incidence Study (NEMESIS). Stroke 2001; 32: 2409-16

9. Dewey HM, Thrift AG, Mihalopoulos C, et al. Informal care for stroke survivors: results from the North East Melbourne Stroke Incidence Study (NEMESIS). Stroke 2002; 33: 1028-33

10. Australian Institute of Health and Welfare. Principal Diagnosis Data Cubes; for 1993-94 to 1997-98 and 1998-99 to 2007-08 [online]. Available from URL: http://www.aihw.gov.au/hospitals/datacubes/datacube_pdx.cfm [Accessed 2009 Jul 11]

11. AIHW. Australian Hospital Statistics 2007-08. Health Services Series No 31. Catalogue No HSE 55. Canberra (ACT), June 2009 [online]. Available from URL: http://www.aihw.gov.au/publications/index.cfm/title/10776 [Accessed 2009 Nov 30]

12. AIHW. Australian Hospital Statistics 2000-01. Health Services Series No 19. Catalogue No HSE 20. Canberra (ACT), 2002 [online]. Available from URL: http://www.aihw.gov.au/publications/hse/ahs00-01/index.html [Accessed 2009 Nov 30]

13. Access Economics. The economic costs of heart attack and chest pain (acute coronary syndrome) 2009 [online]. Available from URL: http://www.accesseconomics.com.au/publicationsreports.php [Accessed 2009 Aug 15]

14. Briffa TG, Eckermann SD, Griffiths AD, et al. Cost-effectiveness of rehabilitation after an acute coronary event: a randomised controlled trial. Med J Aust 2005; 183: 450-5

15. Australian Government Department of Health and Ageing. Data Cubes. Round 9 (2004-05) Cost Report version 5.0 [online]. Available from URL: http://www.health.gov.au/internet/main/publishing.nsf/Content/+Round_9-cost-reports [Accessed 2010 April 27]

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