DELSA/ELSA/WD/HTP(2004)14

OECD OCDE

Selecting Indicators for the Quality of Cardiac Care at the Health Systems Level in OECD Countries

Laura Lambie, Soeren Mattke
and the Members of the OECD Cardiac Care Panel

14

OECD HEALTH TECHNICAL PAPERS

Unclassified **DELSA/ELSA/WD/HTP(2004)14**

Organisation de Coopération et de Développement Economiques
Organisation for Economic Co-operation and Development

28-Oct-2004

English - Or. English

DIRECTORATE FOR EMPLOYMENT, LABOUR AND SOCIAL AFFAIRS
EMPLOYMENT, LABOUR AND SOCIAL AFFAIRS COMMITTEE

DELSA/ELSA/WD/HTP(2004)14
Unclassified

OECD HEALTH TECHNICAL PAPERS NO. 14

SELECTING INDICATORS FOR THE QUALITY OF CARDIAC CARE AT THE HEALTH SYSTEMS LEVEL IN OECD COUNTRIES

LAURA LAMBIE, SOEREN MATTKE AND THE MEMBERS OF THE OECD CARDIAC CARE PANEL

English - Or. English

JT00172779

DIRECTORATE FOR EMPLOYMENT, LABOUR AND SOCIAL AFFAIRS

OECD HEALTH TECHNICAL PAPERS

This series is designed to make available to a wider readership methodological studies and statistical analysis presenting and interpreting new data sources, and empirical results and developments in methodology on measuring and assessing health care and health expenditure. The papers are generally available only in their original language – English or French – with a summary in the other.

Comment on the series is welcome, and should be sent to the Directorate for Employment, Labour and Social Affairs, 2, rue André-Pascal, 75775 PARIS CEDEX 16, France.

Health Technical Papers are available at: www.oecd.org/els/health/technicalpapers.

ACKNOWLEDGEMENTS

The authors[1] would like to thank Peter Hussey and Jeff Chan for their contributions to the indicator selection process, Elizabeth Cote and Leighna Kim for providing research support and Victoria Braithwaite and Orla Kilcullen for their help in preparing this manuscript. The comments of the members of OECD Expert Group on the Health Care Indicators Project and the Ad Hoc Group on the OECD Health Project on an earlier version of this manuscript are greatly appreciated. The authors would also like to thank John Martin, Martine Durand, Peter Scherer and Jeremy Hurst for review and comments.

This work was supported in part by the Commonwealth Fund of New York. The views presented here are those of the authors and not necessarily those of the Commonwealth Fund, its director, officers or staff.

1. Laura Lambie, Ministry of Health, New Zealand, was chair of the OECD Cardiac Care Panel. Soeren Mattke, OECD Secretariat, was convenor of the panel and a co-author of this report. The remaining members of the OECD Cardiac Care Panel and co-authors of this report were: Ulla Idänpään-Heikkilä, National Research and Development Centre for Welfare and Health (STAKES), Finland, Vin McLoughlin, Department of Health and Ageing, Australia, Heather Palmer, International Society of Quality in Health Care, and Jack Tu, Institute for Clinical Evaluative Sciences and University of Toronto, Canada. Brief biographies of the chair and Panel members are to be found in Annex 2.

SUMMARY

1. This report presents the consensus recommendations of an international expert panel on indicators for cardiac care. Using a structured review process, the panel set out to select indicators to cover five key areas: primary prevention, secondary prevention of heart disease, acute coronary syndromes, cardiac interventions and congestive heart failure. In the event, no suitable indicators for primary prevention were retained, and this report proposes 17 indicators as follows:

Area		Indicator Name
Secondary prevention		Aspirin at discharge
		ACE inhibitor at discharge
		Beta blocker at discharge
		Statin treatment after a cardiac event
Acute coronary syndromes		Timing of thrombolytics
		Timing of emergent PTCA
		Aspirin at admission to hospital
		1 year mortality
Cardiac interventions	Coronary Artery Bypass Graft (CABG)	CABG in-hospital mortality rate
		One year mortality following CABG
		CABG re-operations within six months of discharge
	Percutaneous Transluminal Coronary Angioplasty (PTCA)	PTCA in-hospital mortality
		Same-day CABG surgery rate after PTCA
		Repeat PTCA within 30 days of discharge
Congestive heart failure (CHF)		Receiving ACE inhibitor on discharge
		Rate of beta-blocker prescription at hospital discharge
		In-hospital mortality rate

2. The report describes the review process and provides a detailed discussion of the scientific soundness and policy importance of the 17 indicators.

RESUME

3. Ce rapport présente les recommandations consensuelles d'un groupe d'experts internationaux sur les indicateurs relatifs aux soins cardiaques. En suivant une méthodologie détaillée, le groupe d'experts a entrepris de sélectionner des indicateurs devant couvrir cinq grands domaines : la prévention primaire, la prévention secondaire des cardiopathies, le syndrome coronarien aigu, la chirurgie cardiaque et l'insuffisance cardiaque congestive. Aucun indicateur satisfaisant pour la prévention primaire n'ayant été retenu, ce rapport propose donc les 17 indicateurs suivants :

Domaine		Nom de l'indicateur
Prévention secondaire		Prescription d'aspirine à la sortie de l'hôpital
		Prescription d'IEC à la sortie de l'hôpital
		Prescription de bêtabloquants à la sortie de l'hôpital
		Prescription d'une statine à la suite d'un accident cardiaque
Syndromes coronariens aigus		Délai de réalisation d'une thrombolyse
		Délai de réalisation d'une angioplastie primaire
		Délivrance d'aspirine à l'admission à l'hôpital
		Mortalité à un an
La chirurgie cardiaque	Pontage coronarien	Taux de mortalité à l'hôpital après un pontage coronarien
		Mortalité à un an après pontage coronarien
		Réinterventions sur pontage coronarien dans les six mois qui ont suivi la sortie d'hôpital
	Angioplastie	Mortalité hospitalière de l'angioplastie
		Taux de pontage coronarien d'urgence après angioplastie
		Nouvelle angioplastie dans les 30 jours qui ont suivi la sortie de l'hôpital
Insuffisance cardiaque congestive		Recevant de l'IEC à la sortie de l'hôpital
		Taux de prescriptions de bêtabloquants à la sortie de l'hôpital
		Taux de mortalité hospitalière

4. Le rapport décrit la méthodologie employée et démontre, arguments à l'appui, la viabilité scientifique et l'importance stratégique des 17 indicateurs retenus.

TABLE OF CONTENTS

Tables

Boxes

INTRODUCTION

Background

5. This paper presents proposals for indicators of quality of care in the area of cardiac care. This is one of five areas which have been identified by the OECD as having priority for the development of quality indicators (see Box 1) An Expert Group consisting of government officials and academic experts from the participating countries was tasked with identifying a shortlist of potential indicators in close collaboration with the Secretariat. Given resource constraints, this work was limited to reviewing existing indicators in Member countries rather than developing new indicators. This Working Paper summarizes the proceedings and indicator recommendations of the Cardiac Panel and incorporates comments from Member countries on an earlier report of the Panel. The first section describes the panel's methods of indicator selection and the second part the recommended indicators. The third section concludes with a discussion of the comprehensiveness and cohesiveness of the indicator set. A comprehensive discussion of all recommended indicators and short biographies of the Panel members can be found in Annex 1 and Annex 2, respectively.

Box 1. The OECD Quality Indicator Project

The technical quality of medical care, long regarded as a professional responsibility rather than a policy issue, now rivals cost and access as the foremost concern of health policymakers. A growing body of evidence suggests that the daily practice of care does not correspond to the standards that the medical profession itself puts forward. In addition, improving quality of care presents itself as an avenue to restraining the growth of medical expenditures by reducing costly complications and unnecessary procedures. In other words, better organisation and management of medical care would allow countries to spend their health care dollars more wisely. To improve care for their citizens and to realise these potential efficiency gains, policymakers are looking for methods to measure and benchmark the performance of their health care systems as a precondition for evidence-based health policy reforms. As published international health data sets such as OECD Health Data currently lack comparable measures for the technical quality of national health systems, there is, so far, little possibility of such international benchmarking. To fill this gap, the OECD Health Care Quality Indicators Project (HCQI) has brought together 21 countries[2], the World Health Organization (WHO), the European Commission (EC), the World Bank, and leading research organisations, such as the International Society for Quality in Health Care (ISQua) and the European Society for Quality in Healthcare (ESQH). An expert group representing these countries and organizations has identified five priority areas for initial development of indicators: cardiac care, diabetes mellitus, mental health, patient safety, and prevention/health promotion together with primary care

2. The participating countries are Austria, Australia, Canada, Denmark, Finland, France, Germany, Iceland, Ireland, Italy, Japan, Mexico, The Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom and the United States.

Methods of Indicator Selection

Conceptual Approach

6. To ensure comprehensive coverage of the most relevant domains of cardiovascular care by the selected set of measures, the Cardiac Panel decided that the final indicator set ought to cover the following five core domains of cardiac care:

- Primary prevention of cardiac disease;
- Secondary prevention of cardiac disease including cardiac rehabilitation;
- Acute coronary syndromes;
- Cardiac interventions including PTCA and CABG; and
- Congestive heart failure.

Results of the Indicator Selection Process

7. A total of 61 indicators from seven different sources were identified by the Secretariat, submitted by the Expert Group or proposed by members of the Cardiac Panel. The indicator sources are described in Table 1. A total of 14 indicators met the initial selection criteria, 36 indicators were rejected as outlined above, and eleven required further consideration. Through a series of conference calls and email discussions, the Cardiac Panel converged on a final list of 17 indicators that are listed in Table 2. A detailed discussion of their importance and scientific soundness can be found in Annex 1.

Box 2. Selection Criteria for Quality Indicators

Following the recommendations for indicator evaluation developed by the US Institutes of Medicine, the Expert Group and all expert panels agreed on the following three selection criteria for indicators (Hurtado, Swift, and Corrigan, 2001). First, it had to capture an important performance aspect. Second, it had to be scientifically sound. And third, it had to be potentially feasible.

The importance of an indicator can be further broken down into three dimensions:

- Impact on health. What is the impact on health associated with this problem? Does the measure address areas in which there is a clear gap between the actual and potential levels of health?
- Policy importance. Are policymakers and consumers concerned about this area?
- Susceptibility to being influenced by the health care system. Can the health care system meaningfully address this aspect or problem? Does the health care system have an impact on the indicator independent of confounders like patient risk? Will changes in the indicator give information about the likely success or failure of policy changes?

The scientific soundness of each indicator can also be broken down into two dimensions:

- Face validity. Does the measure make sense logically and clinically? The face validity of each indicator in this report is based on the basic clinical rationale for the indicator, and on past usage of the indicator in national or other quality reporting activities.
- Content validity. Does the measure capture meaningful aspects of the quality of care?

The feasibility of an indicator reflects the following two dimensions:

- Data availability. Are comparable data to construct an indicator available on the international level?
- Reporting Burden. Does the value of the information contained in an indicator outweigh the cost of data collection and reporting?

As the panels were not able to make a definite statement about data availability for an indicator in all OECD countries, feasibility was given less weight in the decision process. The participating experts were asked to express their opinion as to whether it was likely, possible or unlikely to find comparable data on the international level for each indicator. If data availability was regarded as unlikely, an indicator was dropped, unless strong conceptual reasons existed to retain it.

All panels also agreed that every member would rate each indicator individually on a scale from one to nine for the scientific soundness and importance dimensions, as originally proposed by the RAND Corporation (Kerr et al., 2000). The panel would then discuss the indicator, potentially ask its members to reconsider their original ratings and make a final decision. Scores from seven to nine reflected support of the indicator, scores between one and three rejection of the indicator and scores between four and six ambivalence towards an indicator. The Cardiac Panel decided that all indicators with a final median score above 7.0 for both importance and scientific soundness and at least possible feasibility should be considered suitable and all indicators with a median rating of 5.0 or below for importance or scientific soundness should be rejected. The remaining indicators, i.e. the ones that fit neither cut-off criterion, were thoroughly discussed by the panel, leading to their adoption or rejection on a case-by-case basis.

Discussion of the Cohesiveness and Comprehensiveness of the Proposed Indicator Set for the Area of Cardiac Care

Primary Prevention

8. Fifteen indicators were put forward for the primary prevention of cardiac disease, but none were selected for the final cardiac set. While some indicators met the rating criteria, they had to be excluded for other reasons. The Cardiac Panel argued that indicators for smoking rate, diabetes prevalence, obesity prevalence and physical activity pertained to primary prevention beyond the narrowly defined field of cardiac care. Thus, it was agreed with the Panel on Health Promotion, Prevention, and Primary Care that this group should discuss those indicators.[3]

9. An indicator on absolute cardiovascular risk, which captures the additive and multiplicative effects of the various risk factors for cardiovascular disease (WHO, 2002), was rated highly, but the Panel decided that this concept was not yet universally accepted and thresholds were still under discussions. Therefore, it seemed not appropriate to include it at the moment, but the issue may be reconsidered in the future.

10. The Panel agreed that the indicator on hypertension measurement was important and sound, but that it would be too difficult to collect internationally, because it would require reliably measuring blood pressure on a large representative sample in each country. Thus, it was excluded from the final set of cardiac indicators on feasibility grounds.

3. The Panel on Health Promotion, Prevention, and Primary Care subsequently recommended all four indicators.

Secondary Prevention

11. Nine secondary prevention indicators were proposed and the Panel selected four. These include indicators on the treatment of people with cardiac disease with aspirin, beta-blockers, statins and ACE-inhibitors, which the Cardiac Panel rated as essential for secondary prevention. The Panel agreed on the importance and scientific soundness of indicators on advice for smoking cessation after AMI and proper discharge instructions for patients with congestive heart failure. However, while those indicators are currently in use in the US, it would not be feasible to consistently define and collect them on the international level.

Acute Coronary Syndromes

12. Four out of the eleven proposed indicators were selected for acute coronary syndromes. Most of the indicators that were selected that met the rating criteria were related to the treatment of AMI. Indicators that did not meet the rating criteria were indicators related to readmission for unstable angina pectoris. The Panel agreed that it would be too difficult to accurately collect and compare the required data internationally.

13. Highly rated indicators included the timing of revascularisation treatment following AMI (thrombolysis and PTCA), treatment on admission to hospital and mortality following AMI. As in-hospital and 30-day mortality rates after AMI are already under discussion by the HCQI Project, there was no need to evaluate an additional indicator for acute AMI mortality.

Cardiac interventions

14. Fourteen indicators proposed for cardiac interventions were mostly related to PTCA and CABG. The six selected indicators included CABG mortality (in-hospital and one year), CABG re-operation, PTCA mortality, same-day CABG and PTCA re-interventions. It was noted that CABG and PTCA rates, which are routinely collected and published as part of OECD Health Data, were important for providing context to those indicators.

Congestive Heart Failure

15. Twelve indicators were proposed for congestive heart failure and three were selected. These included indicators related to mortality, treatment with ACE-inhibitors and beta-blockers. Many of the proposed indicators, like smoking cessation advice, discharge instructions, left ventricular-function assessment and organised treatment clinics, were considered important, but too difficult to define and collect internationally. Other measures, *e.g.,* standardised discharge rates for CHF, were regarded as providing contextual information rather than information on quality.

Summary

16. The Cardiac Panel believes that the selected 17 indicators, in combination with the four indicators for primary prevention that were recommended by the Panel on Health Promotion, Prevention, and Primary Care and the indicators on acute AMI mortality, which are already under consideration by the HCQI Project, constitute a comprehensive set of measures for the most relevant domains of cardiovascular care. As cardiac care is a field, in which the conceptualisation of quality and the development of indicators are well advanced, it was possible to select the set of measures from existing sources. Most of the proposed

measures are currently in use for national policy planning and/or provider comparisons, underscoring their operational feasibility. The Cardiac Panel also recommends interpreting those indicators in the context of information on cardiovascular mortality in different age and risk groups and utilization rates for cardiac procedures. Some of the information is currently collected in OECD Health Data, but further refinement may become necessary.

17. Nevertheless, some gaps remain, in particular in areas with rapidly changing technology and improving treatment options. In those areas, the changing standards of good practice make it difficult to develop solid indicators at the moment, but they should be considered for development of international cardiac indicators in the future. Those areas are:

- *Cardiac transplantation and ventricular assist devices*: Those treatment options constitute the definite treatment of congestive heart failure, a disease of increasing importance in industrialised countries.

- *Cardiac arrhythmias*: Treatment of arrhythmias with percutaneous interventions, implantable devices and drugs has become a growing component of cardiac care. Given the high cost of some interventions and the high risk of those disorders – arrhythmias are the leading cause of sudden cardiac death – indicators should be added to the proposed set.

- *Coronary stenting*: This intervention has developed from an experimental treatment to a standard approach during PTCA in a matter of few years. Its growing relevance suggests the need to include measures in this area.

Table 1. Indicator Sources

Set Name	Description
AHRQ HCUP refinement	This measure set was developed by refinement and further development of the US Agency for Healthcare Research and Quality's (AHRQ) Healthcare Cost and Utilization Project (HCUP) indicators. This process involved identifying indicators reported in the literature and in use by health care organisations, evaluating both the HCUP indicators and other indicators using literature reviews and empirical methods, and incorporating risk adjustment. These measures are all derived from routine hospital administrative data.
AHRQ HCUP refinement/CIHI	Canadian Institute for Health Improvement refined and adapted the AHRQ inpatient HCUP indicators for use in Canada.
CMS (HCFA) CCP	This measure set was developed by the Cooperative Cardiovascular Project, a joint undertaking of the Centers for Medicare and Medicaid Services (CMS) (formerly Health Care Financing Administration (HCFA)) and state Peer Review Organisations. It was developed for use with the Medicare Quality Indicator System (MQIS), and was updated in the spring of 1995. Eleven quality indicators measure aspects of care that are related to improved outcomes for patients hospitalised for acute myocardial infarctions.
US National Quality Report	This measure set was developed by the US Department of Health and Human Services for the US National Quality Report to be published in 2003.
JCAHO ORYX	This measure set was developed by the US Joint Commission on Accreditation of Healthcare Organisations (JCAHO). The measures, intended for hospital-level comparisons, were developed by expert panels with stakeholder input.
National Minimum Data Set (NMDS)	The National Minimum Data Set (NMDS) is a minimum set of data elements agreed for mandatory collection and reporting at the national level in Australia. The NMDS includes cardiovascular disease data from the National Centre for Monitoring Cardiovascular Disease at the Australian Institute of Health and Welfare. The data set contains information on deaths from cardiovascular diseases, prevalence of the traditional cardiovascular disease risk factors and cardiovascular procedures and operations conducted in Australia.
New Zealand Guidelines on the assessment and management of cardiovascular risk.	A guideline development team was convened in March of 2002 by the New Zealand Guidelines Group (NZGG) with the goal of writing guidelines that integrate currently available advice for the management of all cardiovascular risk factors in the prevention of coronary and cerebrovascular disease. A process for adapting overseas guidelines was used. The quality of the international guidelines was assessed, and relevant sections of these international guidelines reviewed through team meetings and literature reviews. Where issues were identified that were not covered by previous guidelines, new searches were either commissioned from New Zealand Health Technology Assessment (NZHTA), or new searches were performed in-house.

Table 2. Summary table of recommended set

Area	Indicator Name	Numerator	Denominator
Secondary Prevention			
	Aspirin at discharge after acute myocardial infarction (AMI)	Number of discharged patients with AMI prescribed aspirin at discharge.	Discharged patients with AMI without aspirin contraindications.
	ACE inhibitor at discharge	Number of discharged patients with left ventricular systolic dysfunction prescribed an ACE inhibitor at discharge.	Discharged patients with left ventricular systolic dysfunction and without ACE inhibitor contraindications.
	Beta blocker at discharge after AMI	Number of discharge patients with AMI prescribed a beta blocker at hospital discharge.	Discharged patients with AMI without beta blocker contraindications.
	Statin treatment after a cardiac event	Number of people who attend primary care who have had a cardiac event and who have been prescribed a statin.	Number of people who attend primary care who have had a cardiac event.
Acute Coronary Syndromes			
	Timing of thrombolytics for patients with AMI	Number of minutes from time of arrival at hospital to time of administration of the thrombolytic.	Number of patients with confirmed AMI receiving thrombolytics and having adequate documentation of the time of arrival and the time of administration of the thrombolytic.
	Timing of emergent PTCA for patients with AMI	Time in minutes from arrival at the hospital until the beginning of the PTCA.	Number of patients with confirmed AMI receiving a PTCA within 12 hours after arrival to the hospital and having adequate documentation of the time of arrival and the time of the PTCA.
	Aspirin at admission to hospital for AMI	Number of hospitalised AMI patients who received aspirin within 24 hours before or after hospital arrival.	Number of AMI patients hospitalised without aspirin contraindications.
	1 year mortality following AMI	Number of deaths in any setting that occurred within one year of hospital admission with a primary diagnosis of AMI.	Number of unique individuals hospitalised with a primary diagnosis of AMI.
Cardiac Interventions including Percutaneous Transluminal Coronary Angioplasty (PTCA) and Coronary Artery Bypass Graft (CABG)			
	CABG in-hospital mortality rate	Number of deaths per 100 discharges with procedure code for CABG in any field. Age 40 years and older.	Number of non-maternal/non-neonatal discharges with procedure code for CABG in any field. Age 40 years and older.
	One year mortality following CABG	Number of patients who have had a CABG operation who have died after one year of	Number of patients who have been discharged from hospital who have had a CABG operation.

Area	Indicator Name	Numerator	Denominator
		discharge of a CABG.	
	CABG re-operations within six months of discharge	Number of unique patients undergoing CABG re-operations within six months of discharge.	Number of unique patients discharged following a CABG operation.
	PTCA in-hospital mortality	Number of deaths in hospital in patients with PTCA.	Number of PTCA performed.
	Same-day CABG surgery rate after PTCA	Number of unique patients who have had a CABG within 24 hours following a PTCA.	Number of unique patients who have had a PTCA.
	Repeat PTCA within 30 days of discharge	Number of unique patients having a second PTCA performed within 30 days of discharge.	Number of PTCA performed.
Congestive Heart Failure (CHF)			
	Proportion (percentage) of patients with congestive heart failure, for whom it is indicated, receiving ACE inhibitor on discharge	Number of individual patients with a principal diagnosis of congestive heart failure who are prescribed an ACE inhibitor at discharge specifications.	Number of individual patients discharged with a principal diagnosis of congestive heart failure.
	Rate of beta-blocker prescription at hospital discharge for CHF	Number of patients discharged with a diagnosis of CHF and prescribed a beta-blocker at discharge.	Number of patients discharged with a diagnosis of CHF.
	CHF in-hospital mortality rate	Number of deaths per 100 discharges with principal diagnosis code for CHF.	Number of discharges with principal diagnosis code for CHF. Exclude discharges with cardiac procedure codes in any field.

ANNEX 1: DETAILED DISCUSSION OF THE RECOMMENDED INDICATORS

Secondary prevention of cardiac disease

Aspirin on discharge after acute myocardial infarction

Operational Definition

18. **Source:** JCAHO, CMS (HCFA), US National Quality Report.

Numerator: Number of discharged patients with AMI prescribed aspirin at discharge.

Denominator: Discharged patients with AMI without aspirin contraindications.

Importance

19. Clinical significance of process or outcome: Coronary heart disease is the most frequent cause of death in middle-aged and elderly adults in most industrialised countries. Acute myocardial infarction (AMI) is the main cause of mortality among cardiac diseases (Moss and Benhorin, 1990; Sans, Lesteloot and Kromhout, 1997; OECD, 2003). Despite improvement in primary prevention and treatment, AMI remains the main cause of death in patients with coronary artery disease: Of several hundred thousand patients hospitalised each year with AMI, 7 to 15% die during hospitalisation and another 7 to 15% die during the following year. Aspirin therapy in patients who have suffered an AMI reduces the risk of adverse events and mortality. Studies have demonstrated that aspirin can reduce this risk by 20% (Elwood *et al.*, 1974; AMISRG, 1980; ATC, 1988). National guidelines strongly recommend long-term aspirin for the secondary prevention of subsequent cardiovascular events in patients discharged after AMI.

20. Identification of process/outcome as quality problem: The clinical practice has fallen far short of following the recommendations based on the results of clinical studies (EUROASPIRE I and II Group, 2001; Bowker *et al.*, 1996; Jencks, Huff and Cuerdon, 2003). Despite these recommendations, aspirin remains underutilised especially in older patients discharged after AMI in many countries.

21. Policy importance: Coronary heart disease and myocardial infarction are conditions with high morbidity, mortality and health care costs in all OECD countries. Successful secondary prevention after myocardial infarction using effective methods would have a significant effect on mortality and prevent non-fatal attacks.

22. Susceptibility to being influenced by the health care system: The results of the studies mentioned above show that the health care system can improve the prognosis of patients who have experienced a myocardial infarction by applying the treatments shown to be effective.

Scientific Soundness of Indicator

23. Face validity: Many clinical trials have shown that aspirin is effective in secondary prevention of myocardial infarction. Measuring the frequency with which aspirin is used in patients after myocardial

infarction and comparing this with the data from other countries is an indicator of the quality of care of myocardial infarction patients.

24. Content validity: The use of aspirin after myocardial infarction is one of the established measures of quality of secondary prevention after myocardial infarction, together with the use of beta-blockers, ACE-inhibitors and statins.[4] A potential threat to the validity of this indicator as an indicator for comparison is the possible variation in the diagnostic criteria for myocardial infarction that are used. The prognosis and risk of recurrence is different in patients with established myocardial infarction and acute coronary attack, although both groups benefit from the use of aspirin.

25. Evidence supporting indicator validity: In addition to the research studies quoted above, several expert groups and task forces recommend the use of aspirin after myocardial infarction (Ryan *et al.*, 1999; ESC, 2002; ESC, 2003).

Operational Issues

26. Data availability: Data is not routinely collected, but reference data may exist from several countries in connection with research projects or professional registries.

ACE inhibitors at discharge

Operational Definition

27. **Source:** JCAHO, CMS (HCFA), US National Quality Report.

Numerator: Number of discharged patients with left ventricular systolic dysfunction prescribed an ACE inhibitor at discharge.

Denominator: Discharged patients with left ventricular systolic dysfunction and without ACE inhibitor contraindications.

Importance of Indicator

28. Impact on health - Clinical significance of process or outcome: Coronary heart disease is one of the major causes of death in adults in their middle years and older in most industrialised countries and myocardial infarction is the leading cardiac cause of mortality (Sans, Lesteloot and Kromhout, 1997; Rosamond *et al.*, 1998; Tunstall-Pedoe *et al.*, 2000; OECD, 2003). Both fatal and non-fatal myocardial infarction is four to seven times more common in patients with diagnosed coronary disease. Several large-scale trials have demonstrated improved survival with ACE-inhibitor therapy started during acute myocardial infarction. These results support the use of ACE inhibitors early in the treatment in the hospital phase of acute MI, either to a wide range of patients or selectively in patients with anterior MI and in those at increased risk of death. Clinical trials have also established that the use of ACEI initiated after recovery from an AMI improves long-term survival. In addition, the likelihood of a recurrent myocardial infarction may also be reduced (Pfeffer *et al.*, 1992; AIRE 1993; Ambrosioni, Borghi and Magnani, 1995; Køber *et al.*,

4. Beta-blockers block the action of adrenalin at the beta-selective receptors of the heart. They decrease oxygen consumption, allowing the heart to better cope with the decreased oxygen supply of coronary artery disease, and the risk of arrhythmias. ACE-Inhibitors (inhibitors of the angiotensin converting enzyme) decrease peripheral vascular resistance and the so-called afterload of the heart, *i.e.* the decrease the pressure that the diseased heart has to provide to pump blood. Statins (HMG-CoA-Inhibitors) decrease blood cholesterol.

1995; AIMICG, 1998; Flather *et al.*, 2000). These results support the statement that the use of ACE inhibitors should be part of routine practice in these patients.

29. Identification of process/outcome as quality problem: Despite these recommendations, ACEIs remain underutilised in patients hospitalised with AMI and there are large differences between countries (EUROASPIRE, 1997; Jencks,Huff and Cuerdon, 2003).

30. Policy importance: Coronary heart disease and myocardial infarction are conditions with high morbidity, mortality and health care costs in all OECD countries. Successful secondary prevention after myocardial infarction using effective methods would have a significant effect on mortality and prevent non-fatal attacks.

31. Susceptibility to being influenced by the health care system: Secondary prevention with ACE inhibitors can be directly influenced by the health care system.

Scientific Soundness of Indicator

32. Face validity: Several clinical studies have shown that treatment with ACE inhibitor in the acute phase of and after myocardial infarction can lead to additional improvement in outcome in patients who received treatment thrombolytic therapy, aspirin, or beta-blockers, as well as those who did not.

33. The first studies showed a favourable effect in patients with signs of left ventricular failure or dysfunction. When the results of the ACE-inhibitor treatment studies were reviewed and evaluated in subgroups of patients according to a multivariate prognostic index, there was no evidence of a difference in the proportional benefits in patients at different underlying risk. Hence, the absolute benefits were greater in patients at greater risk of death. Mortality after MI increased steeply with increasing age, whereas the univariate analyses indicated that the proportional reductions in mortality with ACE inhibitors were greater at younger ages. In each case, the proportional benefits among patients at different absolute risk were not significantly different from each other.[5]

34. Content validity: Secondary prevention after myocardial infarction is a relevant area of quality of care and treatment with ACE inhibitors has been shown to influence the prognosis.

35. Evidence supporting indicator validity (*e.g.*, consensus panels, quantitative testing): Several national and international guidelines strongly recommend ACEI for patients hospitalised with AMI (Ryan *et al.*, 1999; ESC, 2002; ESC, 2003).

Operational Issues

36. Need for/availability of case-mix adjustment: When comparing nationwide data, there is probably no need for case mix adjustment. The ACE inhibitors have been shown to be beneficial in different risk groups, even if the benefit is greatest in the high-risk groups and patients with left ventricular dysfunction, proportionally greatest in younger age groups. For this reason, in sample studies where the case mix might vary between samples, case mix adjustment would improve the comparability.

37. Data availability: This data is not routinely collected in most countries, but has to be collected separately.

5. Indications for ACE inhibitors in the early treatment of acute myocardial infarction: systematic overview of individual data from 100,000 patients in randomized trials (AIMICG, 1998).

Beta blockers at discharge after AMI

Operational Definition

38. **Source:** JCAHO, CMS (HCFA), US National Quality Report.

Numerator: Number of discharge patients with AMI prescribed a beta blocker at hospital discharge.

Denominator: Discharged patients with AMI without beta blocker contraindications.

Importance of Indicator

39. Clinical significance of process or outcome: Coronary heart disease is a major causes of death in adults in their middle years and older in most industrialised countries. Myocardial infarction is the leading cause in mortality among cardiac diseases (Moss and Benhorin, 1990). Despite improvement in primary prevention and treatment, AMI remains the chief cause of death in most developed countries. Of several hundred thousand patients hospitalised each year with acute myocardial infarction, 7 to 15% die during hospitalisation and another 7 to 15% die during the following year.

40. The use of beta-blockers for patients who have suffered an AMI can reduce mortality and morbidity. Studies have demonstrated that the use of beta blockers is associated with about 20% reduction in this risk (MIAMI, 1985; Roberts *et al.*, 1991; BBHATRG, 1982; BBPPRG, 1988), and the difference is maintained for at least six years after the AMI (Pedersen, 1985). National guidelines strongly recommend long-term beta-blocker therapy for the secondary prevention of subsequent cardiovascular events in patients discharged after AMI. Beta-adrenergic antagonists should be given to all patients with AMI who do not have clear contraindications, such as pulmonary oedema, asthma, hypotension, bradycardia, or advanced atrioventricular block. Intravenous treatment followed by oral therapy should be started as soon as possible in patients hospitalised within 24 hours after the onset of symptoms of acute myocardial infarction, and oral therapy should be given to patients presenting later. If it is tolerated, treatment should continue for at least two to three years, and perhaps longer (Hennekens *et al.*, 1996).

41. Identification of process/outcome as quality problem: Despite these recommendations, there is still considerable potential to further reduce coronary heart disease morbidity and mortality and improve patient's chances of survival (EUROASPIRE, 1997; Bowker *et al.*, 1996; Jencks, Huff and Cuerdon, 2003). Beta-blockers remain underutilised in patients discharged after AMI in many countries, especially in older patients.

42. Policy importance: Coronary heart disease and myocardial infarction are conditions with high morbidity, mortality and health care costs in all OECD countries. Successful secondary prevention after myocardial infarction using effective methods would have a significant effect on mortality and prevent non-fatal attacks.

43. Susceptibility to being influenced by the health care system: The process of secondary prevention is an aspect of quality of care, which can be directly influenced by the health care sector.

Scientific Soundness of Indicator

44. Face validity: The fact that the prognosis of myocardial infarction patients can be improved by secondary prevention with beta-blockers is well established.

45. Content validity: The use of beta-blockers after myocardial infarction is one of the established measures of quality of secondary prevention after myocardial infarction, together with the use of aspirin, ACE inhibitors and statins.

46. A potential threat to the validity of this indicator as an indicator for comparison is the possible variation in the diagnostic criteria for myocardial infarction that are used. The prognosis and risk of recurrence is different in patients with established myocardial infarction and acute coronary attack, although both groups benefit from beta-blockers.

47. Evidence supporting indicator validity: In addition to the research studies quoted above, several expert groups and task forces recommend the use of aspirin after myocardial infarction (Ryan *et al.*, 1999; ESC, 2002; ESC, 2003).

Operational Issues

48. Need for/availability of case-mix adjustment: The treatment has been shown to be effective in all patient groups and regardless of the severity of the AMI, even if the benefit is greatest in high-risk patients (BBPPRG, 1988).

49. Availability of interpretative data: Reference data exists from several countries in connection with research projects.

50. Data availability: Data is not routinely collected, but probably has to be collected separately in most countries.

Statin treatment after a cardiac event

Operational Definition

51. **Source:** New Zealand Guidelines on the assessment and management of cardiovascular risk.

Numerator: Number of people who attend primary care who have had a cardiac event and who have been prescribed a statin.

Denominator: Number of people who attend primary care who have had a cardiac event.

Importance of Indicator

52. Clinical significance of process or outcome: Coronary heart disease is a major causes of death in adults in their middle years and older in most industrialised countries. AMI is the leading cause in mortality among cardiac diseases (OECD, 2003). Both fatal and non-fatal myocardial infarction is four to seven times more common in patients with diagnosed coronary disease. Successful secondary prevention after an acute cardiac event using effective methods would have a significant effect on mortality and prevent non-fatal attacks. Cholesterol lowering therapy with statins have been shown to reduce mortality from coronary heart disease and overall mortality, as well as the incidence of recurring cardiovascular events in patients with a history of myocardial infarction or unstable angina and with a broad range of initial cholesterol levels (LIPID, 1998; SSSS, 1994; NCEP, 1994).

53. Identification of process/outcome as quality problem: Several studies have shown that the use of lipid lowering therapy is still far too low, there are large differences between countries, and thus a

considerable potential to improve the secondary prevention of patients with myocardial infarction (Jencks, Huff and Cuerdon, 2003; Wright *et al.*, 2003; Vanuzzo *et al.*, 2000).

54. Policy importance: Coronary heart disease and myocardial infarction are conditions with high morbidity, mortality and health care costs in all OECD countries. Successful secondary prevention after myocardial infarction using effective methods would have a significant effect on mortality and prevent non-fatal attacks.

55. Susceptibility to being influenced by the health care system: Secondary prevention with medication can be directly influenced by the health care system. The final result of lowering cholesterol levels depends on the success of the patient in following a diet.

Scientific Soundness of Indicator

56. Face validity: Several randomised clinical studies have shown that statins given early during or after a cardiac event reduce cardiac death and the incidence of recurring cardiac events. The frequency of applying statin treatment after a cardiac event is indicative of quality and gives, together with other indicators concerning secondary prevention after a myocardial infarction or unstable angina, knowledge about the quality of the care of coronary patients in a country.

57. Content validity: The effect of statins in decreasing mortality and recurrent cardiac events has been shown in addition to diet treatment and in patients with only moderately increased lipid levels (SSSS, 1994).

58. Evidence supporting indicator validity: Based on the research evidence presented above, different expert groups and task forces issuing guidelines for treatment of acute cardiac events recommend the use of statins in addition to lipid lowering diet, even for patients with mild or no hypercholesteremia (Ryan *et al.*, 1999; ESC, 2002; ESC, 2003).

Operational Issues

59. Need for/availability of case-mix adjustment: The effect has been shown in age groups up to 75 years and with near normal cholesterol levels. With nationwide data no case mix adjustment is needed.

60. Data availability: The data are not routinely available in most countries. Representative samples have to be collected separately.

Acute Coronary Syndromes

Timing of thrombolytics for patients with acute myocardial infarction

Operational Definition

61. **Source:** CMS (HCFA) CCP.

Numerator: Number of minutes from time of arrival at hospital to time of administration of the thrombolytic.

Denominator: Number of patients with confirmed acute myocardial infarction receiving thrombolytics and having adequate documentation of the time of arrival and the time of administration of the thrombolytic.

Importance of Indicator

62. Each year an estimated 17 million people die from cardiovascular diseases (www.who.org). Acute myocardial infarction is a leading cause of these deaths. Several studies have indicated that initiating thrombolytic therapy within few hours of symptom onset offers the greatest reduction in mortality (GISSI, 1990; GUSTO, 1993). Initiating therapy up to twelve hours after symptom onset is still beneficial but after that therapy is no longer effective (HSFC, 1996). In order to maximise the efficacy of therapy, several guidelines have stated that all hospital should deliver thrombolytic therapy within 30 minutes of arrival (HSFC, 1996; Ryan *et al.*, 1999a). However, the majority of patients are not treated within this time period. Considering that several modifiable factors have been found to be associated with increased delay, it is essential that changes be made to promote timely administration of thrombolytic therapy (Lambrew *et al.*, 1997; Hourigan *et al.*, 2000). Door-to-needle time, the time from hospital arrival to time of therapy is an important indicator of how efficient a hospital is managing AMI patients.

Scientific Soundness of Indicator

63. It is clear from several studies that mortality rates are significantly increased in patients who have prolonged door to needle times (Newby *et al.*, 1996). In addition, both Canadian (CCS, 2004) and American (ACC/AHA, 1999; ACC/AHA, 2001) consensus panels rely on this indicator to evaluate the efficacy of hospital policy. A potential threat to validity is the imprecise coding of the different times in medical records. Pilot studies done by the Joint Commission on Accreditation of Healthcare Organisation discovered that documentation errors existed in patient's arrival time 75% of the time. In addition, coding of ECG finding can also cause errors, as ST segment elevations may not always be documented. This causes some AMI cases to be missed. However, the importance of measuring AMI patient outcomes supersedes the potential errors that may exist in this indicator.

Operational Issues

64. Need for/availability of case-mix adjustment: There is no need for case-mix adjustment with this indicator.

65. Availability of interpretative data: The standard benchmark in the literature is a median door to needle time of 30 minutes or less.

66. Data availability: This data would need to be collected via chart review and/or a clinical registry (*e.g.*, National Registry of Myocardial Infarction in the US).

Timing of emergent PTCA for patients with acute myocardial infarction

Operational Definition

67. **Source:** CMS (HCFA) CCP.

Numerator: Time in minutes from arrival at the hospital until the beginning of the PTCA.

Denominator: Number of patients with confirmed acute myocardial infarction receiving a PTCA within 12 hours after arrival to the hospital and having adequate documentation of the time of arrival and the time of the PTCA.

Importance of Indicator

68. Each year an estimated 17 million people die from cardiovascular diseases (www.who.org). Acute myocardial infarction is a leading cause of these deaths. Current studies have shown that PTCA is the preferred reperfusion modality (GUSTO, 1997). As with thrombolytic therapy, initiating PTCA within a few hours of symptom onset offers the greatest reduction in mortality (Cannon *et al.*, 2000; Brodie *et al.*, 1998; Berger *et al.*, 1999). In order to maximise the efficacy of therapy, treatment guidelines have stated that all hospital should deliver PTCA within 90 minutes of arrival (Ryan, 1999a). However, the majority of patients are not treated within this time period. Considering that several factors have been found to be associated with increased delay (Angeja *et al.*, 2002), it is essential that policy changes be made to promote timely administration of PTCA. Door-to-balloon time, the time from patient arrival to therapy is an important indicator of how efficiently an AMI patient is being managed.

Scientific Soundness of Indicator

69. Increased "door to balloon" times reliably predict increased mortality rates (Cannon *et al.*, 2000). In addition, there are both Canadian (CCS, 2004) and American (ACC/AHA, 1999; ACC/AHA, 2001) consensus panels that rely on this indicator to evaluate the efficacy of hospital policy. A potential threat to validity may be the imprecise coding of times in medical records. Pilot studies done by the Joint Commission on Accreditation of Healthcare Organisation discovered that documentation errors existed in patient's arrival time 75% of the time. Coding of ECG finding is also a source of error, as ST segment elevation is often not documented. This causes some AMI cases to be missed. Despite these potential problems, the importance of measuring AMI patient outcomes supersedes the potential errors that may exist in this indicator.

Operational Issues

70. Need for/availability of case-mix adjustment: There is no need for case-mix adjustment with this indicator.

71. Availability of interpretative data: The standard benchmark is a door to balloon time of 90 minutes.

72. Data availability: This data would need to be collected by chart review and/or a clinical registry.

Aspirin at admission to hospital for AMI

Operational Definition

73. **Source:** JCAHO ORYX.

Numerator: Number of hospitalised AMI patients who received aspirin within 24 hours before or after hospital arrival.

Denominator: Number of AMI patients hospitalised without aspirin contraindications.

Importance of Indicator

74. Each year an estimated 17 million people die from cardiovascular diseases (www.who.org). Acute myocardial infarction is a leading cause of these deaths. As seen in the International Study of Infarct Survival (ISIS-2), receiving aspirin therapy within 24 hour of admission reduces 35-day mortality by 42% (ISIS-2, 1988). As such, guidelines from around the world have endorsed the early use of aspirin in the treatment of AMI (Ryan *et al.*, 1999a; ESC, 1996). Unfortunately, several studies have found that despite

overwhelming evidence, aspirin continues to be under utilised (Venturini, Romero and Tognoni, 1999). Therefore, it is crucial that an indicator exists to monitor the efficacy of hospital policy in promoting the use of aspirin. The proportion of patients who receive aspirin within 24 hours is an ideal indicator.

Scientific Soundness of Indicator

75. Canadian (CCS, 2004) and American (ACC/AHA, 1999; ACC/AHA, 2001) consensus panel use this indicator to evaluate healthcare performance. Considering the medico-legal ramifications that occur by not providing patients with the standard of care, the documentation of medications given in-hospital should be very accurate. The only validity issue with this indicator is the mislabelling patients who received aspirin before hospital admission. Increased awareness by the general public has caused some patients to take aspirin even before arriving at the hospital. These patients can be mislabelled as not receive therapy. To compensate for this source of error, this indicator looks for aspirin use 24 hour before and after hospital admission.

Operational Issues

76. Need for/availability of case-mix adjustment: Ideally, this indicator should be measured in ideal patients who don't have contraindications to aspirin administration.

77. Availability of interpretative data: There is no standard benchmark in the literature although most clinicians would likely expect 90% or more patients to receive this intervention.

78. Data availability: This data would need to come from chart review and/or a clinical registry.

1-year mortality following AMI[6]

Operational Definition

79. **Source:** National Minimum Data Set (NMDS).

Numerator: Number of deaths in any setting that occurred within one year of hospital admission for a primary (principal) diagnosis of AMI.

Denominator: Number of unique individuals hospitalised with a primary diagnosis of AMI.

80. Data requirements:

- Unique identifier for patients;
- Linkage of data from hospital discharge data to death registries; and
- Potentially require health status data for risk adjustment.

Importance of Indicator

81. Clinical significance of process and outcome: AMI remains the main cause of death in patients with coronary artery disease: Of several hundred thousand patients hospitalised each year with AMI, 7 to

6. This indicator should be interpreted with the acute mortality rates for AMI (in-hospital or 30-days). Such an indicator is already under consideration by the HCQI Expert Group.

15% die during the initial hospitalisation and another 7 to 15% die during the following year. Mortality rates can be influenced through various approaches, such as:

- Appropriate and timely revascularisation in the acute phase, *i.e.* fibrinolytic therapy or PTCA (please see below);
- Secondary prevention with ASS, beta-blockers and statins (see above);
- Risk management strategies to prevent sudden cardiac death through arrhythmias;
- Education of the population about the actions to take on occurrence of chest pain, access to emergency services, including defibrillators; and
- Improvement of patient compliance with medication and behavioural change.

82. Identification of process/outcome as quality problem: Studies show that processes of care linked to survival improvements have resulted in detailed practice guidelines in many countries covering all phases of AMI management (NHFA, 2004; ACC/AHA, 1999; ACC/AHA, 2001).

83. Policy importance: AMI is the leading cause of death in developed countries and myocardial infarction is a major contributor to these deaths (*e.g.*, accounting for 30% of CVD in Australia). It results in a major burden of disease and is the most costly disease for the health system (*e.g.*, in Australia responsible for 12% of health system costs in 1993-94). AMI and coronary heart disease CVD is responsible for a high proportion of the volume of hospital procedures. Apart from the capacity of the health system to treat AMI, it can also promote prevention through reduction of risk factors tobacco smoking and changes to diet and sufficient physical exercise.

84. Susceptibility to being influenced by the health care system: One-year survival following an acute myocardial infarction is a measure of the combined effectiveness of the health system in providing appropriate treatment in the acute phase and appropriate follow-up care following discharge.

Scientific Soundness of Indicator

85. Face validity: The indicator can immediately be understood although interpretation may be complicated by deaths from other causes.

86. Content validity: The indicator includes individual patients with acute myocardial infarction, presuming that the diagnosis and coding of these does not vary between countries, but the death data including all causes may reduce the ability of the indicator to be attributable to treatment and ongoing management of the acute myocardial infarction. This may need adjustment to increase its sensitivity.

87. Evidence supporting indicator validity: The indicator has been used in the OECD study of cross-national differences in the treatment, costs and outcomes of ischemic heart disease.

Operational Issues

88. There may need to be some adjustment for age and/or severity. There may be a need to exclude patients admitted for less than three days if they did not die or be transferred to another facility, to ensure consistency in the diagnosis of acute myocardial infarction.

89. Some data are available in the OECD study of cross-national differences in the treatment, costs and outcomes of ischemic heart disease, but countries may have difficulty providing hospital morbidity data that is uniquely identified and linked to death data on a routine basis.

Cardiac interventions including PTCA and Coronary Artery Bypass Graft (CABG)

CABG in-hospital mortality rate

Operational Definition

90. **Source:** AHRQ HCUP refinement/CIHI.

Numerator: Number of deaths per 100 discharges with procedure code for CABG in any field. Age 40 years and older.

Denominator: Number of non-maternal/non-neonatal discharges with procedure code for CABG in any field. Age 40 years and older.

91. Data Requirements:

- National data on discharges following CABG by unique individuals; and
- National data on hospital deaths following CABG.

Importance of the Indicator

92. Clinical Significance of process or outcome: Coronary Artery Bypass Surgery (CABG) is a common surgical procedure performed under general anaesthesia for multi-vessel or diffuse coronary artery disease. The operation involves bypassing the area of arterial blockage using either the internal mammary artery or a graft from another vessel. The invasive nature of the surgery brings with it a high degree of operative risk and technical errors may lead to clinically significant complications such as myocardial infarction, stroke and death. Studies of in-hospital mortality following CABG in different countries show that it can range from 2.0% -6.3% and can be up to 9.2% if measured between surgeons (Hannan *et al.*, 1995); Ghali *et al.*, 2003; O'Connor *et al.*, 1998; Rosenthal *et al.*, 2003; Tu and Naylor, 1996). A number of clinical risk factors can influence the success of coronary artery bypass surgery including, age, sex, smoking, degree of ventricular failure, previous MI, post-operative complications and the presence of other co-morbid conditions including diabetes mellitus, obesity, hypertension, cerebrovascular disease (Prabhakar *et al.*, 2002; Birkmeyer *et al.*, 1998; Clough *et al.*, 2002; Gao *et al.*, 2003; Herlitz *et al.*, 1998; O'Connor *et al.*, 1992; SIGN, 1998; ACC/AHA, 1999). Studies show that predictive factors for in-hospital mortality following CABG can include age, sex, surface area, presence of co-morbid disease, history of CABG, left ventricular failure, end-diastolic pressure, ejection fraction score, priority of surgery (O'Connor *et al.*, 1992), urgency of the operation (Sadeghi *et al.*, 2002), Type of procedure, intra and post-operative complications (Herlitz *et al.*, 1998).

93. Identification of process/outcome as quality problem: Quality factors that may contribute to in-hospital mortality of patients include:

- The processes that health services use to select suitable patients for CABG (Van Domburg *et al.*, 2002);
- Long waiting times for patients waiting for a CABG which can influence recovery and outcomes following CABG (SIGN, 1998);
- The experience of cardiac surgeons and volumes of surgery (ACC/AHA, 1999);
- Quality of care before, during and after CABG (ACC/AHA, 1999); and

- Length of stay in hospital.

94. Policy importance: Coronary artery disease is a major cause of mortality in most western countries. CABG surgery is a high cost surgical treatment and should be directed at those who would most benefit from surgery. Governments need to ensure that health services are providing quality cardiac surgery services that are directed at improving health outcomes, including morbidity and mortality.

95. Susceptibility to being influenced by the health care system: Health Services can improve in-hospital mortality following CABG. A study of 57,187 undergoing isolated CABG surgery showed a decrease in in-hospital mortality from 4.17% to 2.45%, the authors attributed this decrease to the quality improvement program which collected and disseminated risk adjusted mortality information for CABG surgery (Hannan *et al.*, 1995).

96. Other quality processes aimed at minimising mortality that health services could have in place include:

- An evidenced-based selection process of patients that identifies patients who would benefit from CABG. This would take into consideration clinical risk factors and factors which are known to be predictive of early mortality (Van Domburg *et al.*, 2002);
- A system in place for ensuring that waiting times are not protracted to reduce morbidity/mortality associated with the uncertainty of waiting for a CABG (SIGN, 1998);
- A system in place for ensuring that surgeons are experienced and carry out sufficient volumes in accordance with evidenced based guidelines. The SIGN guidelines recommend that trained surgeons undertake approximately 250 operations per year and work in a centre with a minimum of three surgeons (SIGN, 1998);
- Protocols for quality of the care before, during and after the CABG operation including use of aseptic techniques, keeping perfusion times to a minimum, avoidance of unnecessary electrocautery, appropriate use of peri-operative antibiotics and strict control of blood glucose during and after the operation (ACC/AHA, 1999); and
- Clinical Audit programmes.

Scientific Soundness of Indicator

97. Face validity: CABG mortality rate is one of the most widely used and publicised post-procedural mortality indicators (AHRQ, 2004).

98. Content validity: As indicated above, there are a number of preventative quality measures that can be put in place to prevent in-hospital mortality following CABG.

99. Evidence supporting indicator validity: Information on CABG mortality indicators is available from the Agency for Health Care Research and Quality (AHRQ,2004).

Operational Issues

100. Need for/availability of case-mix adjustment across countries: As for all outcomes indicators, it would be desirable to have both risk-adjusted and unadjusted rates for a richer comparison on the international level.

101. Availability of interpretative data: There are a number of studies on CABG mortality that can provide a benchmark for evaluation (AHRQ, 2004).

102. Data availability: The measure could be constructed from hospital discharge information, combined with follow-up data. If follow-up data is unavailable, in-hospital mortality could be considered as proxy.

One year mortality rate following CABG

Operational Definition

103. **Source:** National Minimum Data Set (NMDS).

Numerator: Number of patients who have had a CABG operation who have died after one year of discharge of a CABG.

Denominator: Number of patients who have been discharged from hospital who have had a CABG operation.

104. Data requirements: National data on discharges following CABG by unique individuals and national mortality data on deaths following CABG.

Importance of the Indicator (See also CABG in-hospital mortality rate indicator)

105. Clinical significance of process or outcome: Coronary artery bypass surgery (CABG) is aimed at improving the quality of life and survival for people with severe coronary artery disease. Studies show that survival following CABG can vary and can be as much as 92% at five years and 81% at ten years (ACC/AHA, 1999). A study of 428 consecutive patients from the Netherlands showed that five, 10 and 15 year survival following CABG was 91.4%, 79.9%, 61.1% respectively (Van Brussel *et al.*, 1997). An 18 year follow up of 686 randomised patients with unstable angina showed that survival following CABG was 30%. Important clinical predictors of success of CABG at one year include age, sex, clinical severity of the disease, the presence of diabetes mellitus, obesity and hypertension (Prabhakar *et al.*, 2002; Birkmeyer *et al.*, 1998; Clough *et al.*, 2002; Gao *et al.*, 2003; Herlitz *et al.*, 1998; O'Connor *et al.*, 1992; SIGN, 1998; ACC/AHA, 1999). Compliance with secondary prevention treatment and changes in lifestyle are also important in improving cardiovascular health (Hedback *et al.*, 1996; Ng *et al.*, 1997, Pasquali *et al.*, 2003; Simchen *et al.*, 2001).

106. Identification of process/outcome as quality problem: Quality factors that may influence mortality at one year include those for in-hospital mortality and may also include:

- The type of procedure or graft used for CABG. It has been shown that some grafts remain more patent than others over time. At ten years 83% of internal mammary artery grafts remain patent compared with only 41% with saphenous vein grafts (SIGN, 1998; Egloff *et al.*, 2002).
- The type of follow up care following CABG and whether patients are taking secondary prevention treatment (Ng *et al.*, 1997; Hedback *et al.*, 2001; Pasquali *et al.*, 2003; Simchen *et al.*, 2001); and
- Whether patients have completed a cardiac rehabilitation programme. Cardiac rehabilitation following CABG is associated with improved functional outcomes and adoption of secondary preventive measures (Hedback *et al.*, 2001; Pasquali *et al.*, 2003; Simchen *et al.*, 2001).

107. Policy importance: Coronary artery disease is a major cause of mortality in most western countries. CABG surgery is a high cost procedure aimed at improving the quality of life and outcome for people with

severe coronary artery disease thus enabling people to be rehabilitated back into being useful members of society. Governments need to ensure that health services are providing quality cardiac surgery services that not only care for people at the time of the CABG operation but also provide the appropriate follow up, ensuring that patients are taking secondary prevention medications and have completed a cardiac rehabilitation programme to improve their lifestyle.

108. Susceptibility to being influenced by the health care system: This indicator can be influenced by the health system, in addition to the quality activities identified for in-hospital mortality following CABG in reducing the one-year mortality following CABG health systems could also:

- Create protocols/clinical pathways for the follow up of patients who have had a CABG to ensure that are taking secondary medication and enrolled in a cardiac rehabilitation programme;
- Undertake innovative enrolment and tailoring of cardiac rehabilitation programmes to better address the needs of patients following CABG to ensure that more people attend (Hedback *et al.*, 2001; Pasquali *et al.*, 2003; Simchen *et al.*, 2001); and
- Ensure that there is continuity of care for patients between tertiary and primary sectors.

Scientific Soundness of Indicator

109. Face validity: CABG mortality rate is one of the most widely used and publicised post-procedural mortality indicators.

110. Content validity: A number of quality factors that can be influenced by health services can affect mortality following a CABG at one year including assessment of ability to benefit from a CABG, the type of operative procedure, secondary prevention treatment and cardiac rehabilitation.

111. Evidence supporting indicator validity: Benchmark data on CABG mortality indicators are available from the Agency for Health Care Research and Quality (AHRQ, 2004).

Operational Issues

112. Need for/availability of case-mix adjustment across countries: As for all outcomes indicators, it would be desirable to have both risk-adjusted and unadjusted rates for a richer comparison on the international level.

113. Availability of interpretative data: CABG mortality data is available from AHRQ. There are a number of studies that provide information on CABG mortality.

114. Data availability: This indicator would require follow-up information after hospital discharge for CABG. Such data may not be available in all countries and data confidentiality rules may restrict access. Professional registries may collect the information on a regional or even national basis.

CABG re-operation within six months of discharge

Operational Definition

115. **Source:** Measure proposed by panel members.

Numerator: Number of unique patients undergoing CABG re-operations within six months of discharge.

Denominator: Number of unique patients discharged following a CABG operation.

116. Data requirements: National data on discharges following CABG by unique individuals and national data on unique individuals who have a CABG re-operation at six months which can be linked to the previous admission for CABG.

Importance of Indicator (See also CABG in-hospital mortality rate indicator)

117. Clinical significance of process or outcome: Re-operative coronary artery bypass operations (redo CABG) can be as much as 20% of CABG operations (Merlo *et al.*, 2001) and are usually done because the initial CABG has not been effective in improving cardiovascular health status. It is a much more difficult operation than a primary coronary artery bypass operation (Shimada, 1998) and carries with it a high degree of morbidity and mortality (Machiraju, 2002; Iscan *et al.*, 2003). A study of 594 redo CABG found that the post-operative mortality rate was 9.6% compared to 2.8% for primary CABG (Christenson, Schumuziger and Simonet, 1997). Studies show that post-operative mortality following a redo CABG can range between 2.5% and 11.4% (Machiraju, 2002; Irarrazaval *et al.*, 2001; Shimada *et al.*, 1998; Merlo *et al.*, 2001). Studies show that independent predictive clinical risk factors for morbidity and mortality following redo CABG can include: age> 69, diabetes, unstable angina, poor preoperative left ventricular function, acute preoperative AMI, renal insufficiency, vascular insufficiency, chronic lung disease, AMI between first and redo CABG, emergency operation, perfusion time, and an interval shorter than one year of the initial operation (Van Eck *et al.*, 2002; Christenson, Schmuziger and Simonet, 1997).

118. Identification of process/outcome as quality problem: In preventing a redo CABG it is important that patients have quality care during their first CABG and good follow-up care to monitor and manage their cardiovascular risk. This care should include ensuring the patient is taking secondary prevention drug treatment is enrolled in a cardiac rehabilitation programme and is undergoing treatment of other co-morbidities that may influence the outcome of CABG such as diabetes (Simchen *et al.*, 2001; Pasquali *et al.*, 2003; Hedback *et al.*, 2001).

119. Policy importance: Redo coronary artery bypass graft surgery brings with it a high risk of morbidity and mortality and incurs additional costs for governments. Governments and health funding agencies need to ensure that health services are providing evidenced-based quality cardiac surgical services that are aimed at aimed at improving morbidity and mortality for those undergoing CABG and which are directed at preventing adverse outcomes including the need for redo CABGs.

120. Susceptibility to being influenced by the health care system: The health care system can influence this indicator. Health services can ensure that they have quality improvement programmes in place that measure and improve their effectiveness. Health systems can also have protocols/clinical pathways in place for the management of people before, during and after a CABG. This should include good follow up procedures to ensure that the cardiovascular risk of those who have had a CABG is being managed *i.e.* people are taking the appropriate secondary prevention treatment and are enrolled in cardiac rehabilitation

programs. It should also ensure that there is continuity of care for patients between tertiary and primary sectors.

Scientific Soundness of Indicator

121. Face and content validity: This indicator does have face and content validity; it measures the effectiveness of the initial CABG and the management of people up to six months following the CABG.

122. Evidence supporting indicator validity: There are a number of studies that provide information on redo CABG that could be used for comparison purposes. No information could be found on consensus panels or quantitative testing.

Operational Issues

123. Need for/availability of case-mix adjustment: As for all outcomes indicators, it would be desirable to have both risk-adjusted and unadjusted rates for a richer comparison on the international level.

124. Availability of interpretative data: No interpretative data for this indicator could be found in the literature.

125. Data availability: This indicator would require follow-up information after hospital discharge for CABG. Such data may not be available in all countries and data confidentiality rules may restrict access. Professional registries may collect the information on a regional or even national basis.

PTCA in-hospital mortality

Operational Definition

126. **Source:** Measure **proposed** by panel members.

Numerator: Number of deaths in hospital in patients with PTCA.

Denominator: Number of PTCA performed.

127. Data requirements: National data on numbers of unique individuals undergoing PTCA and national data on numbers of deaths in hospital following a PTCA.

Importance of Indicator

128. Clinical Significance of Process or Outcome: Percutaneous transluminal coronary angioplasty (PTCA) procedures are done to relieve coronary narrowing and widen coronary arteries in patients with coronary artery disease in order to improve blood flow to the heart and improve morbidity and mortality (ACC/AHA, 2001). Stents are frequently inserted during the PTCA procedure to prevent restenosis of the coronary arteries. Study data shows that survival following PTCA can be 86.5-92.9% at five years and 81% - 89.5% at ten years depending on severity of coronary artery disease (ACC/AHA, 2001). A successful PTCA should achieve the goal of revascularisation of coronary arteries without major clinical complications including in-hospital mortality, myocardial infarction and emergency coronary artery bypass surgery (ACC/AHA, 2001). Studies show that in-hospital mortality following PTCA can range from 1-7% (Beohar *et al.*, 2001; Grassman *et al.*, 1997; Malenka *et al.*, 1999; O'Connor *et al.*, 1999).

129. Clinical and angiographic risk factors associated with in-hospital death following PTCA can include advanced age, female gender, congestive cardiac failure, diabetes, prior MI, increased creatinine

levels, multi-vessel disease, left main or equivalent coronary disease, pre-existing impairment of LV or renal function, a large area of myocardium at risk, treatment of an acute myocardial infarction, treatment of cardiogenic shock, emergent and urgent priority, procedural complication and peripheral or cerebrovascular disease (ACC/AHA, 2001; Lindsay *et al.*, 1994; Grassman *et al.*, 1997; Malenka *et al.*, 1999; O'Connor *et al.*, 1999). Advanced age and female gender have been identified as independent predictors of in-hospital death following PTCA. Older people are more likely to have multi-vessel disease, high-grade stenosis, complex lesions and to have undergone previous PTCA (Wennberg *et al.*, 1999; Watanabe, Maynard and Ritchie, 2001; Grassman *et al.*, 1997; Lindsay *et al.*, 1994; Malenka *et al.*, 1999; ACC/AHA, 2001). Women tended to be older, more likely to have diabetes, hypertension, or a history of congestive cardiac failure and other comorbidities than men (ACC/AHA, 2001; Queiros *et al.*, 2000; Watanabe, Maynard and Ritchie, 2001; Welty *et al.*, 2001; Wennberg *et al.*, 1999). They may also be more likely to die from a procedural complication than men (Malenka *et al.*, 1999).

130. The type of procedure also influence in-hospital mortality *e.g.*, whether a stent is used or not (O'Connor *et al.*, 1999; Kimmel *et al.*, 2001). Of 16,811 people having PTCA those having stents had a significantly reduced in-hospital mortality rate (0.3%) compared with (0.6%) (Kimmel, 2001). This finding was independent of the clinical setting. Koneru *et al.* also found that in 228 patients, stenting was associated with a low in-hospital mortality (1%) (Koneru *et al.*, 2000). Complications during a procedure can also influence mortality following PTCA In a large study of PTCAs, Malenka *et al.* found just over half of the deaths following PTCA were due to a procedural complication the rest were due to a pre-existing acute cardiac condition (Malenka *et al.*, 1999).

131. Identification of Process/Outcome as a Quality Problem: Health service quality factors that can influence the outcome of PTCA include:

- Whether clinical risk factors that may predict in-hospital mortality following PTCA, are taken into account in the selection of patients for PTCA. The ACC/AHA Guidelines (ACC/AHA, 2001) recommend that every time a patient is considered for revascularisation the potential risks and benefits of the particular procedure must be weighted against alternative therapies;
- The quality of care before, during and after the PTCA; Hospitals need to have valid quality systems in place to ensure that PTCA procedures are provided in accordance with evidenced based guidelines. This should include a system for valid peer review among health professionals;
- The selection of the PTCA procedure *e.g.*, whether a stent is used or not (Kimmel *et al.*, 2001; O'Connor *et al.*, 1999);
- Laboratory processes and volume of procedures done. The ACC/AHA Guidelines (ACC/AHA, 2001) (Level of evidence B) recommend that PTCA be performed by higher volume operators (≥ to 75 cases a year) with advanced technical skills and at institutions that are high volume (> 400 cases/year) with fully equipped intervention laboratories and experienced support staff; and
- Whether hospitals have procedures in place for rapid access to an operating theatre for emergency coronary artery bypass surgery.

132. Policy Importance: PTCA is a high cost cardiovascular treatment for Government funding agencies. It has been estimated that annually more than 1,000,000 percutaneous transluminal coronary angioplasties are done worldwide to improve outcomes with people with coronary artery disease (ACC/AHA, 2001). Governments need to ensure that PTCAs are delivered by high quality cardiology services, which meet current evidenced-based guidelines that are directed at those who would be most likely to benefit from a PTCA.

133. Susceptibility to being influenced by the health care system: The Health Sector can influence this indicator by:

- Having comprehensive evidenced placed selection processes in place for PTCA aimed at improving outcomes and minimising adverse outcomes including in-hospital mortality;
- Having safety and quality improvement programmes in place for providers in the overall management of people before, during and after a PTCA;
- Good linkages between cardiac and cardiac surgical services to ensure rapid transfer when needed; and
- Cardiac services that audit and benchmark themselves nationally and internationally.

Scientific Soundness of Indicator

134. Face and content validity: This is a valid measure of the quality of care surrounding PTCA. Providers can put in place quality systems to minimise in-hospital mortality following PTCA.

135. Evidence supporting indicator validity: There was no information in the literature on this indicator. No information on consensus panels or quantitative testing was found.

Operational Issues

136. Need for/availability of case-mix adjustment across countries: This measure needs to be risk adjusted for different countries to enable valid comparisons because of the different rates of coronary artery disease and selection criteria for PTCA between countries.

137. Availability of interpretative data: There are a number of studies that provide information on mortality following PTCA that could be used for comparative purposes.

138. Data availability: The data should be available through hospital discharge documentation systems in many countries.

Same-day CABG surgery rate after PTCA

Operational Definition

139. **Source: Measure** proposed by panel members.

Numerator: Number of unique patients who have had a CABG within 24 hours following a PTCA.

Denominator: Number of unique patients who have had a PTCA.

140. Data requirements: National data on numbers of unique individuals who have had a PTCA and national data on numbers of unique individuals who have had a CABG within 24 hours following a PTCA.

Importance of Indicator (See also PTCA in-hospital mortality indicator)

141. Clinical significance of process or outcome: Coronary complications following a PTCA can result in the need for an emergency coronary artery bypass operation (ACC/AHA, 2001; Andreasan *et al.*, 2000; Shubrooks, 2001). Studies show that emergency CABG following PTCA occurs in approximately 1-2% of

cases (Andreasan *et al.*, 2000, Beohar *et al.*, 2003; Shubrooks *et al.*, 2001), however, in-hospital mortality following emergency CABG for failed PTCA can be as high as 12% (Andreasan *et al.*, 2000). It is possible to identify those people who may be at risk of requiring an emergency CABG following PTCA. Clinical risk factors for emergency CABG include age, gender, co-morbidities, prior history of coronary intervention, clinical condition at time of the PTCA and acute coronary syndromes (Harrel, Schunkert and Palacious, 1999). Clinical instability has been found to be a strong predictor of requiring an urgent CABG (Shubrooks *et al.*, 2001). A successful PTCA should achieve the goal of revascularisation of coronary arteries without major clinical complications including emergency coronary artery bypass surgery (ACC/AHA, 2001).

142. Identification of process/outcome as quality problem: Health service quality factors that influence emergency CABG following PTCA are similar to those that outlined above that can influence in-hospital mortality. These include having evidenced-based selection processes for PTCA that take into account the factors that are predictive of adverse outcomes following PTCA and quality of care before, during and after the PTCA. In minimising high morbidity and mortality associated with emergency CABG it is very important that where an emergency CABG is unavoidable cardiac services should have a procedure in place for rapid access to a cardiac surgery operating theatre (ACC/AHA, 2001).

143. Policy importance: Governments need to ensure that PTCAs are delivered by cardiology services that that meet set quality standards aimed at improving morbidity and mortality from cardiovascular disease.

144. Susceptibility to being influenced by the health care system: This indicator can be influenced by the health care system. Quality systems can be put in place for the selection and management of people with PTCA. The health care system can also ensure that organisational systems are set up so that cardiology services have rapid access to cardiac surgery operating theatres in event of the need for an emergency CABG following PTCA.

Scientific Soundness of Indicator

145. Face and content validity: This is a valid measure of the quality of care surrounding PTCA. Providers can put in place quality systems to minimise emergency CABG following PTCA and to minimise morbidity and mortality following emergency CABG.

146. Evidence supporting indicator validity: There are a number of studies that provide information on emergency CABG following PTCA which could be used for comparative purposes. No information was found on consensus panels or quantitative testing.

Operational Issues

147. Need for/availability of case-mix adjustment: As for all outcomes indicators, it would be desirable to have both risk-adjusted and unadjusted rates for a richer comparison on the international level.

148. Availability of interpretative data: Only information from studies was found.

149. Data availability: This indicator would require detailed hospital information to track several procedures and their sequence. Such data may not be available in all countries and data confidentiality rules may restrict access. Professional registries may collect the information on a regional or even national basis.

Repeat PTCA within 30 days of discharge

Operational Definition

150. **Source:** Measure proposed by panel members.

Numerator: Number of **unique** patients having a second PTCA performed within 30 days of discharge.

Denominator: Number of PTCA performed.

151. Data requirements: National data on discharges following PTCA that can be linked with admission data for repeat PTCA.

Importance of Indicator (See also PTCA in-hospital mortality and same-day CABG surgery rate after PTCA indicators)

152. Clinical significance of process or outcome: Restenosis following PTCA is a complex medical problem occurring in around 20%-30% of people undergoing PTCA at six months (Poyen *et al.*, 2003; Foley *et al.*, 2001). People who develop restenosis following PTCA may suffer a serious cardiac event *e.g.*, myocardial infarction or stroke and will often need another revascularisation procedure either a second PTCA or a CABG to improve/restore coronary blood flow. A number of physiological and clinical risk factors can influence restenosis following PTCA. People with more extensive multi-vessel coronary artery disease are particularly at risk of restenosis (ACC/AHA, 2001).

153. Identification of process/outcome as quality problem: The quality factors identified for in-hospital mortality and same day CABG following PTCA also apply to this indicator. Quality factors that are specific to repeat PTCA at 30 days could include:

- Whether a PTCA is the right revascularisation procedure for the level of coronary artery disease. As indicated above, those patients who have more extensive coronary artery disease including multi-vessel disease, occluded arteries and vessels with extensive coronary artery disease are more likely to have restenosis following a PTCA and may be better having an alternative procedure *e.g.*, CABG;
- The choice of stent technology may also be important. There is much research underway on PTCA stent technology aimed at reducing restenosis *e.g.*, drug eluting stents and various forms of metal stents (NICE, 2003); and
- Whether providers have ensured that patients who have had a PTCA are on the right secondary prevention medications, including aspirin, ace-inhibitor, beta-blocker and statin and have started cardiac rehabilitation.

154. Policy importance: Repeat PTCAs are costly to government and also impact on the nation's health. The quality of a hospital cardiac service could influence the rate of restenosis following PTCA.

155. Susceptibility to being influenced by the health care system: As for the previous PTCA indicators, this indicator can be influenced by the health care system. Quality systems can be put in place for the selection, management and follow up of people following PTCA.

Scientific Soundness of Indicator

156. Face and content validity: Restenosis after PTCA implies a failure of the procedure. The technical quality of the initial procedure, in particular the use of coronary stents, has been shown to influence the restenosis rate, lending the indicator face validity. However, a 30-day follow-up will only capture early restenosis. An additional indicator to compute the more common late restenoses, *e.g.*, after six months, should be added to provide a full picture.

157. Evidence supporting indicator validity: No information from consensus panels or from any quantitative testing was found. Generally, there is more information about repeat PTCA at six months in the literature than there is about repeat PTCA at 30 days.

Operational Issues

158. Need for/availability of case-mix adjustment: As for all outcomes indicators, it would be desirable to have both risk-adjusted and unadjusted rates for a richer comparison on the international level.

159. Availability of interpretative data: There appears to be very little data in the literature on this indicator.

160. Data availability: This indicator would require follow-up information after hospital discharge for PTCA. Such data may not be available in all countries and data confidentiality rules may restrict access. Professional registries may collect the information on a regional or even national basis.

Congestive Heart Failure

Proportion (percentage) of patients with congestive heart failure, for whom it is indicated, receiving ACE inhibitor on discharge

Operational Definition

161. **Source:** JCAHO, CMS (HCFA), US National Quality Report.

Numerator: Number of individual patients with a principal diagnosis of congestive heart failure who are prescribed an ACE inhibitor at discharge specifications.

Denominator: Number of individual patients discharged with a principal diagnosis of congestive heart failure.

162. Data requirements: Prescription data, survey or record review of pharmaceuticals prescribed at discharge.

Importance of Indicator

163. Impact on health: There is an increase in the prevalence of congestive heart failure (CHF) internationally from 1% in those aged 50 – 59 years to over 50% in those 85 years and older and it is now a major public health problem. (In one study in Australia it has been associated with approximately 12% of cardiovascular disease direct health costs in 1993-94) (Mathers and Penm, 1999). In the United States total inpatient and outpatient costs in 1991 were 5.4% of total health budget. The disease burden associated with CHF is expected to increase markedly due to a number of factors including: the ageing of the population; the

projected increase in the number of elderly people with coronary heart disease and hypertension; and the decrease in case-fatality rates associated with acute coronary syndromes (*i.e.*, the increased survival after heart attack); improved diagnosis and management of CHF because of greater utilisation of sensitive techniques such as echocardiography.

164. Clinical significance of process or outcome: Because of the importance of renin-angiotensin system activation in progression of CHF, blockade of this system has become the cornerstone of successful therapy for systolic ventricular dysfunction. ACE inhibitors have been shown to prolong survival, improve patient symptom status and exercise tolerance (ACC/AHA, 2001).

165. Identification of process/outcome as quality problem: Establishment of optimal disease management is important to control and postpone development of symptoms and complications for this condition. Patient outcomes will be improved if treatment is initiated early and adhered to in the community setting. ACE inhibitors can reduce the risk of death as well as the combined risk of death or hospitalisation. (ACC/AHA, 2001). There is evidence that this can be improved (James, 2002).

166. Policy importance: Additional burden and cost of disease incurred for hospital readmissions and with attendances to primary care physicians if treatment guidelines are not followed. Governments will be interested in improved outcomes for these patients.

167. Susceptibility to being influenced by the health care system: The health care system can improve health care through the use of protocols/pathways which are clinically acceptable and which will enable an increase in the adherence to practice guidelines in the appropriate management of the condition. Benchmarking and quality audits have been shown to improve adherence to these treatment practices by practitioners.

Scientific Soundness of Indicator

168. Face validity: The indicator can immediately be understood and is recommended in several national indicator sets developed from consensus processes.

169. Content validity: Some problems with the diagnosis and coding of congestive heart failure have been identified in the administrative data sets.

170. Evidence supporting indicator validity Consensus panel support exists for this indicator, for example, in Canada (Lee *et al.*, 2003), the US (AMA, 2003) and Australia (NICS, 2002).

Operational Issues

171. In OECD countries there will be a requirement for dedicated data collection unless there is a link between the pharmaceutical databases and the hospital morbidity databases.

Rate of Beta-blocker prescription at hospital discharge for congestive heart failure (CHF)

Operational Definition

172. **Source:** AHRQ HCUP refinement/CIHI.

Numerator: Number of patients with a diagnosis of CHF and prescribed a beta-blocker at discharge.

Denominator: Number of patients discharged with a diagnosis of CHF.

173. Data requirements: Pharmacy data, survey or chart review of pharmaceuticals prescribed at discharge.

Importance of Indicator

174. Impact on health: There is an increase in the prevalence of chronic heart failure internationally from 1% in those aged 50 – 59 years to over 50% in those 85 years and older and it is now a major public health problem. In one study in Australia it has been associated with approximately 12% of cardiovascular disease direct health costs in 1993-94 (Mathers and Penm, 1999). In the United States total inpatient and outpatient costs in 1991 were 5.4% of total health budget. The disease burden associated with CHF is expected to increase markedly due to a number of factors including: the ageing of the population; the projected increase in the number of elderly people with coronary heart disease and hypertension; the decrease in case-fatality rates associated with acute coronary syndromes; and improved diagnosis and management of CHF because of greater utilisation of sensitive techniques such as echocardiography.

175. Clinical significance of process or outcome: Long-term treatment with beta-blockers can lessen the symptoms of HF, improve the clinical status of the patients and enhance the overall sense of well being. In addition, drugs like ACE inhibitors and beta-blockers can reduce the risk of death and the combined risk of death and hospitalisation (ACC/AHA, 2001).

176. Identification of process/outcome as quality problem: Establishment of optimal disease management is important to control and postpone development of symptoms and complications for this condition. Patient outcomes will be improved if treatment is initiated early and adhered to in the community setting. Beta-blockers can reduce the risk of death as well as the combined risk of death or hospitalisation. This represents a fairly new treatment recommendation to CHF and is therefore less complied with than for example ACE-inhibitor treatment.

177. Policy importance: Additional burden and cost of disease incurred for hospital readmissions and with attendances to primary care physicians if treatment guidelines are not followed. Governments will be interested in improved outcomes for these patients.

178. Susceptibility to being influenced by the health care system: The health care system can improve health care through the use of protocols/pathways which are clinically acceptable and which will enable an increase in the adherence to practice guidelines in the appropriate management of the condition. Benchmarking and quality audits have been shown to improve adherence to these treatment practices by practitioners.

Scientific Soundness of Indicator

179. Face validity: The indicator can immediately be understood and is recommended in several national indicator sets developed from consensus processes.

180. Content validity: Some problems with the diagnosis and coding of congestive heart failure have been identified in the administrative data sets.

181. Evidence supporting indicator validity (*e.g.*, consensus panels, quantitative testing): Consensus panel support exists for this indicator, for example, in Canada (Lee *et al.*, 2003), the US (AMA, 2003) and Australia (NICS, 2002).

Operational Issues

182. In OECD countries there will be a requirement for dedicated data collection unless there is a link between the pharmaceutical databases and the hospital morbidity databases.

CHF in-hospital mortality rate

Operational Definition

183. **Source:** AHRQ HCUP refinement and CIHI.

Numerator: Number of deaths per 100 discharges with principal diagnosis code for CHF.

Denominator: Number of discharges with principal diagnosis code for CHF. Exclude discharges with cardiac procedure codes in any field.

184. Data Requirements: Hospital discharge data.

Importance of Indicator

185. Impact on health: There is an increase in the prevalence of chronic heart failure internationally from 1% in those aged 50 – 59 years to over 50% in those 85 years and older and it is now a major public health problem. In one study in Australia it has been associated with approximately 12% of cardiovascular disease direct health costs in 1993-94 (Mathers and Penm, 1999). In the United States total inpatient and outpatient costs in 1991 were 5.4% of total health budget. The disease burden associated with CHF is expected to increase markedly due to a number of factors including: the ageing of the population; the projected increase in the number of elderly people with coronary heart disease and hypertension; the decrease in case-fatality rates associated with acute coronary syndromes; improved diagnosis of CHF because of greater utilisation of sensitive techniques such as echocardiography.

186. Clinical significance of process or outcome: Congestive heart failure is a relatively common admission with a relatively high short-term mortality rate. Certain procedures have been shown to decrease short-term CHF mortality on a patient level.

187. Identification of process/outcome as quality problem: The reduction of the death rate for people with congestive heart failure reflects better management of the condition.

188. Policy importance: Governments are interested in improving prognosis in congestive heart failure and have taken initiatives to improve the management of the condition.

189. Susceptibility to being influenced by the health care system: The health care system can improve health care through the use of protocols/pathways which are clinically acceptable and which will enable an increase in the adherence to practice guidelines in the appropriate management of the condition. Benchmarking and quality audits have been shown to improve adherence to these treatment practices by practitioners.

Scientific Soundness of Indicator

190. Face validity: The indicator can immediately be understood and is recommended in several national indicator sets developed from consensus processes.

191. Content validity: Some problems with the diagnosis and coding of congestive heart failure have been identified in the administrative data sets. Levels of severity may need to be included in the diagnosis of congestive heart failure to enable risk adjustment of the data. There may be some difficulties in comparing countries with different treatment settings for patients with terminal episodes of congestive cardiac failure, *i.e.* hospices rather than hospitals.

192. Evidence supporting indicator validity: Consensus panel support exists for this indicator, for example, in Canada (Lee *et al.*, 2003), the US (AMA, 2003), and Australia (NICS, 2002).

ANNEX 2: MEMBERS OF THE PANEL

Laura Lambie (Chair)

193. Laura Lambie's background spans the health sector at all levels including work at the clinical/provider, funder and government level. Her work over the past ten years has been concerned with the strategic development and performance improvement of clinical services and has included a variety of leadership and project management roles. In her most recent position as Senior Advisor (Clinical Development) at the Ministry of Health Ms. Lambie has had the responsibility for the strategic development and implementation of the cardiovascular project under the New Zealand Health Strategy. This has included the project management of an advisory group, project team and health sector organisations to develop a three year Cardiovascular Action Plan and a cardiovascular toolkit for District Health Boards. The implementation of the action plan involves, managing the cardiovascular project team and working with key agencies and providers including Heart Foundation, Stroke Foundation, Cardiac Society, New Zealand Guidelines Group, Pharmac, District Health Board New Zealand, and District Health Boards.

194. In her previous role as Team Leader and Clinical Advisor in the Health Funding Authority Ms. Lambie led the successful development of the New Zealand Palliative Care Strategy, which was launched by the Minister of Health in February 2001. This included the development, public consultation and publishing of the Strategy. It also included the development of a national service framework and pricing model for palliative care services. In this role she was also responsible for a number of other portfolio areas and the day – to day management of the clinical advisor team. In Ms. Lambie's role as Clinical Review Co-ordinator at Capital Coast Health she completed five major clinical reviews to improve service delivery. She has also undertaken a number of other project management/policy development roles.

Heather Palmer

195. Dr. Palmer, a paediatrician by training, is Professor of Health Policy and Management and Director of the Center for Quality of Care Research and Education (QCARE) at the Harvard School of Public Health and Editor-in-Chief of the International Journal for Quality in Health Care. Dr. Palmer earned her baccalaureate degree and her M.B. and B.Ch. degrees (equivalent to the United States M.D. degree) from Cambridge University with clinical training at the Royal London Hospital Medical College. She also has a Master of Science degree in Health Services Administration from the Harvard School of Public Health. Dr. Palmer's research focuses on evaluation and improvement of quality of health care, particularly in the ambulatory setting. She specialises in the development and evaluation of clinical performance measures and improvement programs and serves on several national advisory boards in this capacity. She is currently Principal Investigator of a project entitled "Making Advances in Avoiding Jaundice in Infant Care" (MAJIC). The project is a collaboration between the American Academy of Paediatrics and two large managed care plans. The Agency for Healthcare Research and Quality (AHRQ) funded this five-year project to identify and share ways in which managed care plans can improve detection and treatment of jaundice in newborn babies. Dr. Palmer is co-chair of the Work Group on Implementation of the Physician's Consortium for Performance Improvement, and was a member of the Technical Advisory Panel on the State of Quality, for the Institute of Medicine's Quality of Health Care in America Project. She chairs the Measurement Evaluation Panel of the JCAHO Advisory Council on Performance Measurement and serves on the National

Committee on Quality Assurance (NCQA) Expert Panel on Physician-Level Measurement. She co-chairs the Technical Expert Panel to develop aggregate measures of the quality of chronic disease care at the physician level as part of the CMS Doctor's Office Quality Project. Dr. Palmer is a Member of the Technical Expert Panel for the Medicare Patient Safety Monitoring System (MPSMS).

Vin McLoughlin

196. Dr. Vin McLoughlin is Assistant Secretary of the Health Priorities Branch at the Australian Department of Health and Ageing, where she is responsible for coordinating and managing initiatives designed to improve the safety and quality of health care services in Australia. Previously she was on secondment from the Australian Government as a consultant on health policy to the OECD's Social Policy Division to look at the mechanisms that selected countries are using to identify evidence based medicine and health outcomes approaches and apply them to policy and financing decision-making processes. From 1992-1998 McLoughlin was responsible for the management of the General Practice Strategy. She chaired the Ministerial Review of the General Practice Strategy. Dr McLoughlin has worked in the health care industry for almost 20 years, both in the UK and Australia. She has been involved in 'on the ground' services planning and the provision of services as well as in epidemiological research and in policy (both national and local) spanning the acute and community sectors.

Ulla Idänpään-Heikkilä

197. Dr. Ulla Idänpään-Heikkilä is a medical doctor, a cardiologist, and has also a degree of Master of Public Health from the Nordic School of Public Health in Gothenburg, Sweden. She works currently at the National Research and Development Centre for Welfare and Health (STAKES) in Helsinki, Finland, in the division of Health and Social Services, where she leads the team Quality for Services. The main task of the team is to support the social and health care organisations in implementing the latest national recommendations for quality in social and health care, given out in 1999. Her tasks include also research and consulting in development of health care systems and provision of services. Prior to taking the present job, she worked as a cardiologist, and later as head of internal medicine, at a regional hospital in Espoo, and after that as a consultant in health systems and services in Health Services Research Ltd. She has also been a lecturer in internal medicine at the University of Oulu. Her interest in quality management dates from her time as the head of internal medicine ten years ago. She directed then several clinical quality projects and was project manager in the organisational audit program (King's Fund method) in 1993-1994 in her hospital. Since then she has also been a quality auditor for accreditation of health care institutions and the Finnish Quality Award.

Jack Tu

198. Dr. Tu is a Canada Research Chair in Health Services Research, based at SWCHSC. He has earned a Doctor of Medicine degree from the University of Western Ontario, a Master of Science degree in Clinical Epidemiology from the University of Toronto, and a PhD in Health Policy from Harvard University. He serves on numerous health care committees and supervises students completing their master or doctorate theses. Dr. Tu's research is in the area of cardiovascular and cerebrovascular outcomes research. He has lectured to research associates and at conferences in Canada, the United States and Europe. In 2000-2001, his honours included the Canadian Society of Internal Medicine Young Investigator Award, and the Allan Bruce Robertson Young Investigator Award.

REFERENCES

ACE INHIBITOR MYCARDIAL INFARCTION COLLABORATIVE GROUP (AIMICG) (1998), "Indications for ACE inhibitors in the early treatment of acute myocardial infarction: systematic overview of individual data from 100,000 patients in randomized trials" *Circulation*, Vol.97, pp.2202-2212.

ACUTE INFARCTION RAMIPRIL EFFICACY (AIRE) STUDY INVESTIGATORS (1993), "Effect of ramipril on mortality and morbidity of survivors of acute myocardial infarction with clinical evidence of heart failure" *Lancet*, Vol.342, pp.821-828.

AGENCY FOR HEALTHCARE RESEARCH AND QUALITY (AHRQ), National Quality Measures Clearinghouse, USA, www.qualitymeasures.ahrq.gov, accessed 23/6/2004.

AMBROSIONI, E., BORGHI, C., and MAGNANI, B. (1995), for The Survival of Myocardial Infarction Long-Term Evaluation (SMILE) Study Investigators, "The Effect of the Angiotensin-Converting–Enzyme Inhibitor Zofenopril on Mortality and Morbidity after Anterior Myocardial Infarction" *N Engl J Med*, Vol.332, pp.80-85.

AMERICAN COLLEGE OF CARDIOLOGY (ACC), www.acc.org, accessed 23/6/2004.

AMERICAN COLLEGE OF CARDIOLOGY and AMERICAN HEART ASSOCIATION (ACC/AHA) (1999), "Guidelines for Coronary Artery Bypass Graft".

AMERICAN COLLEGE OF CARDIOLOGY and AMERICAN HEART ASSOCIATION (ACC/AHA) (2001), "Percutaneous Coronary Intervention Guidelines".

AMERICAN HEART ASSOCIATION (AHA), www.americanheart.org, accessed 23/6/2004.

AMERICAN MEDICAL ASSOCIATION (AMA) (2003), "American College of Cardiology, American Heart Association and Physician Consortium for Performance Improvement, Clinical Performance Measures for Heart Failure"

ANDREASAN, J.J., MORTENSEN, P.E., ANDERSEN, L.I., *et al*. (2000), "Emergency coronary artery bypass surgery after failed percutaneous coronary angioplasty" *Scandinavian Cardiovascular Journal*, Vol.34(3), pp.242-6.

ANGEJA, B.G., GIBSON, C.M, CHIN, R., *et al.* (2002), "Predictors of door-to-balloon delay in primary angioplasty" *The American Journal of Cardiology*, Vol.89(10), pp.1156-1161.

ANTIPLATELET TRIALISTS' COLLABORATION (ATC) (1988), "Secondary prevention of vascular disease by prolonged antiplatelet treatment" *Br Med J*, Vol.296, pp.320-332.

ASPIRIN MYOCARIDAL INFARCTION STUDY RESEARCH GROUP (AMISRG) (1980), "A randomized controlled trial of aspirin in persons recovered from myocardial infarction" *JAMA*, Vol.243, pp.661-669.

BEOHAR, N., DAVIDSON, C.J., WEIGOLD, G., *et al.* (2001), "Predictors of long-term outcomes following direct percutaneous coronary intervention for acute myocardial infarction" *American Journal of Cardiology*, Vol.88(10), pp.1103-8.

BERGER, P.B., ELLIS, S.G., HOLMES, D.R. Jr., *et al.* (1999), "Relationship between delay in performing direct coronary angioplasty and early clinical outcome in patients with acute myocardial infarction: results from the global use of strategies to open occluded arteries in Acute Coronary Syndromes (GUSTO-IIb) trial." *Circulation*, Vol.100(1), pp.14-20.

BETA-BLOCKER HEART ATTACK TRIAL RESEARCH GROUP (BBHATRG) (1982), "A randomized trial of propranolol in patients with acute myocardial infarction. I. Mortality results" *JAMA*, Vol.247, pp.1707-1714.

BETA-BLOCKER POOLING PROJECT RESEARCH GROUP (BBPPRG) (1988), "The Beta Blocker Pooling Project (BBPP): subgroup findings from randomized clinical trials in post infarction patient" *Eur Heart J*, Vol.9, pp.8-16.

BIRKMEYER, N.J., CHARLESWORTH, D.C., HERNANDEZ, F., *et al*. (1998), "Obesity and risk of adverse outcomes associated with coronary artery bypass surgery. Northern New England Cardiovascular Disease Study Group" *Circulation*, Vol.97(17), pp.1689-94.

BOWKER, T.J., CLAYTON, T.C., INGHAM J., *et al.* (1996), "A British Cardiac Society survey of the potential for the secondary prevention of coronary disease: ASPIRE (Action on Secondary Prevention through Intervention to Reduce Events) *Heart*, Vol.75, pp.334-342.

BRODIE, B.R., STUCKEY, T.D., WALL, T.C., *et al.* (1998), "Importance of time to reperfusion for 30-day and late survival and recovery of left ventricular function after primary angioplasty for acute myocardial infarction" *Journal of the American College of Cardiology*, Vol.32(5), pp.1312-1319.

CANADIAN CARDIOVASCULAR SOCIETY (CCS), www.ccs.ca, accessed 23/6/2004

CANNON, C.P., GIBSON, C.M, LAMBREW, C.T., *et al.* (2000), "Relationship of Symptom-Onset-to-Balloon Time and Door-to-Balloon Time With Mortality in Patients Undergoing Angioplasty for Acute Myocardial Infarction" *JAMA*, Vol.283(22), pp.2941-2947.

CHRISTENSON, J.T., SCHMUZIGER, M., and SIMONET, F. (1997), "Reoperative coronary artery bypass procedures: risk factors early mortality and late survival" *European Journal of Cardiothoracic Surgery*, Vol.11(1), pp.129-33.

CLOUGH, R.A., LEAVITT, B.J., MORTON, J.R., *et al*. (2002), "The effect of comorbid illness on mortality outcomes in cardiac surgery" *Archives Surgery*, Vol.137(4), pp.428-3.

EGLOFF, L., LASKE, A., SIEBENMANN, R., STUDER, M. (2002), "Coronary artery revascularization using both ITAs as free conduits in patients with three-vessel disease- the lambda graft" *Thoracic Cardiovascular Surgery*, Vol.50(1), pp.31-4.

ELWOOD, P.C., COCHRANE, A.L., BURR, M.L., *et al.* (1974), "A randomised controlled study of acetylsalicylic acid in the secondary prevention of myocardial infarction" *Br Med J*, Vol.9, pp.436-40.

EUROASPIRE I and II GROUP (2001), "Clinical reality of coronary prevention guidelines: a comparison of EUROASPIRE II and II in nine countries" *Lancet*, Vol.357, pp.995-1001.

EUROASPIRE STUDY GROUP (1997), "A European Society of Cardiology survey of secondary prevention of coronary heart disease: principal results" *Eur Heart J*, Vol.18, pp.1569-82.

EUROPEAN SOCIETY OF CARDIOLOGY (ESC) (1996), Task Force on the Management of Acute Myocardial Infarction of the European Society of Cardiology, "Acute myocardial infarction: pre-hospital and in-hospital" *European Heart Journal*, Vol.17(1), pp.43-63.

EUROPEAN SOCIETY OF CARDIOLOGY (ESC) (2002), Task Force on the Management of Acute Coronary Syndromes, "Management of acute coronary syndromes in patients presenting without persistent ST-segment elevation" *European Heart Journal*, Vol.23, pp.1809-1840.

EUROPEAN SOCIETY OF CARDIOLOGY (ESC) (2003), Task Force on the Management of Acute Myocardial Infarction, "Management of acute coronary syndromes in patients presenting with ST-segment elevation" *European Heart Journal*, Vol.24, pp.25-66.

FLATHER, M.D., YUSUF, S., KØBER, L., *et al.* (2000), for the ACE-Inhibitor Myocardial Infarction Collaborative Group, "Long-term ACE-inhibitor therapy in patients with heart failure or left-ventricular dysfunction: a systematic overview of data from individual patients" *Lancet*, Vol.355, pp.1575-1581.

FIBRINOLYTIC THERAPY TRIALISTS' (FTT) COLLABORATIVE GROUP (1994), "Indications for fibrinolytic therapy in suspected acute myocardial infarction: collaborative overview of early mortality and major morbidity results from all randomised trials of more than 1000 patients" *Lancet*, Vol.343(8893), pp.311-322.

FOLEY, D.P., KERERAKES, D., TE RIELE, J.A., *et al.* (2001), "US and European Duet Investigators Acute and 6-month clinical and angiographic outcome after implantation of the ACS Duet stent for single-vessel coronary artery disease: final results of the European and US ACS multi-link Duet Registry" *Catheter Cardiovascular Interven*, Vol.54(1), pp.25-33.

GAO, D., GRUNWALD, G.K., RUMSFELD, J.S., *et al*. (2003), "Variation in mortality risk factors with time after a coronary artery bypass operation" *Annuals Thoracic Surgery*, Vol.75(1), pp.74-81.

GHALI, W.A., QUAN, H., SHRIVE, F.M., and HIRSCH, G.M. (2003), "Canadian Cardiovascular Outcomes Research Team: Outcomes after coronary artery bypass graft surgery in Canada 1992/93 to 2000/2001" *Canadian Journal of Cardiology*, Vol.19(7), pp.774-81.

GRASSMAN, E.D., JOHNSON, S.A., and KRONE, R.J. (1997), "Predictors of success and major complications for primary percutaneous transluminal coronary angioplasty in acute myocardial infarction: An analysis of the 1990-1994 Society Angiography and intervention registries" *Journal of American College Cardiology*, Vol.30(1), pp.201-8.

GRUPPO ITALIANO PER LO STUDIO DELLA SOPRAVIVENZA NELL'INFARTO MIOCARDICO (GISSI) (1990), "GISSI-2: a factorial randomised trial of alteplase versus streptokinase and heparin

versus no heparin among 12,490 patients with acute myocardial infarction" *Lancet*, Vol.336(8707), pp.65-71.

The GUSTO INVESTIGATORS (1993), "An International Randomized Trial Comparing Four Thrombolytic Strategies for Acute Myocardial Infarction" *N Engl J Med*, Vol. 329(10), pp.673-82.

The GLOBAL USE OF STRATEGIES TO OPEN OCCLUDED CORONARY ARTERIES IN ACUTE CORONARY SYNDROMES (GUSTO IIb) Angioplasty Substudy Investigators (1997), "A Clinical Trial Comparing Primary Coronary Angioplasty with Tissue Plasminogen Activator for Acute Myocardial Infarction" *N Engl J Med*, Vol.336(23), pp.1621-1628.

HANNAN, E.L., SU, A.L, KUMAR, D., *et al*. (1995), "The decline in coronary artery bypass graft surgery mortality in New York State. The role of surgeon volume" *JAMA*, Vol.273(3), pp.209-13.

HARREL, L., SCHUNKERT, H., and PALACIOUS, I.F. (1999), "Risk predictors in patients scheduled for percutaneous coronary revascularisation" *Catheter Cardiovasc Interv*, Vol.48(3), pp.253-60.

The HEART AND STROKE FOUNDATION OF CANADA (HSFC) (1996), the Canadian Cardiovascular Society and the Canadian Association of Emergency Physicians for the Emergency Cardiac Care Coalition "Recommendations for ensuring early thrombolytic therapy for acute myocardial infarction" *CMAJ* Vol.154(4), pp.483-487.

HEDBACK, B., PERK, J., HORNBLAD, M., OHLSSON, U. (1996), "Cardiac rehabilitation after coronary artery bypass surgery: 10 years results on mortality, morbidity and readmissions to hospital" *J Cardiovascular Risk*, Vol.8(3), pp.153-8.

HENNEKENS, C.H., ALBERT, C.M., GODFRIED, S.L., *et al.* (1996), "Adjunctive Drug Therapy of Acute Myocardial Infarction — Evidence from Clinical Trials" *N Engl J Med*, Vol.335, pp.1660-1668.

HERLITZ, J., BRANDRUP-WOGNSEN, G., HAGLID, M., *et al.* (1998), "Predictors of death during 5 years after coronary artery bypass grafting" *International Journal Cardiology*, Vol.64(1), pp.15-23.

HURTADO, M.P., SWIFT, E.K., and CORRIGAN, J.M (eds.) (2001). Envisioning the National Health Care Quality Report. The US Institute of Medicine. Washington: National Academy Press.

HOURIGAN, C.T., MOUNTAIN, D., LANGTON, P.E., *et al* (2000), "Changing the site of delivery of thrombolytic treatment for acute myocardial infarction from the coronary care unit to the emergency department greatly reduces door to needle time" *Heart*, Vol.84(2), pp.157-163.

ISCAN, H.Z., KANDEMIR, O., GOL, M.K., *et al.* (2003), "Coronary reoperation without the use of cardiopulmonary bypass" *Cardiovascular Surgery*, Vol.,11(2), pp.155-8.

IRARRAZAVAL, M.J., MORAN, S., ZALAQUETT, R., *et al.* (2001), "Coronary reoperation a 16 year retrospective analysis" *Rev Med Chil*, Vol.(10), pp.1131-41.

JAMES, B. (2002), "Minimising Harm to Patients in Hospital, Health Report Stories" 21/01/2002 Australian Broadcasting Commission.

JENCKS, S.F., HUFF, E.D., and CUERDON, T. (2003), "Change in the quality of care delivered to Medicare beneficiaries, 1998-1999 to 2000-2001" *JAMA*, Vol.289, pp.305-312.

KERR, E.A., ASCH S.M., HAMILTON E.G., MCGLYNN, E.A. "Quality of Care for Cardiopulmonary Conditions. A review of the Literature and Quality Indicators" RAND Health, Santa Monica, CA, 2000.

KIMMEL, S.E., LOCALIO, A.R., KRONE, R.J., and LASKEY, W.K. (2001), "The effects of contemporary use of stents on in-hospital mortality. Registry Committee of the Society for Cardiac Angiography and Interventions" *Journal of American College Cardiology,* Vol.37(2), pp.499-504.

KØBER, L., TORP-PEDERSEN, C., CARLSEN, J.E., *et al.* (1995), for The Trandolapril Cardiac Evaluation (TRACE) study group, "A Clinical Trial of the Angiotensin-Converting–Enzyme Inhibitor Trandolapril in Patients with Left Ventricular Dysfunction after Myocardial Infarction" *N Engl J Med*, Vol.333, pp.1670-1676.

KONERU, S., MONSEN, C.E., PUCILLO, A., *et al.* (2000), "Percutaneous transluminal coronary angioplasty (PTCA combined with stenting improves clinical outcomes compared to PTCA alone in acute myocardial infarction" *Heart Disease*, Vol.2(4), pp.282-6.

LAMBREW, C.T., BOWLBY, L.J., ROGERS, W.J., *et al* (1997), "Factors influencing the time to thrombolysis in acute myocardial infarction. Time to Thrombolysis Substudy of the National Registry of Myocardial Infarction-1" *Arch Intern Med*, Vol.157(22), pp.2577-2582.

LEE, D.S., TRAN, C., FLINTOFT, V., *et al.* (2003), "CCORT/CCS quality indicators for congestive heart failure care" *Canadian Journal of Cardiology*, Vol.19, pp.357-364.

LINDSAY, J. JR., REDDY, V.M., PINNOW, E.E., *et al.* (1994), "Morbidity and mortality rates in elderly patients undergoing percutaneous coronary transluminal angioplasty" *American Heart Journal*, Vol.128 (4), pp.697-702.

The LONG TERM INTERVENTION WITH PRAVASTATIN IN ISCHEMIC DISEASE (LIPID) STUDY GROUP (1998), "Prevention of Cardiovascular Events and Death with Pravastatin in Patients with Coronary Heart Disease and a Broad Range of Initial Cholesterol Levels" *N Engl J Med*, Vol.339(19), pp.1349-57

MACHIRAJU, V.R. (2002), "How to avoid problems in redo coronary artery bypass" *Journal of Cardiac Surgery*, Vol.17(1), pp.20-25.

MALENKA, D.J., O'ROURKE, D., MILLER, M.A., *et al.* (1999), "Cause of in-hospital death in 12,232 consecutive patients undergoing percutaneous transluminal coronary angioplasty. Northern New England Cardiovascular Disease Study Group" *American Heart Journal*, Vol.137 (4pt1), pp.582-4.

MATHERS, C. and PENM, R. (1999), "Health system costs of cardiovascular diseases and diabetes in Australia 1993-94" AIHW Cat No. HWE11, Canberra: AIHW.

MERLO, C., AIDALA, E., LA SCALA, E., *et al.* (2001), "Mortality and morbidity in reoperation comparing to first intervention in coronary revascularisation" *J Cardiovascular Surgery (Torino)*, Vol.42(6), pp.713-7.

MIAMI TRIAL RESEARCH GROUP (1985), "Metoprolol in Acute Myocardial Infarction (MIAMI): a randomised placebo-controlled international trial" *European Heart Journal*,Vol.6, pp.199-226.

MOISE, P. and JACOBZONE, S. (2003), "OECD study of cross-national differences in the treatment, costs and outcomes of ischemic heart disease." OECD Health Working Papers No 3. Paris: OECD.

MOSS, A.J. and BENHORIN, J. (1990), "Prognosis and management after a first myocardial infarction" *N Engl J Med*, Vol.322, pp.743-753.

NATIONAL CHOLESTEROL EDUCATION PROGRAM (NCEP) (1994), "Second Report of the Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel II)" *Circulation*, Vol.89, pp.1333-1445.

NATIONAL HEART FOUNDATION OF AUSTRALIA (NHFA) (2004), www.heartfoundation.com.au, accessed 23/6/2004

The NATIONAL INSTITUTE FOR CLINICAL EXCELLENCE (NICE) (2003), "Coronary artery stents: rapid systematic review & economic evaluation" Liverpool, United Kingdom, February.

NATIONAL INSTITUTE OF CLINICAL STUDIES (NICS) (2004), "National Heart Failure Data Workshop" www.nicsl.com.au , accessed 23/6/04

NEWBY, L.K., RUTSCH, W.R., CALIFF, R.M., *et al.* (1996), "Time From Symptom Onset to Treatment and Outcomes After Thrombolytic Therapy" *Journal of the American College of Cardiology*, Vol.27(7), pp.1646-1655.

NG, W.K., VEDDER, M., WHITLOCK, R.M., *et al*. (1997), "Coronary revascularisation in young adults" *European Journal of Cardiothoracic Surgery*, Vol.11(4), pp.732-8.

NORWEIGIAN MULTICENTER STUDY GROUP (NMSG) (1981), "Timolol-induced reduction in mortality and reinfarction in patients surviving acute myocardial infarction" *N Engl J Med*, Vol.304, pp. 801-807.

O'CONNOR, G.T., PLUME, S.K., OLMSTEAD, E.M., *et al.* (1992), "Multivariate prediction of in-hospital mortality associated with coronary artery bypass graft surgery. Northern New England Cardiovascular Disease Study Group" *Circulation*, Vol.85(6), pp.2110-8.

O'CONNOR, G.T., BIRKMEYER, J.D., DACEY, L.J., *et al.*(1998), "Results of a regional study of modes of death associated with coronary artery bypass grafting. Northern New England Cardiovascular Disease Study Group" *Annals Thoracic Surgery*, Vol.(66)4, pp.1323-8.

O'CONNOR, G.T., MALENKA, D.J., QUINTON, H., *et al.* (1999), "Multivariate prediction of in-hospital mortality after percutaneous coronary interventions in 1994-1996. Northern England Cardiovascular Disease Study Group" *Journal of American College Cardiology*, Vol.34(3), pp.681-91.

OECD (2003), Health Data 2003.

PASQUALI, S.K., ALEXANDER, K.P., COOMBS, L.P., *et al*. (2003), "Effect of cardiac rehabilitation on functional outcomes after coronary artery revascularization" American Heart Journal, Vol.145(3), pp.445-51.

PEDERSEN, T.R. (1985), "Six year follow-up of the Norwegian Multicenter Study on Timolol after Myocardial Infarction" *N Engl J Med*, Vol.313, pp.1055-1058.

PFEFFER, M.A., BRAUNWALD, E., MOYE, L.A., *et al.* (1992), on behalf of the SAVE Investigators, "Effect of captopril on mortality and morbidity in patients with left ventricular dysfunction after myocardial infarction. Results of the survival and ventricular enlargement trial" *N Engl J Med*, Vol.327, pp.669-677.

POYEN, V., SILVESTRI, M., LABRUNIE, P., and VALEIX, B. (2003), "Indications of coronary angioplasty and stenting in 2003 what is left to surgery?" *Journal Cardiovascular Surgery (Torino)*, Vol.44(3), pp.307-12.

PRABHAKAR, G., HAAN, C.K., PETERSON, E.D., *et al.*(2002), "The risks of moderate and extreme obesity for coronary artery bypass grafting outcomes: a study from the Society of Thoracic Surgeon's database" *Ann Thoracic Surgery*, Vol.74(4), pp.1125-30, discussion 1130-1.

QUEIROS, M.C., PINTO, P.F., SILVA, J.C., *et al*. (2000), "Determinants of in-hospital mortality in women with acute myocardial infarction who underwent primary coronary angioplasty" *Rev Port Cardiol*, Vol.19(11), pp.1157-61.

ROBERTS, R., ROGERS, W.J., MUELLER H.S., *et al*. (1991), "Immediate versus deferred beta-blockade following thrombolytic therapy in patients with acute myocardial infarction: results of the Thrombolysis in Myocardial Infarction (TIMI) II-B Study" *Circulation*, Vol.83, pp.422-437.

ROSAMOND, W.D., CHAMBLESS, L.E., FOLSOM, A.R., *et al.* (1998), "Trends in the incidence of myocardial infarction and in mortality due to coronary heart disease, 1987 to 1994" *New England Journal of Medicine*, Vol. 339, pp.861-867.

ROSENTHAL, G.E., VAUGHAN SARRAZIN, M., and HANNAN E.L. (2003), "In-hospital mortality following coronary artery bypass graft surgery in Veterans Health Administration and private sector hospitals" *Med Care*, Vol.41(4), pp.522-35.

RYAN, R.J., ANTMAN, E.M, BROOKS, N.H., *et al*. (1999), "Update: ACC/AHA Guidelines for the Management of Patients with Acute Myocardial Infarction. A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee on Management of Acute Myocardial Infarction)" *J American College of Cardiology*, Vol.34, pp.890-911.

RYAN, R.J., ANTMAN, E.M, BROOKS, N.H., *et al*. (1999a), "Update: ACC/AHA Guidelines for the Management of Patients with Acute Myocardial Infarction: Executive Summary and Recommendations: A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee on Management of Acute Myocardial Infarction)" *Circulation*, Vol.100(9), pp.1016-1030.

SADEGHI, N., SADEGHI, S., MOOD, Z.A., KARIMI, A. (2002), "Determinants of operative mortality following primary coronary artery bypass surgery" *European Journal of Cardiothoracic Surgery*, Vol.21(2), pp.187-92.

SANS, S., LESTELOOT, H., and KROMHOUT, D., on behalf of the Task Force (1997), "The burden on cardiovascular disease mortality in Europe, Task Force of the European Society of Cardiology on Cardiovascular Mortality and Morbidity Statistics in Europe" *Eur Heart J*, Vol.18, pp.1231-48.

SCANDINAVIAN SIMVASTATIN SURVIVAL STUDY GROUP (SSSS) (1994), "Randomised trial of cholesterol lowering in 4444 patients with coronary heart disease: the Scandinavian Simvastatin Survival Study (4S)" *Lancet*, Vol.344, pp.1383-1389.

SECOND INTERNATIONAL STUDY OF INFARCTION SURVIVAL (ISIS-2) COLLABORATIVE GROUP (1988), "Randomised trial of intravenous streptokinase, oral aspirin, both, or neither among 17,187 cases of suspected acute myocardial infarction: ISIS-2" *Lancet* , Vol.2(8607), pp.349-360.

SHIMADA, Y., DIXIT, A., FERMANIS, and G., HORTON, D. (1998), "Reoperation for recurrent coronary artery disease: results of consecutive cases" *Australian NZ Journal of Surgery*, Vol.68 (10), pp.729-34.

SHUBROOKS, S.J. JR., NESTO, R.W., LEEMAN, D., *et al.* (2001), "Urgent coronary bypass surgery for failed percutaneous coronary intervention in the stent era: Is back up still necessary?" *American Heart Journal*, Vol.42(1), pp.190-6.

SIGN: Scottish Intercollegiate Guidelines Network (1998), "Coronary Revascularization in the management of stable angina pectoris. A National Clinical Guideline" November.

SIMCHEN, E., GALAI, N., BRAUN, D., *et al.* (2001), "ISCAB Consortium Socio-demographic and clinical factors associated with low quality of life one year after coronary bypass operations: The Israeli coronary artery bypass study (ISCAB)" *Journal of Thoracic Cardiovascular Surgery*, Vol.121(5), pp.909-19.

TU, J.V., and NAYLOR, C.D. (1996), "Coronary artery bypass mortality rates in Ontario. A Canadian approach to quality assurance in cardiac surgery. Steering Committee of the Provincial Adult Cardiac Care Network of Ontario" *Circulation*, Vol.94(10), pp.2429-33.

TUNSTALL-PEDOE, H., VANUZZO, D., HOBBS, M., *et al.* (2000), "Estimation of contribution of changes in coronary care to improving survival, event rates, and coronary heart disease mortality across the WHO MONICA Project populations" *Lancet*, Vol.355, pp.688-700.

VAN BRUSSEL, B.L., ERNST, J.M., ERNST, N.M., *et al.* (1997), "Clinical outcome in venous coronary artery bypass grafting: year follow-up study" *International Journal of Cardiology*, Vol.58(2), pp.119-26.

VAN DOMBURG, R.T., TAKKENBERG, J.J., VAN HERWERDEN, L.A., *et al*. (2002), "Short-term and 5-year outcome after primary isolated coronary artery bypass graft surgery: results of risk stratification in a bilocation centre" *European Journal Cardiothoracic Surgery*, Vol,21(4), pp.733-40.

VAN ECK, F.M., NOYEZ, L., VERHEUGT, F.W., and BROUWER, R.M. (2002) "Analysis of mortality within the first six months after coronary reoperation" *Annals Thoracic Surgery*, Vol.74(6), pp.2106-12.

VANUZZO, D., PILOTTO, L., AMBROSIO, G.B., *et al*. (2000), "Potential for cholesterol lowering in secondary prevention of coronary heart disease in Europe. Findings from the EUROASPIRE study" *Atherosclerosis*, Vol.153, pp.505-517.

VENTURINI, F., ROMERO, M., and TOGNONI, G. (1999), "Patterns of practice for acute myocardial infarction in a population from ten countries" *Eur J Clin Pharmacol*, Vol,54(11), pp.877-886.

WATANABE, C.T., MAYNARD, C., and RITCHIE, J.L. (2001), "Comparison of short-term outcomes following coronary artery stenting in men versus women" *American Journal of Cardiology*, Vol.88(8), pp.848-52.

WELTY, F.K., LEWIS, S.M., KOWALKER, W., and SHUBROOKS, S.J. JR. (2001), "Reasons for higher in-hospital mortality >24 hours after percutaneous transluminal coronary angioplasty in women compared with men" *American Journal of Cardiology*, Vol.88(5), pp.473-7.

WENNBERG, D.E., MALENKA, D.J., SENGUPTA, A., *et al*. (1999), "Percutaneous transluminal coronary artery angioplasty in the elderly: epidemiology, clinical risk factors and in-hospital outcomes, Northern New England Cardiovascular Disease Study Group" *American Heart Journal*, Vol.137(4Pt 1): 585-7, 1999.

WHO (2002), World Health Organization Integrated Management of Cardiovascular Risk: Report of a WHO meeting Geneva, 9-12 July.

WRIGHT, D.J., FRAYSON, A.D., JACKSON, M., AND DAINTY, C. (2003), "The reality of treating dyslipidemia in patients with coronary heart disease" *Int J Clin Pract*, Vol.57(6), pp.488-91.

Available OECD Health Technical Papers

No. 1. *SHA-BASED HEALTH ACCOUNTS IN THIRTEEN OECD COUNTRIES: COUNTRY STUDIES, AUSTRALIA* Lindy Ingham, Rebecca Bennetts and Tony Hynes

No. 2. *SHA-BASED HEALTH ACCOUNTS IN THIRTEEN OECD COUNTRIES: COUNTRY STUDIES, CANADA* Gilles Fortin

No. 3. *SHA-BASED HEALTH ACCOUNTS IN THIRTEEN OECD COUNTRIES: COUNTRY STUDIES, DENMARK* Iben Kamp Nielsen

No. 4. *SHA-BASED HEALTH ACCOUNTS IN THIRTEEN OECD COUNTRIES: COUNTRY STUDIES, GERMANY* Natalie Zifonun

No. 5. *SHA-BASED HEALTH ACCOUNTS IN THIRTEEN OECD COUNTRIES: COUNTRY STUDIES, HUNGARY* Maria Manno and Mihalyne Hajdu

No. 6. *SHA-BASED HEALTH ACCOUNTS IN THIRTEEN OECD COUNTRIES: COUNTRY STUDIES, JAPAN* Hiroyuki Sakamaki, Sumie Ikezaki, Manabu Yamazaki and Koki Hayamizu

No. 7. *SHA-BASED HEALTH ACCOUNTS IN THIRTEEN OECD COUNTRIES: COUNTRY STUDIES, KOREA* Hyoung-Sun Jeong

No. 8. *SHA-BASED HEALTH ACCOUNTS IN THIRTEEN OECD COUNTRIES: COUNTRY STUDIES, MEXICO* María-Fernanda Merino-Juárez, Maluin-Gabriela Alarcón-Gómez and Rafael Lozano-Ascencio

No. 9. *SHA-BASED HEALTH ACCOUNTS IN THIRTEEN OECD COUNTRIES: COUNTRY STUDIES, THE NETHERLANDS* Cor van Mosseveld

No. 10. *SHA-BASED HEALTH ACCOUNTS IN THIRTEEN OECD COUNTRIES: COUNTRY STUDIES, POLAND* Dorota Kawiorska

No. 11. *SHA-BASED HEALTH ACCOUNTS IN THIRTEEN OECD COUNTRIES: COUNTRY STUDIES, SPAIN,* Jorge Relaño Toledano and María Luisa García Calatayud

No. 12. *SHA-BASED HEALTH ACCOUNTS IN THIRTEEN OECD COUNTRIES: COUNTRY STUDIES, SWITZERLAND* Raymond Rossel and Yves-Alain Gerber

No. 13. *SHA-BASED HEALTH ACCOUNTS IN THIRTEEN OECD COUNTRIES: COUNTRY STUDIES, TURKEY* Mehtap Kartal, Huseyin Ozbay and Halil Erkan Eristi

No. 14. *SELECTING INDICATORS FOR THE QUALITY OF CARDIAC CARE AT THE HEALTH SYSTEMS LEVEL IN OECD COUNTRIES* Laura Lambie, Soeren Mattke and the Members of the OECD Cardiac Care Panel

No. 15. *SELECTING INDICATORS FOR THE QUALITY OF DIABETES CARE AT THE HEALTH SYSTEMS LEVEL IN OECD COUNTRIES* Sheldon Greenfield, Antonio Nicolucci and Soeren Mattke

No. 16. *SELECTING INDICATORS FOR THE QUALITY OF HEALTH PROMOTION, PREVENTION AND PRIMARY CARE AT THE HEALTH SYSTEMS LEVEL IN OECD COUNTRIES* Martin Marshall, Sheila Leatherman, Soeren Mattke and the Members of the OECD Health Promotion, Prevention and Primary Care Panel

No. 17. *SELECTING INDICATORS FOR THE QUALITY OF MENTAL HEALTH CARE AT THE HEALTH SYSTEMS LEVEL IN OECD COUNTRIES* Richard Hermann, Soeren Mattke and the Members of the OECDMental Health Care Panel

No. 18. *SELECTING INDICATORS FOR PATIENT SAFETY AT THE HEALTH SYSTEMS LEVEL IN OECD COUNTRIES* John Millar, Soeren Mattke and the Members of the OECD Patient Safety Panel

www.oecd.org/els/health/technicalpapers