

health

Outcomes

indicators

MYOCARDIAL INFARCTION

Report of a working group
to the Department of Health



FOREWORD

The Government consultation document "A First Class Service - Quality in the new NHS", published in 1998, emphasised three essential aspects of ensuring delivery of high quality of care by the National Health Service: setting, delivering and monitoring standards. It also discussed the importance of partnership between the Government and the clinical professions and patients in achieving such quality.

This series of 10 reports concerns the third aspect - monitoring standards. It represents the culmination of work that was started several years ago under the auspices of the Clinical Outcomes Group, chaired jointly by the then Chief Medical Officer, Sir Kenneth Calman, and the Chief Nursing Officer, Dame Yvonne Moores. The work was commissioned by the former Central Health Outcomes Unit of the Department of Health. The Unit has since moved and is now called the National Centre for Health Outcomes Development (NCHOD), based jointly at the Institute of Health Sciences, University of Oxford and the London School of Hygiene and Tropical Medicine, University of London.

The background to the work was the need to ensure that the NHS is driven by considerations of quality and outcome. The Department wanted to build on an earlier set of Population Health Outcome indicators, which had been limited by the constraints of existing routine data. It therefore commissioned systematic work on ten clinical topics, to be undertaken by a Working Group on each, tasked to make recommendations on 'ideal indicators' for each condition. 'Ideal indicators' were defined as statistical measures of what should be known, and realistically could be known, about the outcomes of the condition in routine clinical practice. The Groups were asked to consider a wide spectrum of possible uses of outcome indicators, from national monitoring of NHS performance by government to the periodic assessment of local services by clinicians and users.

The work of the Working Groups was coordinated by Michael Goldacre, University of Oxford. A particular feature of the work is that the Groups have recommended definitions and technical specifications for each indicator. It is hoped that people interested in monitoring the topic covered by each indicator will use the same definitions so that comparisons can be facilitated. Moreover, the methodology adopted by the Working Groups is applicable to developing health outcome indicators for many other conditions.

The publication of these reports, however, is only one further step on a long road of quality assessment in health care. The reports present 'menus' of suggestions for ways in which outcomes might be monitored in a variety of settings, by a variety of organisations and people. It goes without saying that NCHOD will welcome feedback on the reports and on the development and use of outcome indicators.

I believe that the work described here shows the value and potential of partnerships between various parties. Each working group had members who brought together perspectives of all the relevant clinical professions plus patients, NHS managers, policy makers, researchers and others as appropriate. The recommendations of the Working groups show quite clearly how these various perspectives may contribute to a broader and more balanced monitoring of standards. I would personally like to congratulate and thank everyone who has worked so hard and well to bring this initiative to fruition.

Azim Lakhani (Director - National Centre for Health Outcomes Development)

CONTRIBUTORS TO THIS REPORT

Chair: John Birkhead

Working group: Mike Bellamy, Hugh Bethell, Roger Boyle, Peter Doyle, Godfrey Fowler, David Gray, Martin Hill, Dawn Milner, Caroline Morrison, Robin Norris, Brian Pentecost, David Thompson, Robert West, Clive Watson.

Support groups: ~~Unit of Health-Care Epidemiology, University of Oxford:~~ Michael Goldacre (Project Co-ordinator), Alastair Mason, Ewan Wilkinson.
 CASPE Research, London: James Coles, Moyra Amess and Robert Cleary.

Edited by: John Birkhead, Michael Goldacre, Alastair Mason, Ewan Wilkinson, Moyra Amess and Robert Cleary for the Working Group on Outcome Indicators for Myocardial Infarction.

This report may be referenced as follows:

Birkhead J, Goldacre M, Mason A, Wilkinson E, Amess M, Cleary R (eds). **Health Outcome Indicators: Myocardial Infarction. Report of a working group to the Department of Health.** Oxford: National Centre for Health Outcomes Development, 1999.

OUTCOME INDICATORS FOR MYOCARDIAL INFARCTION

CONTENTS OF REPORT	Page
Summary of recommendations	1
Sections:	
1. Introduction to the Report	3
2. Health outcome model for myocardial infarction	5
3. Choice of candidate indicators	12
4. Candidate indicator specifications	14
5. Recommendations	67
Appendices:	
A. Background to the work	73
B. Myocardial Infarction Working Group	77
C. Definitions of myocardial infarction	78
D. Methods for choosing indicators	81
E. Guidance notes for indicator specifications	83
F. References to text and all appendices.	85

SUMMARY OF RECOMMENDATIONS

Using a variety of check lists including a health outcome model, the Group identified outcome indicators which were fully specified in a standard format and are included in this Report. Outcome indicators, whose numbers correspond to the specifications in Section 4, were grouped under four headings relating to the aim of the intervention.

Recommendations were made for each indicator using the following categories:

- A.** To be implemented generally on a routine basis.
- B.** To be implemented generally by periodic survey.
- C.** To be implemented where local circumstances allow on a routine basis.
- D.** To be implemented where local circumstances allow by periodic survey.
- E.** To be further developed either because link with effectiveness is not clear or because further work is needed on methods of measurement.

Category	Page	
		<i>Indicators related to reduction of risk of a first myocardial infarction (MI)</i>
B	16	*1A. Population-based heart attack rate for MI.
A	18	*1B. Annual hospital admission rate for all MIs.
C	20	1C. Annual hospital admission rate for first-ever MIs.
D	22	2. Percentage of people who report having ceased smoking in the given year.
D	24	3. Mean systolic blood pressure in persons aged 16 and over.
C	26	4. Percentage of general practice patients, identified as hypertensive, whose most recent systolic blood pressure measurement is less than 160 mm Hg.
C	28	5A. Percentage of general practice patients, identified as at high risk of coronary heart disease in the given year.
C	33	5B. Summary of twelve month changes in the risk of coronary heart disease within a general practice population.
		<i>Indicators related to reduction of risk of death from myocardial infarction</i>
A	35	6. Population-based mortality rate from MI.
A	37	7. Case-fatality rates for patients admitted to hospital alive with a MI.
C	39	8. Proportion of patients attending hospital with MI who receive thrombolytic therapy.
C	41	9A. Time from onset of symptoms to call for help.
C	45	9B. Time from call for help to arrival at hospital.
C	48	9C. Time from arrival at hospital to administration of thrombolytic therapy.
C	51	10. Time from call for help to defibrillator availability.

Indicators related to reduction of risk of subsequent myocardial infarction or other related cardiovascular events (*see below)

- | | | |
|----------|-----------|---|
| C | 54 | 11A. Rate of in-patient admission for MI within one year of a previous hospitalised MI. |
| C | 56 | 11B. Rate of in-patient admission for selected cardiovascular conditions within one year of a previous hospitalised MI. |
| E | 58 | 12. Level of risk in respect of defined risk factors for CHD within a population of patients six months after first-ever MI. |

Indicators related to improvement of function and well-being after myocardial infarction

- | | | |
|----------|-----------|--|
| E | 61 | 13. Impact of symptoms on function within a population of patients six months after first-ever MI. |
| E | 64 | 14. Assessment of health status/quality of life within a population of patients six months after first-ever MI. |

*1A and 1B are also related to the reduction of the risk of a subsequent myocardial infarction.

1. INTRODUCTION TO THE REPORT

Health outcome indicators

- 1.1** This Report is one of a series containing the recommendations of working groups set up to develop 'ideal' indicators of the health outcomes of specific conditions. The background to the work, commissioned by the Department of Health, is summarised in Appendix A.
- 1.2** Health outcomes have been defined as changes in health, health related status or risk factors affecting health, or lack of change when change is expected. They may be the result of the natural history of the condition or may be the effect of interventions to prevent or treat it. The particular concern of the working groups has been to make recommendations about outcomes which may be attributable to interventions or the lack of them.
- 1.3** The term indicator has been defined as an aggregated statistical measure, describing a group of patients or a whole population, compiled from measures or assessments made on people in the group or the population. An indicator may not necessarily provide answers to whether care has been 'good' or 'bad'; but well chosen indicators, as the term implies, should at least provide pointers to circumstances which may be worth further investigation.
- 1.4** An 'ideal' indicator has been taken to mean what should be known, and realistically could be known, about the outcomes of the prevention and care of specific conditions. The development of the recommendations has, of course, been tempered by considerations of the likely cost and availability of information. However, the working groups have tried to be reasonably far-sighted in their views about future advances in information systems.
- 1.5** For each condition the working group has developed a menu of indicators which can be used by different groups of people for a variety of purposes. In particular, an attempt has been made to recommend, within each set, indicators which reflect a population, clinical, patient, and in relevant cases, a carer perspective.

Myocardial Infarction Working Group

- 1.6** The terms of reference and membership of the Group are shown in Appendix B. The Group included representatives of professional, managerial and patient groups involved with the prevention and treatment of myocardial infarction.

1.7 The work of the Group had three main components:

- development of check lists, including a health outcome model for myocardial infarction, to assist members choose candidate indicators, by which is meant potential indicators worth detailed consideration
- specification of candidate indicators
- recommendations about implementation and further development.

1.8 In this Report:

- the health outcome model is described in Section 2
- issues related to the definition of myocardial infarction are discussed in Appendix C
- check lists for choosing candidate indicators are outlined in Appendix D
- guidelines for specifying candidate indicators are described in Appendix E
- candidate indicators chosen for specification are listed in Section 3
- candidate indicator specifications are included in Section 4
- recommendations about implementation and development are made in Section 5
- references to all sections and appendices are in Appendix F.

Recommendations

1.9 The recommendations made by the Group were categorised as those which:

- can be implemented generally throughout the NHS as there are systems available which can provide the requisite data
- could be implemented now where local circumstances allow, and more generally in the near future once expected developments are in place
- will not be possible to implement in the near future but, because of their desirability, they should be considered in the future development of clinical and management information systems
- require further work before a recommendation can be made.

1.10 The recommendations have been further categorised as to whether the requisite indicators should be available:

- routinely on a universal and continuous basis
- from periodic surveys and/or sampling, either at different points in time nationally or in geographical areas when there is a particular need or interest.

2. HEALTH OUTCOME MODEL FOR MYOCARDIAL INFARCTION

Definition and scope of the work

2.1 The Group recognised the difficulty of recommending a single definition of myocardial infarction to meet all the purposes for which outcome information would be used. A discussion of the key issues is in Appendix C. It was agreed that the basis for the definition should be a clinical diagnosis depending on the presence of at least two of the following:

- A history of symptoms, which will usually include chest pain of greater than 20 minutes duration.
- ECG changes consisting of (i) ST segment elevation equal to or greater than 1mV in two standard leads and/or equal to or greater than 2mV in two or more contiguous chest leads, and or the development of new Q waves, or (ii) new left bundle branch block.
- Increased activity of cardiac enzymes (lactate dehydrogenase, aspartate transaminase or creatinine kinase total) to more than twice the normal upper limit.

The Group decided to exclude unstable angina.

2.2 Using a definition based on standardised clinical criteria will underestimate significantly the true incidence of myocardial infarction as it does not include people:

- with a post-mortem diagnosis only
- who die suddenly without a post-mortem but who have had symptoms and a history of heart disease
- with a post-mortem diagnosis of acute or chronic myocardial ischaemia
- with a post-mortem diagnosis of coronary disease but no acute syndrome.

2.3 The definitions used in specifying the candidate indicators are:

- Standardised clinical criteria as in paragraph 2.1.
- Standardised clinical criteria with, in addition:
 - patients diagnosed by a GP as having had a myocardial infarction
 - patients who have died suddenly from a myocardial infarction.
- Standardised clinical criteria with, in addition:
 - patients who were admitted to and have died in an accident and emergency department from a myocardial infarction.

Developing a health outcome model

2.4 The greater part of the input to the development of the myocardial infarction model has been summarised from already published work including:

- *Coronary heart disease : an epidemiological overview* published by the Central Health Monitoring Unit (Department of Health 1994).
- *An epidemiologically based needs assessment review of coronary heart disease*. This was one of the 19 reviews commissioned by the Department of Health (Langham et al. 1994).
- *A systematic literature review of the evidence of effectiveness of interventions for secondary prevention and treatment of coronary heart disease in primary care* (Moher 1995).
- *Acute myocardial infarction: pre-hospital and in-hospital management, guidelines* produced by the Task Force on the management of acute myocardial infarction of the European Society of Cardiology (1996).

2.5 The health outcome model was developed as an aid to help Group members to identify potential indicators. The model contains four elements:

- overview of the occurrence of the disease in England
- review of the causes and risk factors
- review of the course, complications and consequences
- review of relevant interventions.

Overview of the occurrence in England

2.6 The overall incidence of myocardial infarction in general practice is estimated to be 2.6 per 1000 population per year. Myocardial infarction is currently three to four times more frequent in men than women when comparing men and women of comparable age.

2.7 In 1990 Coronary Heart Disease (CHD) accounted for 30% of male and 23% of female deaths and 79% of the male deaths from CHD and 93% of female deaths from CHD occurred over the age of 65. Nevertheless, CHD accounted for 40% of male deaths under 65 years and 19% of female deaths. It should be noted that:

- Mortality rates in England from myocardial infarction are higher:
 - in social class V than in social class I
 - in those living in the north of England than in the south
 - in those born in the Indian sub-continent than those born in England.
- England and the other parts of the UK have some of the highest standardised mortality rates for coronary heart disease in Western Europe. These have been declining gradually over the last twenty years.

Cause and risk factors

- 2.8** In myocardial infarction the underlying pathology is coronary artery plaque rupture and thrombolytic occlusion causing obstruction of the coronary artery blood flow. The odds ratio associated with some of the risk factors for myocardial infarction are shown in Exhibit 1, expressed as how many more times likely it is that someone with a risk factor will have a myocardial infarction compared to the individual without it.
- 2.9** Some risk factors are unalterable. These include age and family history of heart disease. The main modifiable risk factors are cigarette smoking, raised blood pressure, elevated serum cholesterol, inappropriate dietary intake, physical inactivity and obesity. When combined these interact with each other. Other factors which may need to be considered include excessive alcohol consumption, glucose intolerance and psycho-social stress.
- 2.10** Current smokers are more likely than non smokers to have a myocardial infarction. This risk gradually reduces on stopping smoking and returns to normal after three to ten years.

EXHIBIT 1 : SUMMARY OF RISK FACTORS FOR ALL CHD EVENTS IN MEN AND WOMEN AGE 40 TO 59 FROM THE SCOTTISH HEART HEALTH STUDY FOLLOW UP (Tunstall-Pedoe et al. 1996).

Risk factors	Odds ratio
	Men
Serum total cholesterol < 5.4 v > 7.3 mmol/l	3.6
Systolic blood pressure < 119 v > 149 mm Hg	2.5
Diastolic blood pressure < 74 v > 95 mm Hg	2.4
Body mass index < 23.3 v > 28.7	2.1
Cigarette smoking - never smoked v current smoker at screening	2.1
Diabetes diagnosed at initial screening	1.4
Serum HDL cholesterol < 1.7 v > 1.6 mmol/l	0.4
	Women
Risk factors	Odds ratio
	Women
Serum total cholesterol < 5.5 v > 7.6 mmol/l	5.2
Diabetes diagnosed at initial screening	3.7
Cigarette smoking - never smoked v current smoker at screening	2.8
Systolic blood pressure < 114 v > 148 mm Hg	2.8
Diastolic blood pressure < 71 v > 90 mm Hg	1.8
Body mass index < 22.1 v > 28.9	1.4
Serum HDL cholesterol < 1.3 v > 2.0 mmol/l	0.2

Course, complications and consequences

2.11 Of those who die of myocardial infarction, 33% of males and 25 % of females between 25 and 64 years old die within one hour of onset of symptoms.

2.12 About 20-25% of all patients admitted to hospital with acute myocardial infarction die within 30 days. Thirty day survival after recognised acute myocardial infarction in all patients, including those admitted to hospital and those not, is about 50%. Case fatality increases with age.

2.13 The risk of myocardial infarction is three to eight times higher in those who have already had an infarct than in those who have not.

2.14 A poor prognosis after myocardial infarction is associated with:

- continued smoking
- greater age
- cardiac failure
- a low left ventricular ejection fraction
- frequent ventricular extra systoles (more than 10 per hour)
- post-infarction angina
- co-existing conditions such as diabetes and depression.

2.15 A better prognosis is associated with:

- young age
- good residual left ventricular function
- a normal post-infarction exercise test.

Relevant interventions

2.16 The Group reviewed the relevant interventions for myocardial infarction using the following classification of interventions aimed to :

- reduce the risk of a first myocardial infarction
- reduce the risk of death from myocardial infarction
- reduce the risk of subsequent myocardial infarction or other related cardiovascular events
- improve function and well-being after myocardial infarction.

2.17 The main interventions that may **reduce the risk of a first myocardial infarction** are:

- Behavioural:
 - stopping smoking
 - altering the diet to increase consumption of oil-rich fish, fresh fruit and fresh or frozen vegetables and changing from saturated to polyunsaturated fats where possible and reducing total fat intake
 - increasing physical activity
 - avoidance of obesity
 - consumption of only moderate amounts of alcohol.
- Behavioural and pharmacological:
 - detection and lowering of raised serum cholesterol levels
 - detection and lowering of high blood pressure.

2.18 Smoking cessation has been shown to be the single most important factor in reducing CHD. This and the management of diet, exercise, obesity and alcohol consumption are discussed in the Health of the Nation documents (Department of Health 1992) and will not be considered further here.

2.19 A prolonged reduction of diastolic blood pressure by at least 6 mm mercury reduces the risk of stroke by 42% and that of fatal or non-fatal myocardial infarction by 14%.

2.20 Dietary treatment should be the cornerstone of cholesterol lowering, especially in primary prevention of CHD. Some individuals with other risk factors will also require drug treatment. In those with hypercholesteraemia, reduction of the cholesterol level using drugs within a trial context reduces fatal and non fatal myocardial infarctions by 25-30%.

2.21 Surgical management of chronic stable angina is more effective than medical management for left main stem disease and three vessel disease (five year survival 88% v 63%) and probably for two vessel disease (five year survival 92% v 82%). Anti-platelet therapy reduces the number of re-occlusions following surgery (CASS 1983).

2.22 Interventions employed in the acute stage to **reduce the risk of death** are :

- early access to defibrillation
- thrombolysis
- aspirin, ACE inhibitors and beta blockers.

2.23 Early access to effective resuscitation including defibrillation for potentially lethal ventricular dysrhythmias reduces 30 day mortality from myocardial infarction (UKHAS Collaboration Group 1998).

2.24 Thrombolytic therapy in patients without contraindications reduces mortality (Boersma et al. 1996) by about:

- 65 deaths per 1,000 patients if given within one hour of the onset of symptoms
- 35 deaths per 1,000 patients if given within one to three hours
- 30 deaths per 1,000 patients if given within three to six hours
- 20 deaths per 1,000 patients if given within six to twelve hours.

2.25 For the other drugs, clinical trial evidence is as follows:

- Aspirin following acute myocardial infarction reduces 35 day mortality by about 25 per 1,000 patients. This effect is in addition to the effect of thrombolytic agents. Lifelong treatment may be beneficial unless there are contra-indications (ISIS 1988).
- ACE inhibitors reduce mortality in patients with overt left ventricular dysfunction post-infarction by about 60 deaths per 1,000 patients when started between day three and ten after the infarction and continued for a minimum of six months (AIRE 1993).
- Intravenous beta blockers following myocardial infarction reduce mortality by 13% in the first week by decreasing the incidence of cardiac rupture (ISIS 1986).
- Oral beta blockers reduce morbidity and mortality following infarction with the greatest benefit in patients with evidence of left ventricular dysfunction (Yusuf et al. 1985).

2.26 The main interventions that may **reduce the risk of a subsequent myocardial infarction or other related cardiovascular events** and **improve function and well-being after myocardial infarction** are:

- Educational and behavioural:
 - information about appropriate behaviour, the diagnosis and its implications, medication and its effects, and available support when needed
 - stopping smoking
 - altering the diet to increase consumption of oil-rich fish, fresh fruit and fresh or frozen vegetables and changing from saturated to polyunsaturated fats where possible
 - increasing physical activity
 - avoidance of obesity
 - consumption of only moderate amounts of alcohol
 - psychological support and stress management.

- Behavioural and pharmacological:
 - detection and lowering of raised serum cholesterol levels
 - detection and treatment of hypertension.

- Pharmacological:
 - anti-platelet agents
 - beta blockers
 - ACE inhibitors
 - anticoagulation
 - lipid lowering.

- Surgical:
 - coronary revascularisation in selected patients.

2.27 Cardiac rehabilitation may reduce cardiovascular mortality, increase exercise tolerance and improve some, but not all, aspects of psychosocial and health-related quality of life. Though exercise training and education remain the central components of rehabilitation programmes, psychological support is important and may show both short and long term benefits. Guidelines and audit standards for cardiac rehabilitation in the UK have recently been produced and these identified three essential elements:

- the process of explanation and understanding, which should start simultaneously with the process of medical diagnosis and management
- specific rehabilitation interventions including where appropriate secondary prevention, exercise training, and psychological support, tailored to the needs of the individual patient
- long-term process of re-adaptation and re-education.

2.28 Clinical trial evidence relating to the effectiveness of the pharmacological agents is:

- Antiplatelet therapy reduces non-fatal myocardial infarction by 18/1,000, vascular deaths by 13/1,000, and non-fatal strokes by 6/1,000 (Antiplatelet Trialists Collaboration 1994).
- Beta blockers given to patients long term following myocardial infarction reduce the number of vascular events by at least 20%. These events are mainly sudden deaths but also non-fatal re-infarctions. The benefit is greatest in those who have had complicated infarcts but are no longer in heart failure or shock.
- ACE inhibitors used in patients with heart failure reduces mortality by about 40 per 1,000 patients in the year following a myocardial infarction (AIREX 1997).

- Anticoagulation long-term in low risk patients reduces the risk of re-infarction by 28/1,000, and cerebrovascular events by 31/1,000, at a cost of 10/1,000 of patients having a major bleed (ASPECT 1994).
- In those with a previous myocardial infarction, reduction of the cholesterol level using drugs reduces fatal and non fatal myocardial infarctions.

2.29 Coronary revascularisation improves survival compared to medical management in those patients with symptoms after a myocardial infarction who have three vessel disease or left main stem disease and impaired left ventricular function.

3. CHOICE OF CANDIDATE INDICATORS

3.1 To ensure that all potentially useful aspects of outcomes were considered the matrix shown in Exhibit 2 was drawn up using the following dimensions:

- aims of intervention (see paragraph 2.16)
- perspectives of measurement (see paragraph D6).

3.2 For each part of the matrix, consideration was given to possible indicators. The following paragraphs describe which indicators were chosen, grouped together by the aim of the health intervention. The numbers in the text relate to the Exhibit and to the indicator specifications in Section 4.

3.3 With respect to the **reduction of risk of a first myocardial infarction**, three candidate indicators were specified related to rates for the condition:

- 1A** : population-based heart attack rate for MI
- 1B** : annual hospital admission rate for all MIs
- 1C** : annual hospital admission rate for first-ever MIs.

3.4 Candidate indicators were specified related to the specific risk factors of smoking and raised blood pressure as follows:

- 2** : percentage of people who report having ceased smoking in the given year
- 3** : mean systolic blood pressure in persons aged 16 and over
- 4** : percentage of general practice patients, identified as hypertensive, whose most recent systolic blood pressure measurement is less than 160 mm Hg.

EXHIBIT 2: MATRIX FOR MYOCARDIAL INFARCTION OUTCOME INDICATORS

Aim of health intervention	Primary measurement perspective		
	Popn.	Clinical	Patient
*Reduce the risk of a first myocardial infarction	1A,1B,1C, 2,3,5A	4,5B	
*Reduce the risk of death from myocardial infarction	6	7,8,9A,9B, 9C,10	
*Reduce the risk of subsequent myocardial infarction or other related cardiovascular events		11A,11B,12	
*Improve function and well-being after myocardial infarction			13,14

3.5 Two indicators which were specified related to individuals identified as at high risk of having coronary heart disease:

5A : percentage of general practice patients, identified as at high risk of coronary heart disease in the given year

5B : summary of twelve month changes in the risk of coronary heart disease within a general practice population.

3.6 With respect to the **reduction of risk of death from myocardial infarction** two candidate indicators about mortality rates were specified:

6 : population based mortality rate from MI

7 : case-fatality rates for patients admitted to hospital alive with a MI.

3.7 The importance of thrombolytic therapy and defibrillation and the speed with which these should be available were recognised in the specification of the following indicators:

8 : proportion of patients attending hospital with MI who receive thrombolytic therapy

9A : time from onset of symptoms to call for help

9B : time for call for help to arrival at hospital

9C : time from arrival at hospital to administration of thrombolytic therapy

10 : time from call for help to defibrillator availability.

3.8 Three indicators were specified with respect to the **reduction of the risk of subsequent myocardial infarction or other related cardiovascular events:**

11A : rate of in-patient admission for MI within one year of a previous hospitalised MI

11B : rate of in-patient admission for selected cardiovascular conditions within one year of a previous hospitalised MI

12 : level of risk in respect of defined risk factors for CHD within a population of patients six months after first-ever MI.

3.9 With respect to the **improvement of function and well-being after myocardial infarction** two indicators were specified:

13 : impact of symptoms on function within a population of patients six months after first-ever MI

14 : assessment of health status/quality of life within a population of patients six months after first-ever MI.

4. CANDIDATE INDICATOR SPECIFICATIONS

- 4.1** This section contains the detailed specifications of the candidate indicators chosen by the Group. They have been grouped together by their association with the types of health intervention as shown in Exhibit 2.
- 4.2** Guidance notes which explain the attributes used in these specifications are included in Appendix E.
- 4.3** The detailed work of the specifications was carried out by Moyra Amess, Robert Cleary and James Coles of CASPE Research.

Candidate indicator 1A

Characteristics

Perspective: Population
Timeframe: Cross-sectional
Outcome relationship: Direct

Title	Population-based heart attack rate for MI
Intervention aim	Reduce the risk of a first or subsequent myocardial infarction.
Definition	For a given resident population and year: <i>the total number of identified MIs in the given population and year, divided by the size of the resident population.</i> The resulting fraction, expressed as a rate per 100,000 people should be reported with its numerator both as a crude, and age-standardised figure, and by age-group and sex.
Rationale	Mortality following MI may in part represent an adverse outcome of antecedent health care or its lack. Comparisons of attack rates across local populations will reflect the combined effectiveness of health promotion, preventive care and treatment within provider units.
Potential uses	Changes over time in heart attack rates, nationally; clinical audit within primary care and in provider units.
Potential users	Commissioners and clinicians.
Possible confounders	Variability in the recording of MI on death certificates is likely to be a major confounder of this indicator.
Data sources	The indicator as defined requires information about all acute MIs. An ideal source would be a population-based register of MIs which would include all cases; i.e. those patients admitted to hospital with a MI; those given a diagnosis of MI by their GP (which did not involve a hospital admission); and those who died as a result of a MI. These data are obtainable from three sources. For hospital admissions, the data may be obtained from the health authority's copy of the CMDS for the given year identifying the number of provider spells relating to the resident population, with admission episodes with a primary, subsidiary or secondary diagnosis of acute myocardial infarction (ICD-10 I21). For MIs diagnosed by the GP, the number of GP patient records with a diagnosis of MI which occurred in the given year and were treated in the community and did not involve a hospital admission need to be identified. A general practice register of myocardial infarctions would be an ideal source to obtain accurate information and/or computerised information systems which would also yield such information. Sudden deaths from a MI must also be counted and should be obtained from death certificates for the relevant year. Care should be taken to ensure patients are not counted twice; i.e. having had a MI and then subsequently dying from it.

Data quality

Potential problems lie with the accuracy of data with respect to diagnostic information (especially co-morbidity and severity, but also with recognition of an MI having occurred) and with the accurate recording of the occurrence of an MI on the death certificate and in general practices. Identification of old MIs on CMDS records may result in over-inclusion of some cases. Equally, heart attacks occurring as a result of major trauma following a car accident may also be included. Linkage of GP records to death certificates has not been tested on any large scale although studies are commencing to investigate such possibilities (Oxford Record Linkage System, personal communication). A validation exercise conducted as part of the UK Heart Attack Study (Norris 1997) indicates that acceptably accurate population level estimates of mortality can be obtained in this way for residents under 65 - a conclusion supported by the results of the MONICA project (Tunstall-Pedoe et al. 1994). However, for those aged 65-74, the UK Heart Attack Study found evidence of significant over-recording of MI as the underlying cause. No data are available on the accuracy of recording in those 75 and over. Techniques used for the Heart Attack Study may be worth considering at a wider level.

Comments

Problems with linking data from general practice should be reduced when there is a unique identifier such as the new NHS number recorded on the death certificate. In the meantime, it may be preferable to restrict examination of case-fatality rates to those following admission to hospital (Indicator 7). Whilst accurate and consistent information from general practices is still difficult to obtain, it may only be practical to include cases from hospital and deaths as the denominator. Where the relevant information is available, it would be useful to divide the indicator into all MIs and first-ever MIs.

Further work required

None recommended.

Conclusions & priority

B - To be implemented generally by periodic survey.

References

Norris, R.M. (1997). After the infarction: current evidence-based practice. *General and Elderly Medicine*, **1**, 4-7.

Tunstall-Pedoe, H., Kuulasmaa, K., Amouyel, P., Arveiler D., Rajakangas, A.M., and Pajak, A. (1994). Myocardial infarction and coronary deaths in the World Health Organisation MONICA Project. Registration procedures, event rates, and case-fatality rates in 38 populations from 21 countries in four continents. *Circulation*, **90**, 583-612.

Candidate indicator 1B

Characteristics

Perspective: Population
Timeframe: Cross-sectional
Outcome relationship: Direct

Title	Annual hospital admission rate for all MI
Intervention aim	Reduce the risk of a first or subsequent myocardial infarction.
Definition	For a given resident population and year: <i>the number of emergency admissions to hospital with a primary diagnosis of myocardial infarction, divided by the size of the resident population.</i> The resulting fraction, expressed as a rate per 100,000 people should be reported with its numerator both as a crude, and age-standardised figure, and by age-group and sex. Where possible, such rates should also be reported by socio-economic group.
Rationale	A high incidence of hospitalised myocardial infarction could denote a lack of success in changing people's lifestyles and the management of risk factors through health promotion and other preventative programmes. For men aged 40 to 59 the British Regional Heart Study estimated an annual incidence of 62 per 10,000 for myocardial infarction and/or sudden coronary death (Shaper et al. 1985b). In a population of 100,000 with an age-sex breakdown identical to that of England it has been predicted that there will be at least 255 people presenting with an acute MI per year (Langham et al. 1994).
Potential uses	Trends over time nationally and geographical comparisons.
Potential users	Policy makers, health care commissioners and providers.
Possible confounders	Varying admission rates to hospital, particularly since the threshold for admission varies over time. Social class can confound trend data, in particular. The indicator may vary according to the availability of beds and services.
Data sources	Data may be obtained from a health authority's copy of the contract minimum data set (CMDS) which includes all relevant episodes of care provided anywhere in the country for the local resident population. The numerator is given by the number of provider spells in the CMDS of the given year, with admission episodes with a primary diagnosis of acute myocardial infarction (ICD-10 I21 and I22) and an emergency admission method. The denominator may be obtained from population estimates held by health authorities or other relevant bodies.
Data quality	The validity of this indicator is dependent on the coding of the diagnosis which may be variable.
Comments	To improve on hospitalised cases as an estimate for true incidence, GP reports of MIs either through the use of a CHD practice register or other mechanisms in general practice (such as reporting through the weekly RCGP returns service, or via spotter practices) could be used. Complementary use of Indicators 1 and 6 (population based mortality rates) may provide a more accurate estimate to reflect the incidence of MI.

Further work required Confirm the relationship of hospitalised MI to incidence of MI.

Conclusions & priority **A - To be implemented generally on a routine basis.**

References Langham, S., Norman, C., Piercy, J., and Rose, G. (1994). Coronary heart disease. In *Health care needs assessment* (ed. A. Stevens and J. Raftery) pp.341-378. Radcliffe Medical Press, Oxford.

Shaper, A.G., Pocock, S.J., Walker, M., Phillips, A.N., Whitehead, T.P., and Macfarlane, P.W. (1985b). Risk factors for ischaemic heart disease: the prospective phase of the British Regional Heart Study. *Journal of Epidemiology and Community Health*, **39**, 197-209.

Candidate indicator 1C

Characteristics

Perspective: Population
Timeframe: Cross-sectional
Outcome relationship: Direct

Title	Annual hospital admission rate for first-ever MIs
Intervention aim	Reduce the risk of a first myocardial infarction.
Definition	For a given resident population and year: <i>the number of emergency admissions to hospital with a primary diagnosis of myocardial infarction, with no record of previous MIs, divided by the size of the population of interest.</i> The resulting fraction, expressed as a rate per 100,000 people should be reported with its numerator both as a crude, and age-standardised figure, and by age-group and sex. Where possible, such rates should also be reported by socio-economic group.
Rationale	A high incidence of hospitalised myocardial infarction could denote a lack of success in changing people's lifestyle and the management of risk factors through health promotion and other preventative programmes. For men aged 40 to 59 the British Regional Heart Study estimated an annual incidence of 62 per 10,000 for myocardial infarction and/or sudden coronary death (Shaper et al. 1985b). In a population of 100,000 with an age-sex breakdown identical to that of England it has been predicted that there will be at least 255 people presenting with an acute MI per year (Langham et al. 1994).
Potential uses	Trends over time nationally and geographical comparisons.
Potential users	Policy makers, health care commissioners and providers.
Possible confounders	Varying admission rates to hospital, particularly since the threshold for admission varies over time. Social class can confound trend data, in particular.
Data sources	Data may be obtained from a health authority's copy of the contract minimum data set which includes all relevant episodes provided anywhere in the country for the total resident population. The numerator is the number of provider spells in the CMDS of the given year, which include admission episodes with a primary diagnosis of acute myocardial infarction (ICD-10 I21) and an emergency admission method but which have no record of an 'old myocardial infarction' (ICD-10 I25.2). The denominator may be obtained from population estimates held by health authorities or other relevant bodies.
Data quality	The validity of this indicator is dependent on the reliability of inclusion of previous MIs in patient records. The quality of documentation for, and accuracy of coding previous events will be variable. To ensure patients who have had a previous MI are excluded, a manual review of the notes of all patients admitted for MI would need to be undertaken to identify any reference to previous MIs in their clinical history.

A significant number of myocardial infarcts are silent, thus some infarcts thought to be initial are in fact subsequent infarcts. This should be taken into account when interpreting the indicator.

Comments

To improve on hospitalised cases as an estimate for true incidence, GP reports of MIs either through the use of a CHD practice register or other mechanisms in general practice (such as reporting through the weekly RCGP returns service, or via spotter practices) could be used. Complementary use of Indicators 1 and 6 (population based mortality rates) may provide a more accurate estimate to reflect the incidence of MI.

Further work required

Investigation of the extent to which old myocardial infarctions are coded as a diagnosis on records of patients admitted with a second or subsequent MI. Confirm the relationship of hospitalised first MI to incidence of first MI, bearing in mind the occurrence of silent infarcts.

Conclusions & priority

C - To be implemented where local circumstances allow on a routine basis.

References

Langham, S., Norman, C., Piercy, J., and Rose, G. (1994). Coronary heart disease. In *Health care needs assessment* (ed. A. Stevens and J. Raftery) pp.341-378. Radcliffe Medical Press, Oxford.

Shaper, A.G., Pocock, S.J., Walker, M., Phillips, A.N., Whitehead, T.P., and Macfarlane, P.W. (1985b). Risk factors for ischaemic heart disease: the prospective phase of the British Regional Heart Study. *Journal of Epidemiology and Community Health*, **39**, 197-209.

Candidate indicator 2

Characteristics

Perspective: Population
Timeframe: Cross-sectional
Outcome relationship: Direct

Title	Percentage of people who report having ceased smoking in the given year
Intervention aim	Reduce the risk of a first myocardial infarction.
Definition	For a given population and year: <i>the number of people who report having ceased smoking in the given year, divided by the total number of smokers at the start of the given year.</i> The resulting fraction should be expressed as a percentage and reported together with its numerator and denominator, by patient age-group and sex.
Rationale	Smoking is a strong risk factor for a first myocardial infarction and for fatal and non-fatal recurrences. The Government Green Paper 'Our Healthier Nation' (Department of Health 1998) has suggested a target to reduce the death rate from heart disease, stroke and related illnesses amongst people under 65 by at least a further third by 2010 from a baseline at 1996. Although there is not a specific target for reducing the prevalence of cigarette smoking, a number of measures to extend downward pressure on prevalence are proposed. Monitoring and addressing this important risk factor may contribute to a reduction in the incidence of MI in the long term and help in the evaluation of health education and promotion programmes.
Potential uses	Monitoring impact of preventive measures, trends over time; HA and other population based comparisons.
Potential users	Policy-makers, clinicians, health care commissioners and providers.
Possible confounders	Self-reporting of smoking habits is notoriously unreliable. However, unless known biases exist, unreliable responses are likely to occur at random through the population and over time. Biochemical measurements could be used to validate patient responses, but these are likely to be considered too intrusive.
Data sources	The Health Survey for England, using the same questions as the biennial General Household Survey but in a different context, has been carried out on behalf of the Department of Health since 1991 and is designed to monitor trends in the nation's health. The national annual survey (1991-5) asks questions on smoking, providing population based trends in the prevalence of smoking. Data on smoking should be collected by survey, possibly annually through the application of questions as used in the Health Survey for England 1995 (by interview for aged 18+; and self completion booklet for 16 and 17 year olds). Questions included in the young adults booklet are "Have you ever smoked a cigarette?" and "Do you smoke cigarettes nowadays?". Questions included in the adult interview schedule were "Have you ever smoked cigarettes?" and a further question asks "How long ago did you stop smoking cigarettes?" Further questions in the survey would allow greater detail regarding differences between regular and occasional smokers (Primatesta and Prescott-Clarke 1997). This method could also be used for local surveys of GP

populations, with the statistics produced from the national survey being invaluable for GPs to benchmark their own data. Alternatively, the Read coding system codes 'current smoker' as Va28x and 'current non-smoker' as 137L if monitoring a GP practice population (NHS Centre for Coding and Classification 1997).

Data quality	As mentioned above, self-reporting of smoking habits can vary in its reliability. The correct interpretation of trends and/or comparative data will depend on the validity of the assumption that the degree of reliability is consistent.
Comments	No specific points.
Further work required	None recommended.
Conclusions & priority	D - To be implemented where local circumstances allow by periodic survey.
References	<p>Department of Health (1998). <i>Our healthier nation</i>. The Stationery Office, London.</p> <p>NHS Centre for Coding and Classification (1997). <i>The Read Codes October 1997 Demonstrators</i>. NHS Executive, Leeds.</p> <p>Primatesta P., and Prescott-Clarke, P. (1997). <i>Health Survey for England 1995</i>. Joint Health Surveys Unit, SCPR and Dept of Epidemiology and Public Health, University College, London.</p> <p>Shaper, A.G., Pocock, S.J., Walker, M., Phillips, A.N., Whitehead, T.P., and Macfarlane, P.W. (1985b). Risk factors for ischaemic heart disease: the prospective phase of the British Regional Heart Study. <i>Journal of Epidemiology and Community Health</i>, 39, 197-209.</p>

Candidate indicator 3

Characteristics

Perspective: Population
Timeframe: Cross-sectional
Outcome relationship: Direct

Title	Mean systolic blood pressure in persons aged 16 and over
Intervention aim	Reduce the risk of a first myocardial infarction.
Definition	For a given population and year: <i>the mean systolic blood pressure: mean of second and third systolic readings taken using a sphygmomanometer then averaged over the whole population measured within the given year.</i> These statistics, with the associated number of cases, should be reported by patient age-band and sex.
Rationale	Significant public health gains would be expected from reducing the average blood pressure level of the whole population, and from the detection and appropriate treatment of raised blood pressure in individuals (Department of Health 1992). For the majority of individuals, whether conventionally 'normotensive' or 'hypertensive', it has been concluded that a lower blood pressure should confer a lower risk of coronary heart disease (Department of Health 1992). A prolonged reduction of diastolic blood pressure by at least 6 mm mercury reduces the risk of fatal and non-fatal myocardial infarction by 14% (Collins et al. 1990). As well as screening for patients with raised blood pressure within the local population, this indicator will facilitate action towards the achievement of the proposed 'Our Healthier Nation' (Department of Health 1998) overall target on heart disease and stroke.
Potential uses	National and local monitoring.
Potential users	Policy makers, clinicians, commissioners.
Possible confounders	Because the denominator for this indicator is all of the population for whom a measurement was taken, the indicator will be influenced by the mix of patients recorded and hence by any selection bias.
Data sources	<p>Prior to October 1st 1996, the GMSC health promotion programme package (bands II and III) required the recording of blood pressure of the practice population. Targets of 90% coverage were achieved after five years of running the programme (General Medical Services Committee 1993). Although this data collection is no longer compulsory (NHS Executive 1996), the inclusion of monitoring of this nature is encouraged within the locally specified programmes which have now replaced it.</p> <p>The Health Survey for England currently collects information on the distribution of blood pressure at a national level and reports this indicator by age and sex, social class and region (Prescott-Clarke and Primatesta 1997). However, the use of this indicator locally at a practice level is also encouraged. This should be feasible for general practices with computerised records. Read codes (used within computerised systems) exist for BP screening for example, first call (90D1), check that the BP was measured (901A) and the systolic blood pressure itself (X779Q) (NHS Centre for</p>

Coding and Classification 1996) so allowing the recording of the actual mean systolic blood pressure of the population where recordings are available and the proportion of the GP population for which recordings are available.

Data quality

Accuracy of data in general practices will depend on the quality of data yielded by the new health promotion programmes and that kept by individual practices with computerised systems. Although there are no requirements to monitor the quality of this data, some individual HAs are considering the introduction of local checks to assess the accuracy and validity of the data.

Comments

There should be local encouragement for general practices to continue to monitor blood pressure as part of their health promotion programme. As well as monitoring change at a population level, data collected to derive the indicator could be used to look at changes in blood pressure within individuals.

Further work required

None recommended.

Conclusion & priority

D - To be implemented where local circumstances allow by periodic survey. There should also be periodic national surveys.

References

Collins, R., Peto, R., MacMahon, S., Hebert, P., Fiebach, N.H., Eberlein, K.A., Godwin, J., Qizilbash, N., Taylor, J.O., and Hennekens, C.H. (1990). Blood pressure, stroke and coronary heart disease. Part 2, short-term reductions in blood pressure: overview of randomised drug trials in their epidemiological context. *Lancet*, **335**, 827-838.

Department of Health (1992). *Health of the nation: a strategy for health in England*. HMSO, London.

Department of Health (1998). *Our healthier nation*. The Stationery Office, London.

General Medical Services Committee (1993). *The new health promotion package*. BMA, London.

NHS Executive (1996). *GP health promotion*. FHSL (96) 35. NHS Executive, Leeds.

NHS Centre for Coding and Classification (1996). *The Read Codes October 1996 Demonstrators*. NHS Executive, Leeds.

Prescott-Clarke, P., and Primatesta, P. (1997). *Health Survey for England 1995*. Joint Health Surveys Unit, SPCR and Department of Epidemiology and Public Health, University College, London.

Candidate indicator 4

Characteristics

Perspective: Clinical

Timeframe: Cross-sectional

Outcome relationship: Direct

Title	Percentage of general practice patients, identified as hypertensive, whose most recent systolic BP measurement is less than 160 mm Hg
Intervention aim	Reduce the risk of a first myocardial infarction.
Definition	For a given general practice population and year: <i>the number of patients previously diagnosed as hypertensive, whose most recent systolic blood pressure measurement in the previous six months is less than 160 mm Hg, divided by the number of patients previously diagnosed as hypertensive.</i> The resulting fraction should be expressed as a percentage and reported together with both its numerator and denominator, by patient age-group and sex. The proportion of patients who have a BP recording available from the previous six months should also be reported.
Rationale	<p>Raised blood pressure, both systolic and diastolic, is a significant risk factor for MI. An overview of trials indicates a highly significant reduction in CHD with blood pressure reduction (MacMahon et al. 1990).</p> <p>The indicator is defined in terms of patients previously identified (within their GP records) as hypertensive, because continued blood pressure monitoring is considered appropriate in such cases. The specification is such that if those who have previously been identified as hypertensive have not subsequently had their blood pressure checked and recorded within the following six months, this scores against the indicator i.e. suggesting this is inadequate care. However, the proportion of patients identified as hypertensive without a blood pressure recording should be reported separately to allow the distinction to be made between this latter group and those with a blood pressure over 160 mm Hg.</p> <p>The indicator assumes a definition of hypertension to be have been made on the basis of a series of systolic blood pressure recordings of greater than 160 mm Hg.</p>
Potential uses	GP audit; national monitoring; GP provider based comparisons; HA comparisons.
Potential users	Policy makers, clinicians, commissioners.
Possible confounders	Variation in recording blood pressure within individual practices. Potential variability in the definition of hypertension should be considered when interpreting comparisons across practices.
Data sources	Prior to October 1st 1996, the GMS health promotion programme package (bands II and III) required the recording of blood pressure of the practice population. Targets of 90% coverage were achieved after five years of running the programme (General Medical Services Committee 1993). Although the data from the health promotion programmes are no longer required by the GMC (NHS Executive 1996), general practitioners are encouraged to undertake regular checks on the blood pressure of their local population.

The Health Survey for England currently collects information on the distribution of blood pressure at a national level reporting by age and sex. It also classifies adult informants into four categories; (1) Normotensive-untreated SBP < 160 mm Hg and DBP < 95 mm Hg, not currently taking any anti-hypertensive drugs; (2) Normotensive-treated SBP < 160 mm Hg and DBP < 95 mm Hg, currently taking anti-hypertensive drugs; (3) Hypertensive-treated SBP < 160 mm Hg and/or DBP < 95 mm Hg, currently taking anti-hypertensive drugs; (4) Hypertensive-untreated SBP 160 mm Hg and/or DBP < 95 mm Hg, not currently taking any anti-hypertensive drugs (Prescott-Clarke and Primatesta 1997).

The indicator is specified for use locally at a practice level but a similar classification may be helpful. This should be feasible for general practices with computerised practices. Read codes (used within computerised systems) exist for BP screening for example, first call (90D1), check that the BP was measured (901A), the systolic blood pressure itself (X779Q) and hypertension (G2...) (NHS Centre for Coding and Classification 1996).

Data quality

Accuracy of data will depend on the quality of data yielded by the new health promotion programmes and GP information systems in general.

Comments

GPs should be reminded that the national survey which records BP at a national level may offer useful background information.

GP information systems should be developed to encourage the collection of this information routinely.

Further work required

None recommended.

Conclusion & priority

C - To be implemented where local circumstances allow on a routine basis.

References

General Medical Services Committee (1993). *The new health promotion package*. BMA, London.

MacMahon, S., Peto, R., Cutler, J., Collins, R., Sorlie, P., Neaton, J., Abbott, R., Godwin, J., Dyer, A., and Stamler, J. (1990). Blood pressure, stroke and coronary heart disease. Part 1, prolonged differences in blood pressure: prospective observational studies corrected for the regression dilution bias. *Lancet*, **335**, 765-774.

NHS Executive (1996). *GP health promotion*. FHSL (96) 35. NHS Executive, Leeds.

NHS Centre for Coding and Classification (1996). *The Read Codes October 1996 Demonstrators*, NHS Executive, Leeds.

Prescott-Clarke, P., and Primatesta, P. (1997). *Health Survey for England 1995*. Joint Health Surveys Unit, SPCR and Department of Epidemiology and Public Health, University College, London.

Candidate indicator 5A

Characteristics

Perspective: Clinical
Timeframe: Cross-sectional
Outcome relationship: Direct

Title **Percentage of general practice patients, identified as at high risk of coronary heart disease in the given year**

Intervention aim Reduce the risk of a first myocardial infarction.

Definition For a given general practice population and year: *the number of patients, identified as at high risk of coronary heart disease (using a risk scale to be defined) for a given year, divided by the number of patients in the general practice population.* The resulting fraction should be expressed as a percentage and reported together with both its numerator and denominator, and by patient age-group and sex. The proportion of patients within the practice population who have a risk score recorded for the given year should also be reported.

Rationale The importance of identifying populations of adults at risk of coronary heart disease in an attempt to target care and reduce the number of heart disease events (heart attacks) is emphasised by several Department of Health initiatives (Shaper et al. 1985a). A practice of 10,000 patients will have between 300 and 500 patients with established coronary heart disease (Royal College of General Practitioners et al. 1995). Accurate assessment of risk has been found to be difficult for many doctors (Grover et al. 1995) and guidelines to help practitioners undertake organised assessment and management of this large group have been called for (Moher et al. 1997). The four major modifiable risk factors for coronary heart disease were described in the Health of the Nation White Paper as cigarette smoking, raised total cholesterol, raised blood pressure and lack of physical exercise (Department of Health 1992).

Ideally, information on risk factors should be obtained for all patients within general practice populations. However, the difficulties of obtaining full coverage are recognised. To assist in comparisons the proportion of the general practice population with a risk score should be reported alongside the percentage identified as at risk from that risk score. Information on risk factors has been collected in the Health Survey for England in 1994 (Colhoun and Prescott-Clarke 1996) which provides a national picture. Local data will however be more valuable to GPs to support the health care of their local population.

Scoring systems have been designed which assess the cumulative effects of these and other risk factors for CHD and produce a 'risk' score. No single scoring system can currently be recommended so a number of instruments are offered here from which to select one for use in this indicator. They vary in that they each incorporate a slightly different group of risk factors to obtain the overall risk assessment - although the main three; smoking, blood pressure and cholesterol, are included in all. This may influence the selection choice.

This cross-sectional indicator is intended to provide an figure indicating the proportion of patients who are at risk from coronary heart disease and possible myocardial infarction in a given population. It will also provide baseline data for changes in risk status as measured by Indicator 5B.

The Sheffield Risk Table

The Sheffield table is based on a logistic regression equation predicting coronary risk derived from the Framingham population (Anderson et al. 1991a). It allows the user to identify patients at high risk according to the presence of four risk factors: hypertension, smoking, diabetes and left ventricular hypertrophy by ECG. It has been used to identify those who should have a cholesterol test and then who should then be treated if, on testing, their average cholesterol is above a certain level (Haq et al. 1995). Three different cut-off points allow a choice of definition of 'high risk'.

Dundee Coronary Risk-Disk (Tunstall-Pedoe 1991).

This simple scoring system was developed for use in general practice as a system which would put the coronary risk factors in perspective to one another and would help doctors to target for special attention those patients at highest risk, with a view to extra counselling on life-style modification. The Risk-Disk calculates two scores: a rank risk; and a relative risk score. The rank risk is 1 to 100, the nearer 1 the higher the risk and the relative risk is the risk of having a MI (on a scale of 1.5 to 50) over a five year period. The rank score is calculated from details of smoking, blood pressure and cholesterol. If a cholesterol level is not available a substitute value can be entered from population norms for cholesterol. A cut off score between 1 and 100 would need to be specified to identify the proportion of patients in a practice considered to be at high risk.

Basic GP Scoring System

This scoring system is recommended for opportunistic screening in general practice as it does not require ECG or blood cholesterol. Risk of having a heart attack is assessed using a nurse-administered questionnaire on smoking, current angina, recall of doctor giving a diagnosis of ischaemic heart disease, diabetes and cause of paternal death, plus measurements of height, weight and blood pressure (Shaper et al. 1987). Studies using this tool showed that it identified 53% of ischaemic heart disease cases - that is men who went on to experience major ischaemic heart disease over the next five years (Shaper et al. 1985). The limitation of this score tool is that it was developed for men and it has not been validated in a female population.

Coronary Risk Chart

The Coronary Risk Chart (like the Sheffield Risk Table) is also based on a risk function derived from the Framingham Study (Anderson et al. 1991b). An individual's absolute risk of developing a coronary heart disease event over the next ten years is found by reading off the appropriate box in the Chart. The factors used to assess the risk are systolic blood pressure, cholesterol level, age, sex and smoking status. A persons' relative risk can also be calculated, and other risks such as the effect of lifetime exposure to risk factors and the effect of changing cholesterol status or blood pressure can be read from the chart (Pyörälä et al. 1994).

Potential uses	GP audit; HA comparisons.
Potential users	Clinicians, commissioners.
Possible confounders	No specific ones identified.
Data sources	The indicator relies on the use of one of the risk scoring systems outlined above. General practitioners are being encouraged to undertake such assessments on their patients so increasing the likely availability of this information (Moher et al. 1997). As approximately 97% of a practice population is typically seen over a five year period, good coverage is potentially obtainable through opportunistic assessment over this time period. GP information systems using Read codes can be used to identify the following information needed for the scales: blood pressure (XM02X) and numerical findings, cholesterol level (X772L) and numerical findings, smoking status (current non-smoker-137L) and current prescriptions (e.g. aspirin - x02LX), all dated and linked to patient records with a diagnosis of acute MI (G30...) (NHS Centre for Coding and Classification 1997). Where already in use such scores should be directly retrievable from GP information systems.
Data quality	Data quality will vary depending on the accuracy and reliability of general practice information systems and the routine use of risk score assessment. Such assessments are being encouraged as a systematic part of the primary care management of patients and should therefore improve over time.
Comments	The measurement of cardiac risk and systematic documentation of this information should be encouraged among GPs as part of their routine patient assessments. However, there may also be a need for further education and training for general practitioners to interpret the significance of risk at an individual versus global level.
Further work required	Studies to identify a single preferred scoring system for risk assessment. Further studies to assess the use of the Basic GP Scoring System in women.

Conclusion & priority

C - To be implemented where local circumstances allow on a routine basis.

References

Anderson, K.M., Odell, P.M. Wilson, P.W.F., and Kannel, W.B. (1991a) Cardiovascular disease risk profiles. *American Heart Journal*, **121**, 293-298.

Anderson, K.M., Wilson, P.W.F., Odell, P.M., and Kannel, W.B. (1991b). An updated coronary risk profile: a statement for health professionals. *Circulation*, **86**, 858-869.

Colhoun, H., and Prescott-Clarke, P. (1996). *Health Survey for England*. Joint Health Surveys Unit, SCPR and Department of Epidemiology and Public Health, University College, London.

Department of Health (1992). *Health of the nation: a strategy for health in England*. HMSO, London.

General Medical Services Committee (1993). *The new health promotion package*. BMA, London.

Grover, S.A., Lowensteyn, I., Esrey, K.L., Steinert, Y., Joseph, L., and Abrahamowicz, M. (1995). Do doctors accurately assess coronary risk in their patients? Preliminary results of the coronary health assessment study. *British Medical Journal*, **310**, 975-978.

Haq, I.U., Jackson, P.R., Yeo, W.W., and Ramsey, L.E. (1995). Sheffield risk and treatment table for cholesterol lowering for primary prevention of coronary heart disease. *Lancet*, **346**, 1467-1471.

Moher, M., Schofield, T., Weston, S., and Fullard, E. (1997). Managing established coronary heart disease. *British Medical Journal*, **315**, 69-70.

NHS Centre for Coding and Classification (1997). *The Read Codes March 1997 Demonstrators*. NHS Executive, Leeds.

Pyörälä, K., De Backer, G., Graham, I., Poole-Wilson, P., and Wood, D. on behalf of the Task Force. (1994). Prevention of coronary heart disease in clinical practice. Recommendations of the Task Force of the European Society of Cardiology, European Atherosclerosis Society and European Society of Hypertension. *European Heart Journal*, **15**, 1300-1331.

Royal College of General Practitioners, Office of Population Censuses and Surveys and Department of Health (1995). *Morbidity statistics from general practice, fourth national study 1991-1992*. HMSO, London.

Shaper, A.G., Pocock, S.J., Phillips, A.N., and Walker, M. (1985a). Identifying men at high risk of heart attacks: strategy for use in general practice. *British Medical Journal*, **293**, 474-479.

Shaper, A.G., Pocock, S.J., Phillips, A.N., and Walker, M. (1987). A scoring system to identify men at high risk of a heart attack. *Health Trends*, **19**, 37-39.

Tunstall-Pedoe, H. (1991). *The Dundee coronary risk-disk-manual and technical description*. Dundee University.

Candidate indicator 5B

Characteristics

Perspective: Clinical

Timeframe: Cross-sectional

Outcome relationship: Direct

Title	Summary of twelve month changes in the risk of coronary heart disease within a GP population
Intervention aim	Reduce the risk of a first myocardial infarction.
Definition	For a given general practice population and year: <i>a summary of the distribution of changes in the CHD risk of individual patients, from a baseline assessment made during the given year to a follow-up assessment made twelve months later.</i> The risk scale to be used is yet to be defined and alterations are discussed below. The summary statistics might include mean (or median) absolute difference, or mean (or median) proportional change relative to baseline. Summary statistics will in part be determined by choice of risk scale. These averages, might be expressed as unitary values within each grouping of patient age-group and sex, or might be further broken down by some categorisation of baseline score (e.g. low, medium or high risk). The size of the relevant population together with the number of cases for which an assessment was available should also be reported.
Rationale	<p>While cross-sectional indicators can provide some indication of the success of interventions, longitudinal measures allow a better assessment of the benefits of targeted interventions, as they take into account the particular characteristics of the individual at the outset. The information on the types of scoring system to be used is given in Indicator 5A.</p> <p>By assessing the change in risk status of a given population, this indicator is intended to reflect the impact of health promotion interventions targetted at patients previously identified as at high risk (see Indicator 5A). Information on risk factors was collected in the Health Survey for England in 1994 (Colhoun and Prescott-Clarke 1996) and is likely to be collected again in a future survey, which would allow changes in population risk at a national level to be tracked. Local data will however be more valuable to the GP to support the health care of the local population.</p>
Potential uses	GP audit; HA comparisons.
Potential users	Clinicians, commissioners.
Possible confounders	No specific ones identified.
Data sources	This longitudinal indicator relies on assessments of a risk score at two points in time. The baseline assessment scores will be obtained from Indicator 5A for the given population in a given year. The second measurement will be a second set of scores for the same population a year (\pm 21 days) after the initial assessment. The methods for data collection should be those described in Indicator 5A. A variety of

statistics may be reported depending on the choice of scoring system. As the Dundee Risk-Disk reports a continuous score, it lends itself to more sophisticated reporting of change.

Data quality	Longitudinal indicators can encounter difficulty in achieving complete follow-up. Presentation of the longitudinal indicator should take this into account by giving a count of those lost to follow-up and details of the distribution of their baseline risk scores, in a format that allows comparison with the corresponding distributions for those where follow-up was possible.
Comments	No specific points.
Further work required	None recommended.
Conclusion & priority	C - To be implemented where local circumstances allow on a routine basis.
References	See Indicator 5A for relevant references.

Candidate indicator 6

Characteristics

Perspective: Population

Timeframe: Cross-sectional

Outcome relationship: Direct

Title	Population based mortality rate for myocardial infarction
Intervention aim	Reduce death from myocardial infarction.
Definition	<p>For a given resident population and year: <i>age specific mortality rates associated with an underlying cause of myocardial infarction (ICD-10 I21-I22)</i>. The rate, expressed per 100,000 residents, should be reported in ten yearly age-groups and then standardised for comparisons within the following age groups: under 65; 65-74; and 75 and over.</p> <p>Additionally, equivalent rates should be reported for all underlying causes (including MI) in the more general category of coronary heart disease (ICD-10 I21-I22).</p>
Rationale	<p>In 1990, coronary heart disease accounted for nearly 170,000 deaths in the UK population (Department of Health 1994) - the majority being associated with an underlying cause of myocardial infarction. A reduction in this mortality is clearly the primary aim of interventions targeting MI.</p> <p>The indicator specifies reporting within three age bands. This not only allows the indicator to document the impact of MI on premature death, but also reflects different data quality considerations operating within the three bands (see below).</p> <p>Mirroring the Health of the Nation indicators HON-A1 and HON-A2, the indicator also reports rates for all coronary heart disease, including MI. While less specific as an outcome of interventions targeting MI, this additional formulation acts as a proxy for the burden of ischaemic heart disease from which MI arises.</p>
Potential uses	Population based comparisons; analysis of trends over time.
Potential users	Local and national policy makers.
Possible confounders	Socio-economic status is associated with the risk of coronary heart disease and is likely to vary at the population level.
Data sources	The underlying cause recorded on death certificates.
Data quality	The indicator relies on the validity and reliability of the recording of the underlying cause of death. A validation exercise conducted as part of the UK Heart Attack Study (Norris 1987) indicates that acceptably accurate population level estimates of mortality can be obtained in this way for residents under 65 - a conclusion supported by the results of the MONICA project (Tunstall-Pedoe et al. 1994). However for those aged 65-74, the UK Heart Attack Study found evidence of significant over-recording of MI as the underlying cause. No data are available on the accuracy of recording in those 75 and over.

Comments	No specific points.
Further work required	None recommended.
Conclusion & priority	A - To be implemented generally on a routine basis.
References	<p>Department of Health (1994). <i>Coronary heart disease - an epidemiological overview</i>. HMSO, London.</p> <p>Norris, R.M. (1997). After the infarction: current evidence-based practice. <i>General and Elderly Medicine</i>, 1, 4-7.</p> <p>Tunstall-Pedoe, H., Kuulasmaa, K., Amouyel, P., Arveiler D., Rajakangas, A.M., and Pajak, A. (1994). Myocardial infarction and coronary deaths in the World Health Organisation MONICA Project. Registration procedures, event rates, and case-fatality rates in 38 populations from 21 countries in four continents. <i>Circulation</i>. 90, 583-612.</p>

Candidate indicator 7

Characteristics

Perspective: Clinical

Timeframe: Cross-sectional

Outcome relationship: Direct

Title	Case-fatality rates for patients admitted to hospital alive with a MI
Intervention aim	Reduce death from myocardial infarction.
Definition	<p>For a given provider unit population and year: <i>the number of patients registered as having died (from any cause) within a specified interval following admission with a diagnosis of MI to the given unit in the given year, divided by the total number of patients admitted with a diagnosis of MI to the given unit in the given year.</i> The resulting fraction expressed as a percentage should be reported with its associated numerator and denominator as both overall figures and by age-group and sex.</p> <p>The suggested follow-up time periods are during hospital admission and 30 days and one year after admission.</p>
Rationale	<p>Mortality following MI may in part represent an adverse outcome of antecedent health care. Comparisons of case-fatality rates across local populations will reflect both the effectiveness of care within individual provider units and the presenting characteristics of patients. The indicator is specified as a proportion of patients admitted to hospital with a MI as it is known that of those who die within 30 days of an MI, 95-97% of them die in hospital (Capewell et al. 1996). All those admitted should include those admitted to accident & emergency alone.</p> <p>Two follow-up time periods in addition to during hospital admission are proposed:</p> <ul style="list-style-type: none"> - Thirty days as adopted in the Scottish Clinical Outcome Indicators (Clinical Outcomes Working Group 1995). - One year to facilitate use alongside Indicator 11A as identification of those who have died within a year of their MI, which will assist the reliable interpretation of re-admissions rates at one year.
Potential uses	Changes over time in fatality rates, nationally; clinical audit within provider units.
Potential users	Commissioners and clinicians.
Possible confounders	<p>Comparisons should be made in the context of case-mix information covering co-morbidities and the severity of patient populations. Secondary diagnoses on the current admission record provide one source.</p> <p>Alternatively, with general linkage of hospital activity, previous admissions for defined groups could be used as a basis for standardisation. This method was used by the Scottish Clinical Outcomes Working Group in their Report (1995).</p>

Data sources	<p>The data would be predominantly obtained from the CMDS of a given unit for the given year, and related death certificates. The numerator may be obtained from death certificates linked by a patient identifier to previous emergency hospital admissions for MI (ICD-10 I21), with an admission date within the specified period before death. As well as admissions recorded as part of the CMDS, patients admitted to A&E but who are not admitted to that unit (due to death or transfer) need to be identified. Where collected these data would be available from the A&E minimum data set and would include all episodes with an A&E diagnosis code of 201228 (cardiac conditions- myocardial ischaemia & infarction), and an arrival date within the year of interest. The denominator may be obtained from CMDS data and A&E MDS data with a diagnosis of myocardial infarction (ICD-10 I21) on admission, or attendance at A&E in the given year and unit. Where the A&E data set is not regularly recorded, a manual survey of A&E notes would be required to identify these cases.</p>
Data quality	<p>Potential problems lie with the accuracy of CMDS data with respect to diagnostic information (especially co-morbidity and severity), and those fields shared with death certificates which are required for linkage with them. The A&E MDS is not mandatory and may not be commonly available. Use of manual records will therefore be required and the validity of the indicator will depend on the accuracy of the A&E documentation.</p>
Comments	<p>It is recognised that identification of fatalities at 30 days and one year after admission will require record linkage which may be beyond the current information systems of some provider units. Although the capability should be more widespread in the future, it may only be practical now to monitor in-patient fatalities (i.e. deaths prior to discharge).</p>
Further work required	<p>None recommended.</p>
Conclusion & priority	<p><i>In-hospital. A - To be collected generally on a routine basis. Thirty day/one year mortality. C - To be implemented on a routine basis where local circumstances allow.</i></p>
References	<p>Capewell, S., Kendrick, S., Boyd, J., Cohen, G., Juszez, E., and Clarke, J. (1996). Measuring outcomes: one month survival after acute myocardial infarction in Scotland. <i>Heart</i>, 76, 70-75.</p> <p>Clinical Outcomes Working Group of the Clinical Resource and Audit Group (1995). <i>Clinical outcome indicators</i>. The Scottish Office, Edinburgh.</p>

Candidate indicator 8

Characteristics

Perspective: Clinical

Timeframe: Cross-sectional

Outcome relationship: Indirect

Title	Proportion of patients attending hospital with MI who receive thrombolytic therapy
Intervention aim	Reduce death from myocardial infarction.
Definition	For a given provider unit and year: <i>the number of patients who attend hospital as an emergency with a final diagnosis of MI, who receive thrombolytic therapy, divided by the number of patients with a final diagnosis of MI attending the given unit as an emergency, in the given year.</i> The resulting fraction expressed as a percentage should be reported with its associated numerator and denominator, by age-group and sex.
Rationale	<p>Thrombolytic therapy has been shown to reduce 35 day mortality by about 25% (ISIS-2 1988). The early provision of treatment to the maximum number of patients who will benefit is therefore important. On present evidence benefit is limited to those patients who have typical ECG changes of ST elevation consistent with thrombotic occlusion of a major epicardial artery. Of patients presenting to hospital who are given a final diagnosis of myocardial infarction only about 60% have typical cardiographic changes at admission to hospital (Birkhead 1997).</p> <p><i>Concerns</i></p> <p>ST segment elevation is not a categorical variable. The decision to offer thrombolytic therapy on borderline ST segment elevation is often difficult. Thresholds for treating patients vary. The decision is normally made by the junior hospital doctor who admits the patient. Use of thrombolytic therapy will be determined by clinical experience and local departmental policy. There is a grey area where there is no clear cut right or wrong decision. At present the use of biochemical markers of necrosis remains to be validated as a means of determining the use of thrombolytic therapy in difficult cases. Due to the likely variation across provider units in the eligible group (which cannot be controlled for), the interpretation of this indicator may be problematic. Higher scores on the indicator will not necessarily indicate appropriate use nor equally lower scores necessarily equate with inappropriate underutilisation of this treatment.</p>
Potential uses	Clinical audit; comparisons across units.
Potential users	Commissioners; providers; clinicians.
Possible confounders	No specific ones identified.

Data sources	The denominator should be given as the sum of both 'the hospital spells with a primary diagnosis of MI on admission (ICD-10 I21) and a discharge date within the given year', and the 'A&E attendances with an arrival date in the given year, an A&E diagnosis code of myocardial infarction (201228), and an arrival mode of brought in by ambulance'. This will ensure that those who die in A&E as well as those directly admitted to CCU are included. Patients identified by both attendance and admission records should only be counted once. To identify the numerator, these data should be linked by a patient identifier to relevant prescription data. As this is not recorded within the CMDS, other information systems recording drug administrations are required. The two main anti-thrombolytic agents used which should be identified are tissue plasminogen activator (tPA) and streptokinase. Systems using Read codes should identify records with bv3.. (tPA) or bv1..(streptokinase).
Data quality	The validity of the indicator relies on the quality of both diagnosis and A&E coding, and should thus be the subject of further investigation. The accuracy of the prescription data may be quite high but will depend on the nature of the information system. As the indicator relies on surveying the notes manually, this may enhance its accuracy.
Comments	Some patients may be treated outside of hospital particularly in rural areas where rapid pre-hospital administration has resulted in a reduced mortality (GREAT Group 1992).
Further work required	None recommended.
Conclusion & priority	C - To be implemented where local circumstances allow on a routine basis.
References	<p>Birkhead J.S. on behalf of the Myocardial Infarction Audit Group (1997). Thrombolytic treatment for myocardial infarction; an examination of practice in 39 United Kingdom hospitals. <i>Heart</i>, 78, 28-35.</p> <p>GREAT Group (1992). Feasibility, safety, and efficacy of domiciliary thrombolysis by general practitioners: Grampian region early anistreplase trial. <i>British Medical Journal</i>, 305, 548-553.</p> <p>ISIS-2 (Second International Study of Infarct Survival) and Collaborative Group (1988). Randomised trial of intravenous streptokinase, oral aspirin, both or neither among 17,187 cases of suspected acute myocardial infarction. <i>Lancet</i>, ii, 349-360.</p>

Candidate indicator 9A

Characteristics

Perspective: Clinical

Timeframe: Cross-sectional

Outcome relationship: Indirect

Title	Time from onset of symptoms to call for help
Intervention aim	Reduce death from myocardial infarction.
Definition	<p>For a given provider unit population, year and specified time-period (see below): <i>the number of patients given a definite diagnosis of MI on admission for whom the time between the onset of their symptoms (to be defined) and call for help from medical or ambulance services* falls into the specified time-period, divided by the total number of patients given a diagnosis of MI on admission in the given population and year.</i> The resulting fractions will give a distribution of the delay and should be expressed as percentages, by sex and as age-specific group rates. The numerators and denominator should be reported separately as overall figures. The indicator should also report each time-period distribution for each type of call separately.</p> <p><i>*Call for help may be one of four types:</i></p> <ul style="list-style-type: none"> - call to the GP (leading to GP attendance) - call to the GP (who then calls the ambulance immediately) - call for an ambulance - time of independent arrival at A&E. <p><i>The specified time periods are:</i></p> <ul style="list-style-type: none"> - less than 30 minutes - between > 30 minutes and 1 hour - between > 1 hour and 2 hours - between > 2 hours and 4 hours - above 4 hours.
Rationale	<p>As a group, Indicators 9A, 9B and 9C are designed to reflect the extent of delays which occur between the onset of symptoms and the administration of thrombolytic treatment to patients with acute myocardial infarction. The benefit of thrombolytic treatment is greatest for those patient with acute myocardial infarction who receive this treatment most quickly after the onset of symptoms. Administration of thrombolytic therapy within one hour of onset of symptoms may save about 65 lives per 1,000 patients treated; treatment within 1-3 hours, 35 lives per 1,000; and within 3-6 hours, 30 lives per 1,000, (Boersma et al. 1996). It follows that every attempt should be made to reduce unnecessary delays before treatment.</p>

There are three components to the delay prior to thrombolytic treatment in hospital. These are specified in candidate Indicators 9A, B and C as:

- delay in calling for help
- delay from call to reaching hospital
- delay from reaching hospital to provision of thrombolytic therapy (door to needle time).

Each component is largely independent of the other. For Indicators 9A and 9B, the denominator is specified as all patients who receive a definite *admission* diagnosis of myocardial infarction. Indicator 9C however specifies the denominator as those who receive an admission diagnosis of myocardial infarction *and* then subsequently receive thrombolytic treatment.

The causes of patient delay in calling for help are complex and include failure to recognise the significance of symptoms, the time of day and place of onset (Hartford et al. 1990). Psychological factors such as denial are also important (Kenyon et al. 1991). In addition older persons and women tend to call for help more slowly than the young and males. Patients who direct their call for help to their doctor delay longer than patients who approach the emergency services. While the overall median delay for patients with a final diagnosis of myocardial infarction is about 60 minutes, during day light hours this is about 40 minutes while at night median delays of up to three hours may occur (Birkhead, personal communication). The results of mass education campaigns have been disappointing in influencing patient delay (Hartford et al. 1990). Indicator 9A will therefore seek to reflect the success of antecedent health education about cardiac symptoms and the need to seek help.

Potential uses

Clinical audit and provider based comparisons.

Potential users

Clinicians, commissioners.

Possible confounders

The extent to which different patients recognise the onset of their symptoms is unlikely to vary systematically as a result of demographic or sociological factors at the population level (Hackett and Cassem 1969; Erhardt et al. 1974), although some psychological factors may be important (Kenyon et al. 1991). However, more recent studies have shown that patients' reactions to their symptoms have been found to vary depending on their location at the time: those away from home (e.g. at work, shopping etc.) reacting approximately twice as quickly as those at home (Birkhead 1992). As the latter typically represents about 85% of all infarctions, some consideration of this effect may need to be given in provider unit populations which have a large catchment of day influx patients (office workers, shoppers etc.)

Data sources

The denominator is given by the number of patients admitted to a given provider unit with an initial medical diagnosis of MI. This initial diagnosis will be recorded on A&E attendance or CCU admission records and a review of notes within a given year would identify this group of patients.

It is recommended that data required for the numerator be collected routinely for all patients admitted with a suspected diagnosis of acute myocardial infarction regardless of final outcome or treatment. Such information e.g. time of onset of the symptoms and call for help should be collected contemporaneously from the patient (and/or relative) using a proforma. An alternative additional source for this information may be ambulance records (at least in some areas) where details of the incident, including the time of onset of symptoms, are routinely documented.

Data quality

The quality of this indicator depends in part on obtaining complete information. Contemporaneous collection of the information through use of a suitable proforma is essential to obtain such data. The quality of the information will also depend on the reliability of the patient's memory of the timing of events. Experience suggests that satisfactory data can be obtained from the patient in the majority of cases (Birkhead, personal communication). The ambulance service who are responsible for the transport to hospital of about 90% of patients with infarction can be expected to provide confirmatory data where the patient is not able to do so.

Comments

There are problems with this indicator in that it relies on patient reporting which may vary depending on how the information is collected and by whom. Information needs to be collected in such a way as to ensure the information is reliable and eligible for comparison. Reliability of data collection will need improvement and may cause added burden to junior medical staff if no extra resources are made available.

The indicator as specified will exclude patients who call for help but who subsequently die on the way to hospital.

The residential population may be an alternative population for this indicator as commissioners will be interested in possible improvements to the services being provided for a population. However, this creates complications with current data sources, but may be worthy of future consideration.

Further work required

Further work on the attributes required for a reliable history taking of antecedent cardiac symptoms. Further studies to confirm that such a method is practical in a routine setting.

Conclusion & priority

C - To be implemented where local circumstances allow on a routine basis.

References

Birkhead, J.S. on behalf of the Joint Committee of the British Cardiac Society and the Cardiology Committee of the Royal College of Physicians of London (1992). Time delays in provision of thrombolytic treatment in six district general hospitals. *British Medical Journal*, **305**, 445-448.

Boersma, E., Maas, A.C.P., Deckers, J.W., and Simoons, M.L. (1996). Early thrombolytic treatment in acute myocardial infarction: reappraisal of the golden hour. *Lancet*, **348**, 771-775.

Erhardt, L.R., Sjogren, A., Sawe, U., and Theorell, T. (1974). Pre-hospital phase of patients admitted to a coronary care unit. *Acta Medical Scandinavia*, **196**, 41-46.

Hackett, T.P., and Cassem, N.H. (1969). Factors contributing to delay in responding to the signs and symptoms of acute myocardial infarction. *American Journal of Cardiology*, **24**, 651-658.

Hartford, M., Herlitz, J., Karlson, B.W., and Risenfors, M. (1990). Components in delay time in suspected myocardial infarction with particular emphasis on patient delay. *Journal of Internal Medicine*, **228**, 519-523.

Kenyon, L.W., Ketterer, M.W., Gheorghide, M., and Goldstein, S. (1991). Psychological factors related to pre-hospital delay during acute myocardial infarction. *Circulation*, **84**, 1969-1970.

Candidate indicator 9B

Characteristics

Perspective: Clinical

Timeframe: Cross-sectional

Outcome relationship: Indirect

Title

Time from call to help to arrival at hospital

Intervention aim

Reduce death from myocardial infarction.

Definition

For a given provider unit population, year and specified time-period (see below): *the number of patients given a definite diagnosis of MI on admission for whom the time between the call for help from medical or ambulance services* and arrival at the hospital falls into the specified time-period, divided by the total number of patients given a diagnosis of MI on admission in the given population and year.* The resulting fractions will give a distribution of the delay and should be expressed as percentages, by sex and as age-specific group rates. The numerators and denominator should be reported separately as overall figures. The indicator should also report each time-period distribution for each type of call separately.

**Call for help may be one of three types:*

- call to the GP (leading to GP attendance)
- call to the GP (who then calls the ambulance immediately)
- call for an ambulance.

Patients who transport themselves to hospital are excluded from this indicator.

The specified time periods are:

- less than 30 minutes
- between > 30 minutes and 1 hour
- between > 1 and 2 hours
- between > 2 and 4 hours
- between > 4 and 6 hours
- above 6 hours
- time unknown.

Rationale

As a group, Indicators 9A, 9B and 9C are designed to reflect the extent of delays which occur between the onset of symptoms and the administration of thrombolytic treatment to patients with acute myocardial infarction. The benefit of thrombolytic treatment is greatest for those patients with acute myocardial infarction who receive this treatment most quickly after the onset of symptoms. Administration of thrombolytic therapy within one hour of onset of symptoms may save about 65 lives per 1,000 patients treated; treatment within 1-3 hours, 35 lives per 1,000; and within 3-6 hours, 30 lives per 1,000 (Boersma et al. 1996). It follows that every attempt should be made to reduce unnecessary delays before treatment.

There are three components to the delay prior to thrombolytic treatment in hospital. These are specified in candidate Indicators 9A, B and C as:

- delay in calling for help
- delay from call to reaching hospital
- delay from reaching hospital to provision of thrombolytic therapy (door to needle time).

Each component is largely independent of the other. For Indicators 9A and 9B, the denominator is specified as all patients who receive a definite admission diagnosis of myocardial infarction. Indicator 9C however specifies the denominator as those who receive an *admission* diagnosis of myocardial infarction *and* then subsequently receive thrombolytic treatment.

Indicator 9B measures delay between calling for help and reaching hospital. This delay is dependent on which of the medical services are used by the patient or relative in calling for help. Patients who call their own doctor, and are seen by the doctor have a median delay of about 80 minutes while those who dial 999 directly have a median delay of about 40 minutes (Birkhead 1992, Rowley et al. 1992). Where the home to hospital distances are great the median call to arrival delay is likely to be longer and may reflect a need to consider pre-hospital use of thrombolytic treatment (Trent et al. 1995). In a largely urban setting with a long record of public and general practitioner training median delays of 35 minutes have been recorded (More et al. 1995). Ninety per cent of patients with acute myocardial infarction reach hospital by ambulance while about 10% reach hospital by other means (Birkhead, personal communication). The ambulance response to any call, either from a doctor or a member of the public where there is any indication of chest pain is now treated as a 'blue-light' emergency by the ambulance service. Ambulance crews in many areas routinely record all details of emergency calls and in the case of chest pain will record the timing of onset of symptoms, the time of the call for help, and the time of arrival at hospital. This indicator when taken in conjunction with how the patient called for help (to GP, to emergency service) is a measure of the response of different parts of the medical service to dealing with acute myocardial infarction.

Potential uses	Clinical audit; comparisons between populations.
Potential users	Clinicians, commissioners.
Possible confounders	No specific ones identified.
Data sources	The denominator is given by the number of patients admitted to a given provider unit with an initial admission diagnosis of MI. This initial diagnosis will be recorded on A&E attendance or CCU admission records and a review of notes within a given year would identify this group of patients.

To identify the numerator, the time the patient called for help and the time of arrival in hospital should be collected using the same methods as specified in Indicator 9A.

Data quality

The quality of this indicator depends in part on obtaining complete information. Contemporaneous collection of the information through use of a suitable proforma is essential to obtain such data. The quality of the information will also depend on the reliability of the patient's memory of the timing of events. Experience suggests that satisfactory data can be obtained from the patient in the majority of cases (Birkhead, personal communication). The ambulance service who are responsible for the transport to hospital of about 90% of patients with infarction can be expected to provide confirmatory data where the patient cannot.

Comments

The residential population may be an alternative population for this indicator as commissioners will be interested in possible improvements to the services it is providing for its population. However, this creates complications with current data sources, but may be worthy of future consideration.

Further work required

None recommended.

Conclusion & priority

C - To be implemented where local circumstances allow on a routine basis.

References

Birkhead, J.S. on behalf of the Joint Audit Committee of the British Cardiac Society and a Cardiology Committee of the Royal College of Physicians of London (1992). Time delays in provision of thrombolytic treatment in six district hospitals. *British Medical Journal*, **305**, 445-448.

Boersma, E., Maas, A.C.P., Deckers, J.W., and Simoons, M.L. (1996). Early thrombolytic treatment in acute myocardial infarction: reappraisal of the golden hour. *Lancet*, **348**, 771-775.

More, R., Moore, K., Quinn, E., Perez Avila, C., Davidson, C., Vincent, R., and Chamberlain, D. (1995). Delay times in the administration of thrombolytic therapy: the Brighton experience. *International Journal of Cardiology*, **49**, Suppl: S39-46.

Rowley, J.M., Mounsey, P., Harrison, E.A., Skene, A.M., and Hampton, J.R. (1992). Management of myocardial infarction: implications for current policy derived from the results of the Nottingham Heart Attack Register. *British Heart Journal*, **67**, 255-262.

Trent, T.J., Rose, E.L., Adams, J.N., Jennings, K.P. and Rawles, J.M. (1995). Delay between the onset of symptoms of acute myocardial infarction and seeking medical assistance is influenced by left ventricular function at presentation. *British Heart Journal*, **73**, 125-128.

Candidate indicator 9C

Characteristics

Perspective: Clinical
Timeframe: Cross-sectional
Outcome relationship: Indirect

Title	Time from arrival at hospital to administration of thrombolytic therapy
Intervention aim	Reduce death from myocardial infarction.
Definition	<p>For a given provider unit population, year and specified time-period (see below): <i>the number of patients who receive thrombolytic therapy following an definite admission diagnosis of MI for whom the time between arrival at hospital and administration of thrombolytic therapy falls into the specified time-period, divided by the total number of patients who receive thrombolytic therapy following an definite admission diagnosis of MI in the given population and year.</i> The resulting fractions will give a distribution of the delay and should be expressed as percentages, by sex and as age-specific group rates. The numerators and denominator should be reported separately as overall figures.</p> <p><i>The specified time periods are:</i></p> <ul style="list-style-type: none"> - between 0 and 15 minutes - between > 15 and 30 minutes - between > 30 and 45 minutes - between > 45 and 60 minutes - between > 1 and 2 hours - above 2 hours - time unknown.
Rationale	<p>As a group, Indicators 9A, 9B and 9C are designed to reflect the extent of delays which occur between the onset of symptoms and the administration of thrombolytic treatment to patients with acute myocardial infarction. The benefit of thrombolytic treatment is greatest for those patient with acute myocardial infarction who receive this treatment most quickly after the onset of symptoms. Administration of thrombolytic therapy within one hour of onset of symptoms may save about 65 lives per, 1,000 patients treated; treatment within 1-3 hours, 35 lives per, 1,000; and within 3-6 hours, 30 lives per 1,000 (Boersma et al. 1996). It follows that every attempt should be made to reduce unnecessary delays before treatment.</p> <p>There are three components to the delay prior to thrombolytic treatment in hospital. These are specified in candidate Indicators 9A, B and C as:</p> <ul style="list-style-type: none"> - delay in calling for help - delay from call to reaching hospital - delay from reaching hospital to provision of thrombolytic therapy (door to needle time).

Each component is largely independent of the other. For Indicators 9A and 9B, the denominator is specified as all patients who receive a definite admission diagnosis of myocardial infarction. Indicator 9C however specifies the denominator as those who receive an *admission* diagnosis of myocardial infarction *and* then subsequently receive thrombolytic treatment.

This Indicator 9C assesses delays to thrombolytic treatment in hospital. While hospitals may differ in how patients with infarction receive their initial assessment, the place where thrombolytic treatment is given to patients with infarction is usually either i) the accident & emergency department, ii) following direct admission to the cardiac care unit, or iii) 'slow track', where the patient is assessed in accident & emergency and then transferred to the cardiac care unit before treatment is started. Methods i and ii provide thrombolytic therapy more rapidly than iii, typically 30-40 minutes following admission to hospital versus 60 minutes. Nevertheless, the greater proportion of thrombolytic therapy is still given following 'slow-track' admission (Birkhead, from data in National Audit of Myocardial Infarction). This indicator (9C), commonly referred to as the 'door to needle time', varies widely between hospitals (Birkhead 1992). The Health of the Nation document (Department of Health 1992) suggests a target median 'door to needle time' of 30 minutes.

Potential uses	Clinical audit; comparisons between populations.
Potential users	Clinicians, commissioners.
Possible confounders	No specific ones identified.
Data sources	The denominator is given by the number of patients admitted to a given provider unit with an admission diagnosis of MI who subsequently receive thrombolytic therapy. This initial diagnosis and the administration of thrombolytic therapy will be recorded on A&E attendance records and a review of notes within a given year would identify this group of patients.

Numerator data regarding the times of arrival and administration of treatment should also be obtainable from a proforma as described in Indicator 9A. Details of the time of arrival at the hospital should be subtracted from the time of administration of the thrombolytic agent to obtain the relevant time period for the indicator. Alternative sources for times relating to administration of the therapy may be from prescription systems or the drug chart within the notes.

Data quality	The quality of this indicator depends in part on obtaining complete information. Contemporaneous collection of the information through use of a suitable proforma is essential to obtain such data. The quality of the information will also depend on the reliability of the patient's memory of the timing of events. Experience suggests that satisfactory data can be obtained from the patient in the majority of cases (Birkhead, personal communication). The ambulance service who are responsible for the transport to hospital of about 90% of patients with infarction can be expected to provide confirmatory data where the patient is not able to do so.
Comments	Some services have introduced pre-hospital treatment, and demonstrated substantial time savings when compared with in-patient hospital times (GREAT Group 1992; European Myocardial Infarction Group 1993). The indicator may need to be adjusted in the future if this becomes more common practice.
Further work required	None recommended.
Conclusion & priority	C - To be implemented where local circumstances allow on a routine basis.
References	<p>Birkhead, J.S. on behalf of the Joint Audit Committee of the British Cardiac Society and a Cardiology Committee of the Royal College of Physicians of London (1992). Time delays in provision of thrombolytic treatment in six district hospitals. <i>British Medical Journal</i>, 305, 445-448.</p> <p>Boersma, E., Maas, A.C.P., Deckers, J.W., and Simoons, M.L. (1996). Early thrombolytic treatment in acute myocardial infarction: reappraisal of the golden hour. <i>Lancet</i>, 348, 771-775.</p> <p>Department of Health (1992). <i>Health of the nation: a strategy for health in England</i>, HMSO, London.</p> <p>European Myocardial Infarction Group (1993). Pre-hospital thrombolytic therapy in patients with suspected myocardial infarction. <i>New England Journal of Medicine</i>, 329, 383-389.</p> <p>GREAT Group (1992). Feasibility, safety and efficacy of domiciliary thrombolysis by general practitioners: Grampian region early trial. <i>British Medical Journal</i>, 305, 548-553.</p>

Candidate indicator 10

Characteristics

Perspective: Clinical

Timeframe: Cross-sectional

Outcome relationship: Indirect

Title	Time from call for help to defibrillator availability
Intervention aim	Reduce death from myocardial infarction.
Definition	<p>For a given ambulance service, year and specified time-period (see below): <i>the number of patients with an ambulance incident recorded as 'cardiac', for whom the time between the call for help from medical or ambulance services* and the availability of a defibrillator (with trained operator) falls into the specified time-period, divided by the total number of patients with an ambulance incident recorded as 'cardiac' by the given ambulance service and year.</i> The resulting fractions will give a distribution of the delay and should be expressed as percentages, by sex and as age-specific group rates. The numerators and denominator should be reported separately as overall figures. The indicator should also report the time-period distribution by each type of call separately.</p> <p><i>*Call for help may be one of two types:</i></p> <ul style="list-style-type: none"> - call to the GP - call for an ambulance. <p>Patients who transport themselves to hospital are excluded from this indicator.</p> <p><i>The current specified time periods are:</i></p> <ul style="list-style-type: none"> - less than 8 minutes - between > 8 and 11 minutes - between > 11 and 30 minutes - above 30 minutes - time unknown.
Rationale	<p>Rapid medical attention allows for prompt defibrillation when serious arrhythmias occur. The benefits of early access to defibrillation in terms of better mortality outcomes have been demonstrated (UKHAS 1998). All front-line ambulances are now fitted with defibrillators, (Langham et al. 1994) and the government's objective is that by 1997 every emergency ambulance crew should have at least one paramedically trained crew member (Department of Health 1992). Provision of ambulances with equipment and training of staff have allowed the introduction of out-of-hospital defibrillation in some areas and there is some evidence that this has increased the annual survival in various rural communities (Cobbe et al. 1991). As well as ambulances, a few general practitioners carry defibrillators when attending patients with chest pain (Wilcox and Rowley 1990). Ninety per cent of patients with a MI however arrive by ambulance (Birkhead, personal communication).</p>

Potential uses	Clinical audit and provider based comparisons.
Potential users	Commissioners, providers.
Possible confounders	No specific ones identified.
Data sources	<p>The denominator data are given by the number of patients in the given ambulance service population whose incident on the ambulance record is identified as ‘cardiac’ and is dated in the given year. Unless an information system exists which records this information as a computerised record or similar, a manual survey of the records will be required. For the time the patient called for help different sources are needed.</p> <p><i>a) For calls to the GP</i></p> <p>The time the patient/relative called the GP needs to be obtained from GP records or again relies on the patient’s memory and should be obtained through the history taking described in Indicator 9A.</p> <p><i>b) For calls for an ambulance</i></p> <p>This should be obtainable from ambulance service records of ‘time of call’. Defibrillator availability should be taken as any one of the following: arrival of the ambulance at the scene (if equipment and trained staff are on board); arrival at the hospital (in cases where no defibrillator or trained staff are on board) or; arrival of the GP at the scene (in those few cases where the GP vehicle has a defibrillator). Most of this information should be available from either the ambulance unit record or from the GP. Using a patient identifier, time of the call and time of the defibrillator availability should be collected for each patient. The time of the call should be subtracted from the time of defibrillator availability to obtain the time period for that patient.</p>
Data quality	<p>The quality of the indicator will depend on the accuracy of the ambulance records and whether GPs who attend emergencies document both the time they were called and time of arrival at such events. This may vary from GP to GP. It is recognised that on many occasions such as when attending high rise flats with unreliable lifts, there may be considerable delay from arrival of the ambulance and actual availability of the defibrillator.</p>
Comments	<p>It may be appropriate to compare rural and urban populations separately due to the large variation of distances involved.</p>
Further work required	None recommended.

Conclusion & priority **C - To be implemented where local circumstances allow on a routine basis. In time, this indicator should be collected generally on a routine basis.**

References

Cobbe, S.M., Redmond, M.J., Watson, J.M., Hollingworth, J., and Carrington, D.J. (1991). 'Heartstart Scotland': initial experience of a national scheme for out of hospital defibrillation. *British Medical Journal*, **302**, 1517-1520.

Department of Health (1992). *Health of the nation: a strategy for health in England*. HMSO, London.

Langham, S., Normand, C., Piercy, J., and Rose, G. (1994) Coronary heart disease. In *Health care needs assessment* (ed. A. Stevens and J. Raftery) pp 341-378. Radcliffe Medical Press, Oxford.

UKHAS Collaboration Group (1998). Effect of time from onset to coming under care on fatality of patients with acute myocardial infarction: effect of resuscitation and thrombolytic treatment. *Heart*, **80**, 114-120.

Wilcox, R.G., and Rowley, J.M. (1990). Pre-hospital management of acute myocardial infarction: patient and general practitioner interactions. In *The management of acute ischaemia*, (ed. D. Chamberlain, D. Julian, and P. Sleight), pp.133-138. Current Medical Literature, London.

Candidate indicator 11A

Characteristics

Perspective: Clinical

Timeframe: Cross-sectional

Outcome relationship: Direct

Title	Rate of in-patient admission for MI within one year of a previous hospitalised MI
Intervention aim	Reduce risk of subsequent myocardial infarction or other related cardiovascular event.
Definition	<p>For a given provider unit, year and follow-up period: <i>the number of MI patients discharged alive from the given unit in the given year having been admitted with an MI, who were subsequently admitted (to any unit) within the specified follow-up period with another MI, divided by the number of patients discharged alive from the given unit in the given year having been admitted with an MI.</i> This fraction, expressed as a percentage, should be reported with its numerator both as an overall figure and by patient age-group and sex.</p> <p>Each of these figures should be further broken down by the status of the diagnosis associated with the index admission, categorised as initial MI and subsequent MI.</p>
Rationale	<p>A reduction in the proportion of people who suffer a second MI should reflect the success of health care interventions and advice provided following the initial MI. e.g. administration of aspirin and other drugs and advice on smoking cessation, exercise, and blood pressure reduction. Long term treatment with ACE inhibitors reduces mortality particularly in patients with impaired left ventricular function (AIRE study investigators 1993; AIREX study investigators 1997). Beta blockers given to patients long-term following myocardial infarction reduce the number of vascular events by about 20 per 1,000 patients. The reduction of lipid levels with diet as well as medication may be effective in the longer term in reducing the re-admission rate. Adverse events are mainly sudden deaths but also include non-fatal re-infarcts (Yusuf et al. 1995). The indicator is specified to count patients rather than hospital spells to ensure that multiple admissions per patient are not counted.</p>
Potential uses	Clinical audit; provider-based comparisons.
Potential users	Clinicians, provider management, commissioners.
Possible confounders	Comparisons should be made in the context of case-mix information covering the severity and co-morbidity of the patients populations. Use of secondary diagnoses on the earlier admission record may provide one method of controlling for co-morbidity. A similar method was used by the Scottish Clinical Outcomes Group in their report on Clinical Outcome Indicators (1995).
Data sources	The denominator is defined within the CMDS by the number of patients associated with provider spells ending within the given year for which the admission episode records a primary ICD-10 diagnosis of 'acute myocardial infarction' (I21) or 'subsequent myocardial infarction' (I22).

Records relevant to the numerator will be included among hospital admissions (to any provider unit) with a primary ICD-10 diagnosis of 'acute myocardial infarction' (I21) or 'subsequent myocardial infarction' (I22). The subset of these records that relate to denominator patients who were re-admitted within the specified follow-up period may be identified with reference to the NHS number and the difference between the index discharge date and the new admission date.

Data quality

The validity of the indicator is dependent on the quality of CMDS diagnosis data, which is unlikely to be uniformly high.

Comments

As specified, the denominator includes those patients dying within the follow-up period. As a result, the indicator's estimate of the re-admission rate for a unit may be influenced by that unit's mortality rate. Patients dying within a year of the index admission could be excluded from the denominator (the number of such deaths is available from Indicator 7).

It may also be valuable to report this indicator over a five year period to obtain a longer term picture of the success of rehabilitation following a hospital admission.

Further work required

None recommended.

Conclusion & priority

C - To be implemented where local circumstances allow on a routine basis.

References

- AIRE study investigators (1993). Effect of Ramipril on mortality and morbidity of acute myocardial infarction with clinical evidence of heart failure. *Lancet*, **342**, 821-828.
- AIREX study investigators (1997). Follow-up study of patients randomly allocated to Ramipril or placebo for heart failure after acute myocardial infarction: AIRE extension study (AIREX). *Lancet*, **349**, 1493-1497.
- Clinical Outcomes Working Group of the Clinical Resource and Audit Group (1995). *Clinical outcome indicators*. The Scottish Office, Edinburgh.
- Yusuf, S., Peto, R., Lewis, J., Collins, R., and Sleight, P. (1985). Beta-blockade during and after myocardial infarction: an overview of the randomised trials. *Progress in Cardiovascular Diseases*, **17**, 335-371.

Candidate indicator 11B

Characteristics

Perspective: Clinical
Timeframe: Cross-sectional
Outcome relationship: Direct

Title	Rate of in-patient admission for selected cardiovascular conditions within one year of a previous hospitalised MI
Intervention aim	Reduce the risk of subsequent myocardial infarction or other related cardiovascular event.
Definition	<p>The indicator is intended to monitor emergency re-admissions associated with any of the following cardiovascular diagnostic categories (corresponding ICD-10 code blocks are given in brackets):</p> <ul style="list-style-type: none">- Ischaemic heart disease (I20-I25), excluding acute myocardial infarction (I21) and subsequent myocardial infarction (I22).- Other forms of heart disease (I30-I52).- Cerebrovascular disease (I60-I69). <p>For a given provider unit, year and follow-up period: <i>the number of patients discharged from the given unit in the given year, having been admitted with an MI, who were subsequently admitted (to any unit) as an emergency within the specified follow-up period with any one of the specified cardiovascular events/diseases (specified above), divided by the number of patients discharged from the given unit in the given year, having been admitted with an MI.</i> This fraction, expressed as a percentage, should be reported with its numerator both as an overall figure and by patient age-group and sex.</p> <p>Each of these figures should be further broken down by the status of the diagnosis associated with the index admission, categorised as initial MI and subsequent MI.</p>
Rationale	Reducing risk factors for MI will also reduce the risk of suffering other cardiovascular events. The number of emergency admissions for such related events should therefore reflect, in part, the success of health care interventions and advice provided following the initial MI. The indicator is specified to count patients rather than hospital spells to ensure that multiple admissions per patient are not counted.
Potential uses	Clinical audit; provider-based comparisons.
Potential users	Clinicians, provider management, commissioners.
Possible confounders	Comparisons should be made in the context of case-mix information covering the severity and co-morbidity of the patient population. Use of secondary diagnoses associated with the index admission may provide one method of controlling for co-morbidity. A similar method was used by the Scottish Clinical Outcomes Group in their report on Clinical Outcome Indicators (1995).

Data sources	<p>The denominator is defined within the CMDS, by the number of patients associated with provider spells ending within the given year for which the admission episode records a primary ICD-10 diagnosis of ‘acute myocardial infarction’ (I21) or ‘subsequent myocardial infarction’ (I22).</p> <p>Records relevant to the numerator will be included among emergency hospital admissions (to any provider unit) with a primary ICD-10 diagnosis matching one of those within the ICD-10 code blocks specified in the definition. The subset of these records that relate to denominator patients who were re-admitted within the specified follow-up period may be identified with reference to the NHS number and the difference between the index discharge date and the new admission date.</p>
Data quality	<p>The validity of the indicator is dependent on the quality of CMDS diagnosis data, which is unlikely to be uniformly high.</p>
Comments	<p>As specified, the denominator includes those patients dying within the follow-up period. As a result, the indicator’s estimate of the re-admission rate for a unit may be influenced by that unit’s mortality rate. Patients dying within a year of the index admission could be readily excluded from the denominator (the number of such deaths is available from Indicator 7).</p> <p>It may also be valuable to report this indicator over a five year period to obtain a longer term picture of the success of rehabilitation following a hospital admission.</p>
Further work required	<p>None recommended.</p>
Conclusion & priority	<p>C - To be implemented where local circumstances allow on a routine basis.</p>
References	<p>Clinical Outcomes Working Group of the Clinical Resource and Audit Group (1995). <i>Clinical outcome indicators</i>. The Scottish Office, Edinburgh.</p>

Candidate indicator 12

Characteristics

Perspective: Clinical
Timeframe: Cross-sectional
Outcome relationship: Indirect & direct

Title	Level of risk in respect of defined risk factors for CHD within a population six months after first-ever MI
Intervention aim	Reduce the risk of subsequent myocardial infarction or other related cardiovascular event.
Definition	<p>For a given population and year: <i>the number of patients, identified as high risk (using a risk assessment scale- to be specified) six months (\pm 21 days) after their first-ever MI, occurring in the given year, divided by the number of patients who had their first-ever MI in the given year.</i> The resulting fraction should be expressed as a percentage and reported together with both its numerator and denominator, by patient age-group and sex. The size of the relevant population together with the number of cases for which an assessment was available should also be reported.</p> <p>Few instruments exist which quantify an individual's risk following a coronary heart disease event. An instrument has not therefore been specified. There are risk score tools developed for assessing risk factors in primary prevention of CHD which could also be used in this group of patients (see Indicators 5A & 5B). An alternative approach may be to use a proxy for risk status and assess whether specific treatments known to be beneficial following a coronary event have been given and/or specific healthier behaviour adopted as a result of health care advice.</p> <p>Seven preventive measures which are supported by a degree of evidence have been identified (Norris 1997):</p> <ul style="list-style-type: none">- smoking status- use of aspirin- use of beta-blockers- use of angiotensin converting enzyme (ACE) inhibitors- use of cholesterol-lowering drugs- persisting ischaemia and the need for revascularisation- taken/taking part in a cardiac rehabilitation programme.
Rationale	<p>Risk status six months after a myocardial infarction is important in the evaluation of health promotion and other health care interventions. Secondary prevention of ischaemic heart disease offers the greatest opportunity for reducing coronary mortality. Supervision and treatment after a coronary attack are therefore of great importance (Norris 1997).</p> <p>Following a myocardial infarction patients are provided with education, counselling, support and drug therapy to tackle these risk factors and reduce the risk of suffering a second attack or other cardiovascular event. Cessation in smoking has been shown to reduce subsequent coronary mortality by up to 50% (Salonen 1980). Aspirin, beta blockers, ACE inhibitors and cholesterol lowering drugs have all</p>

shown benefits in terms of morbidity and mortality in patients following coronary events (Norris 1997). The resulting physiologically assessed risk factors may be assessed to obtain a risk score or an alternative approach may be to measure the use of certain treatments as a proxy for risk status.

Various models of care for rehabilitation following acute myocardial infarction exist and therefore the responsibility and location of a follow-up risk assessment may vary. It may be appropriate for a post-hospitalised population of patients to be assessed by an appropriately trained health care professional, e.g. cardiologist, or cardiac rehabilitation nurse at a hospital follow-up appointment. Alternatively the indicator may be assessed for a population of patients at a general practice, by a GP with a specialist expertise.

Potential uses	Clinical audit; monitoring trends over time; comparisons between providers.
Potential users	Clinicians, commissioners, and provider management.
Possible confounders	No specific ones identified.
Data sources	<p>This indicator relies on the collection of data six months after a myocardial infarction using a form of risk scoring system or proxy for current treatment. In the general practice population data could be collected by the GP or other member of the primary care team over the period of follow-up following the infarction. GP information systems using Read codes can be used to identify the following: blood pressure (XM02X) and numerical findings, cholesterol level (X772L) and numerical findings, smoking status (current non-smoker-137L) and current prescriptions (e.g. aspirin - x02LX, betablockers - x01Bz, ACE inhibitors - bi..., statins - x01R1 etc.), all dated within six months of a diagnosis of acute MI (G30...). Where already in use such scores should be directly retrievable from GP information systems. If used, Read codes can identify such assessment scales (XMOZx) (NHS Centre for Coding and Classification 1997).</p> <p>Prior to October 1st 1996, the GMSC health promotion programme package required the collection of information on risk factors for CHD, particularly smoking status and blood pressure. Targets of 90% coverage were achieved after five years of running the programme (General Medical Services Committee 1993). Although this data collection is no longer compulsory (NHS Executive 1996), the inclusion of monitoring of this nature is encouraged within the locally specified programmes which have now replaced it (Moher et al. 1997).</p> <p>Patients who have died in the six month period should be identified and reported separately.</p>

Data quality	Accuracy of data will depend on the quality of data yielded by the new health promotion programmes and generally held on GP information systems. There may be problems in analysis at the individual GP level due to small numbers.
Comments	It may be considered more valuable to collate data at the health authority level rather than the GP practice level. Such a system should be included as part of a GP audit programme. Although six months is specified as the period for follow-up after acute myocardial infarction, monitoring should ideally be continuous so follow-up at one to two years and so on should be considered.
Further work required	The testing and validation of a measuring tool to the indicator is a high priority. Methods of capturing this information other than by GPs should be explored such as via the rehabilitation nurse or at out-patient follow-up. Incorporation of aspirin prescriptions into overall risk score.
Conclusion & priority	E - To be further developed as a matter of urgency because the indicator specification is incomplete in that work is needed on the measurement tool. Once a tool is available it should be implemented generally by periodic survey (B).
References	<p>General Medical Services Committee (1993). <i>The new health promotion package</i>. BMA, London.</p> <p>Moher, M., Schofield, T., Weston, S., and Fullard, E. (1997). Managing established coronary heart disease. <i>British Medical Journal</i>, 315, 69-70.</p> <p>NHS Executive (1996). <i>GP health promotion. FHSL (96) 35</i>. NHS Executive, Leeds.</p> <p>NHS Centre for Coding and Classification (1997). <i>The Read Codes March 1997 Demonstrators</i>. NHS Executive, Leeds.</p> <p>Norris, R. M. (1997). After the infarction: current evidence-based practice. <i>General and Elderly Medicine</i>, 1, 4-7.</p> <p>Salonen, J.T. (1980). Stopping smoking and long term mortality after acute myocardial infarction. <i>British Heart Journal</i>, 43, 463-469.</p>

Candidate indicator 13

Characteristics

Perspective: Clinical

Timeframe: Cross-sectional

Outcome relationship: Indirect & direct

Title	Impact of symptoms on function within a population of patients six months after first-ever MI
Intervention aim	Improve function and well-being after myocardial infarction.
Definition	For a given population of patients having had their first-ever MI within a given year: <i>a summary of patients' scores from an assessment of symptom impact on function (to be specified), as administered six months (± 21 days) after their first-ever MI.</i> The summary statistics will describe the distribution of scores, broken down by patient age-band and sex. The size of the relevant population together with the number of cases for which an assessment was available should also be reported.
Rationale	<p>Indicators 13 & 14 intend to capture aspects of physical and psycho-social functioning in a population of patients six months after their first myocardial infarction. Assessment of impact of symptoms on function six months after MI will reflect, in part the quality of rehabilitation and community service provision.</p> <p>Cardiac status can be ascertained by assessment of symptoms of breathlessness (attributable to left ventricular dysfunction) and symptoms of angina pectoris (attributable to coronary ischaemia). The presence of these symptoms to various degrees will impact on an individual's ability to function satisfactorily in everyday life. This indicator specifies the use functional scales to assess the impact of such cardiac symptoms on function.</p> <p>For the purposes of this indicator, the required instrument to assess function should meet practical considerations relating to its administration. Secondly, metrical properties of the instrument (in terms of validity, reliability and sensitivity to clinical intervention) should also have been demonstrated in the population of interest. The selection of a single standard instrument to measure functioning following MI would be helpful and facilitate comparisons across provider units or districts. However, further work is needed to determine a suitable tool.</p> <p>A number of scales and measures exist which can be used to assess functional capacity following cardiovascular disease.</p> <p><i>New York Heart Association Functional Classification Scale</i></p> <p>Patients are graded according to the degree of impairment - 1= No limitation on activities; suffers from no symptoms from (performance of) ordinary activities; 2 = Slight limitation on activities; comfortable at rest or on mild exertion; 3= Marked limitation on activities; comfortable only at rest; 4= Discomfort with any physical activity; should be completely confined to bed. Doctors generally make the gradings. There are some concerns regarding poor correlation with exercise testing and high inter-observer reliability (Goldman et al. 1981).</p>

Canadian Cardiovascular Society Functional Classification for Angina Pectoris

Four classes very similar to above scale. Developed as more detailed scale than one above. Developed to measure changes in the severity of chest pain (Coronary Artery Surgery Study: CASS 1983).

The Specific Activity Scale (SAS)

Used to assess cardiac functional class based on the metabolic demands of a variety of daily activities (Goldman et al. 1981). Along the lines of the well-known NYHA/CLA classification (above) it is an ordinal scale with four classes of function (best = I to worse = IV). The scale is reported to have good psychometric properties, specifically sensitivity to change. It has also been modified for use in telephone interviews assessing ability rather than performance (Cleary et al. 1991). The tasks should be revised for a UK population.

Ratio Property Scale

Used in studies of recovery after myocardial infarction (Fridlund et al. 1991). Symptoms are rated between 0 and 10 ('nothing at all' to 'maximal'). The scale has shown some sensitivity to improvements at five weeks and six months (Fridlund et al. 1991).

Potential uses	Clinical audit; monitoring trends over time; comparisons between providers.
Potential users	Clinicians, commissioners, and provider management.
Possible confounders	Comparisons between population should be made in the context of case-mix information covering severity and co-morbidity.
Data sources	The identification and follow-up of patients following MI is best achieved through use of a coronary heart disease register. Such a register may be general practice based allowing GPs to follow-up their patients through either a postal survey or during a consultation. Patients who have had an MI in the given year (and who are still living) could be identified, and forms generated for an assessment of their functioning six months after their MI.
Data quality	The quality of the data will also depend on the methods of data collection employed. Further investigation and study are required to establish the likely data quality. The value of the indicator would be compromised by low rates of completion - a danger where the data are not derived from information systems which support operational activities.
Comments	While cross-sectional indicators provide some indication of therapeutic and rehabilitative success, longitudinal measures allow for a better assessment of the benefits of treatment as they take into account the severity of the patient's condition at the outset of treatment and care. Further work is still needed however on obtaining retrospective assessments of function following MI.

Further work required	Identification of most appropriate tool to allow the indicator to be used for comparative purposes.
Conclusion & priority	E - To be further developed because the indicator specification is incomplete in that work is needed on the measurement tool.
References	<p>Cleary, P.D., Epstein, A.M., Oster, G., Morrissey, G.S., Stason, W.B., Debussey, S., Plachetka, J., and Zimmerman, M. (1991). Health-related quality of life among patients undergoing percutaneous transluminal coronary angioplasty. <i>Medical Care</i>, 29, 939-950.</p> <p>Coronary Artery Surgery Study (CASS) (1983). Coronary Artery Surgery Study (CASS): a randomised trial of coronary artery bypass surgery. Quality of life in patients randomly assigned to treatment groups. <i>Circulation</i>, 68, 951-960.</p> <p>Fridlund, B., Hogstedt, B., Lidell, E., and Larsson, P.A. (1991). Recovery after myocardial infarction: effects of a caring rehabilitation programme. <i>Scandinavian Journal of Caring Science</i>, 5, 23-32.</p> <p>Goldman, L., Hashimoto, B., Cook, E.F.L., and Loscalzo, A. (1981). Comparative reproducibility and validity of systems for assessing cardiovascular functional class: advantages of a new specific activity scale. <i>Circulation</i>, 64, 1227-1234.</p>

Candidate indicator 14

Characteristics

Perspective: Clinical
Timeframe: Cross-sectional
Outcome relationship: Direct

Title	Assessment of general health status/quality of life within a population of patients six months after first-ever MI
Intervention aim	Improve function and well-being after myocardial infarction.
Definition	For a given population having had an MI within a given year: <i>a summary of patients' scores from an assessment of general health status (to be specified), as administered six months (\pm 21 days) after their first-ever MI.</i> The summary statistics will describe the distribution of scores, broken down by patient age-band and sex. The size of the relevant population together with the number of cases for which an assessment was available should also be reported.
Rationale	<p>Indicators 13 & 14 intend to capture aspects of physical and psycho-social functioning in a population of patients six months after their first myocardial infarction.</p> <p>Recognition of the complexities of health as a notion has led to increased attention to the concept of 'quality of life'. In cardiovascular disease, where the goal of treatment is not only to prolong life but to relieve symptoms and improve function, it is accepted that evaluation of clinical effectiveness in the treatment of cardiovascular disease should include an assessment of health-related quality of life (Wenger et al. 1984). In response to this, a number of generic measures have been used in studies and trials of rehabilitation and secondary prevention, and some disease-specific instruments have been developed.</p> <p>A well-known generic instrument is the Short Form-36 (SF-36) (Ware et al. 1993), a general health status questionnaire which includes physical functioning and has been fully tested for its appropriateness with people with cardiovascular diseases. As well as having been adapted for a UK population, normative data also exists for the UK. The instrument has been well tested for validity and reliability unlike other less developed instruments.</p> <p>The Nottingham Health Profile (NHP) is another alternative general health status questionnaire developed in the UK. It has been used to evaluate the outcome of many therapies from the patient's perspective and to assess the perceived health status of coronary patients before and after specific surgery. The instrument is short and simple and can be used for the general population or groups of patients. Population norms also exist for this instrument (Hunt et al. 1984).</p> <p>Another example is the Quality of Life after Myocardial Infarction (QLMI). This is an easy-to-use questionnaire that would address physical, emotional and social function following MI (Hilliers et al. 1994). The questionnaire consists of 26 questions which cover five domains: symptoms, restriction, confidence, self-esteem and emotion and asks the respondent to consider the time period of the last two</p>

weeks. The respondent has a seven-point ordinal scale (1=poor and 7=good) to rate their response to each question and it is estimated to take less than ten minutes to complete. A score is given for each domain which are reported separately, so each patient will have five separate scores.

The McMaster Health Index Questionnaire (MHIQ) was developed as a measure of physical, social and emotional functioning and intended to be a health-status questionnaire suitable for administration to general populations. It has been used in patients with myocardial infarction and includes items relating to symptoms and behaviour.

Potential uses	Clinical audit and provider based comparisons.
Potential users	Clinicians, provider management, commissioners.
Possible confounders	No specific ones identified.
Data sources	The identification and follow-up of patients following MI is best achieved through use of a coronary heart disease register. Such a register may be general practice based allowing a GP to follow-up their patients through either a postal survey or during a consultation. Patients who have had an MI in the given year (and who are still living) could be identified, and forms generated for a general health status questionnaire six months after their MI. Although aspects of quality of life are likely to be the subject of informal clinical assessment, such assessments are rarely made in a standard form. General use of one tool to collect data on health-related quality of life would allow collation of data and comparisons between populations.
Data quality	<p>The SF-36 and NHP have advantages in that they are short with good psychometric properties. They also have the benefit of relatively widespread use in the UK, and in cardiovascular diseases.</p> <p>The QLMI has been tested both as an interview administered tool and modified for use as a self-administered instrument (Lim et al. 1993). The measure was however developed for a psychologically abnormal subset of MI patients, administered in an unusual (i.e. previous responses were given) and its validity was sought post-hoc. (Hilliers et al. 1994).</p> <p>The McMaster Health Index Questionnaire is a self-administered tool which has been reported to be superior in terms of sensitivity to change than using other methods. This would facilitate its use in a postal survey (Chambers 1984).</p>

The quality of these data will depend on the methods employed. Further investigation and study is required to establish the likely quality. The value of the indicator would also be compromised by low rates of completion - a danger where the data are not derived from information systems which support operational activities.

Comments

No specific points.

Further work required

Identification of most appropriate tool to allow this indicator to be used for comparative purposes.

Conclusion & priority

E - To be further developed because the indicator specification is incomplete in that work is needed on the measurement tool.

References

Chambers, L.W. (1984). The McMaster Health Index Questionnaire. In *Assessment of quality of life in clinical trials of cardiovascular therapies* (ed. N. Wenger, M. Mattson, and C. Furberg). Le Jacq Publications, New York.

Hilliers, T.K., Guyatt, G.H., Oldridge, N., Crowe, J., Willan, A., Griffith, L., and Feeny, D. (1994). Quality of life after myocardial infarction. *Journal of Clinical Epidemiology*, **47**, 1287-1296.

Hunt, S.M., McEwan, J., and McKenna, S.P. (1984). Perceived health: age and sex comparisons in a community. *Journal of Epidemiology and Community Health*, **34**, 281-287.

Lim, L.L., Valenti, L.A., Knapp, J.C., Dobson, A.J., Plotnikoff, R., Higgenbotham, N., and Heller, R.F. (1993). A self-administered quality of life questionnaire after acute myocardial infarction. *Journal of Clinical Epidemiology*, **46**, 1249-1256.

Ware, J.E., Snow, K.K., Kosinski, M., and Gandek, B. (1993). *SF-36 Health Survey: manual and interpretation guide*, The Health Institute, Boston, MA.

Wenger, N.K., Mattson, M.E., Furberg, C.D., and Elison, J. (1984). Assessment of quality of life in clinical trials of cardiovascular therapies. *American Journal of Cardiology*, **54**, 908-913.

SECTION 5: RECOMMENDATIONS

To be implemented generally

5.1 It is **recommended** that the following indicators be implemented generally (the numbers refer to the indicator specifications in Section 4):

1A : population-based heart attack rate for MI

1B : annual hospital admission rate for all MIs

6 : population-based mortality rate for MI

7 : case-fatality rates for patients admitted to hospital alive with a MI.

Indicator 1A should be derived from periodic surveys, the other three should be produced on a routine basis.

5.2 To obtain a **population-based heart attack rate** information is required about all acute infarctions including patients admitted to hospital, those given a diagnosis of infarction by their GP and those who died suddenly as a result of an infarction. An ideal data source would be a population-based register but a well planned survey could bring together the requisite data. The variability of the recording of myocardial infarction on death certificates is likely to be a major confounder for this indicator.

5.3 The **annual hospital admission rate for all myocardial infarctions** provides information about success in changing peoples' lifestyles. The data are reasonably easy to collate but the validity of the indicator is dependent on the quality of diagnosis coding.

5.4 Age-specific **mortality rates** for myocardial infarction allow for the impact on premature deaths to be identified and also for the way the recording of the underlying cause of death varies with age. For patients aged 65 and over there is evidence of significant over-recording of myocardial infarction as the underlying cause of death.

5.5 **Case-fatality rate** comparisons may reflect the effectiveness of the care provided in different units and the presenting characteristics of the patients. Those who are admitted to and die in an accident and emergency department should be included in the compilation of this indicator. The case-fatality rates in hospital should be collected generally on a routine basis but, wherever local circumstances allow, attempts should be made to obtain rates for 30 days and one year after admission.

To be implemented where local circumstances allow on a routine basis

5.6 It is **recommended** that the following indicators be implemented where local circumstances allow on a routine basis:

- 1C : annual hospital admission rate for first-ever MIs**
- 4 : percentage of general practice patients, identified as hypertensive, whose most recent systolic blood pressure measurement is less than 160 mm Hg**
- 5A : percentage of general practice patients identified as at high risk of coronary heart disease in the given year**
- 5B : summary of twelve month changes in the risk of coronary heart disease within a general practice population**
- 8 : proportion of patients attending hospital with MI who received thrombolytic therapy**
- 9A : time from onset of symptoms to call for help**
- 9B : time from call for help to arrival at hospital**
- 9C : time from arrival at hospital to administration of thrombolytic therapy**
- 10 : time from call for help to defibrillator availability**
- 11A: rate of in-patient admission for MI within one year of a previous hospitalised MI**
- 11B: rate of in-patient admission for selected cardiovascular events within one year of a previous hospitalised MI.**

5.7 The data for **the hospital admission rate for first-ever MIs** should be obtained from the contract minimum data set. The extent to which first-ever MIs are distinguished from the others in these data needs to be reviewed.

5.8 Raised blood pressure is a significant risk factor for MI. **Indicator 4** reflects the extent to which hypertensive patients are having their systolic blood pressure controlled. GP information systems should be developed to encourage the collection of these data routinely.

5.9 Two indicators relate to **patients at high risk of coronary heart disease**. GPs are encouraged to use one of a limited number of instruments, as no single measuring tool has been shown to be better than the others. While the cross-sectional Indicator 5A can provide some indication of the success of interventions, the longitudinal measure 5B allows a better assessment of the benefits of targetted interventions. However, there are difficulties in achieving complete follow-up in the completion of longitudinal indicators.

- 5.10 Thrombolytic therapy** reduces 30 day mortality significantly. The indicator as specified includes patients admitted to the wards as well as those who die in an accident and emergency department. Information about prescribing can currently only be obtained by a manual survey of the case notes.
- 5.11 Indicators 9A-C** relate to the time distribution for three specific delays. The importance of reducing these delays relates to the benefit of thrombolytic therapy which is greatest for those patients who receive it most quickly after the onset of symptoms. Experience has shown that these data can be obtained satisfactorily by well designed proforma.
- 5.12** The benefits of reducing **the time from call for help to defibrillator availability** have been demonstrated and all front line ambulances are now fitted with defibrillators when attending patients with chest pain.
- 5.13 Indicators 11A and B** should reflect the success of health care interventions and the advice provided following the initial MI. As specified, both indicators include in the denominator patients dying within the follow-up period. As a result, the indicator's estimate of the re-admission rate for a unit may be influenced by the case-fatality rate (Indicator 7).

To be implemented where local circumstances allow by periodic survey

- 5.14** It is **recommended** that the following indicators be implemented where local circumstances allow by periodic survey:
- 2 : percentage of people who report having ceased smoking in the given year**
 - 3 : mean systolic blood pressure in persons aged 16 and over.**

In addition to local studies, there should also be a regular national survey to obtain Indicator 3.

- 5.15 Smoking** is an important risk factor for a first myocardial infarction and for fatal and non-fatal recurrences. A variety of well-validated questions about smoking are available but self reporting of smoking habits is not always reliable.
- 5.16** Significant public health gains would be expected from **reducing the mean blood pressure** of a population. There should be local encouragement for general practices to continue to monitor blood pressure as part of their health promotion programme.

To be further developed

5.17 It is **recommended** that the following indicators require further development before implementation is considered, either because the link with outcomes is not clear or because work is needed on methods of measurement:

12 : level of risk in respect of defined risk factors for CHD within a population of patients six months after first-ever MI

13 : impact of symptoms on function within a population of patients six months after first-ever MI

14 : assessment of health status/quality of life within a population of patients six months after first-ever MI.

5.18 The Group considered that it was important that all patients should have a multi-factorial assessment six months after a first-ever MI. The specifications for **Indicators 12-14** contain a summary of the current tools available but none are ready for general implementation without extra development. The validation of an acceptable tool for Indicator 12 is a high priority and as soon as it is available this indicator should be implemented generally by periodic survey.

APPENDIX A: BACKGROUND TO THE WORK

Summary

A1. Over the last few years a major component of the Department of Health's and NHS Executive's strategy has been to promote the development and use of measures of health outcome. In July 1993 the Central Health Outcome Unit (CHOU) was set up within the Department of Health (DoH). Commissioned by the DoH, in 1993 a feasibility study of potential outcome indicators was published by the Faculty of Public Health Medicine and a package of indicators was published by the University of Surrey for consultation. Following these two phases of development, a third phase of work was initiated by the CHOU. Its remit is to report on 'ideal' health outcome indicators.

Central Health Outcome Unit

A2. The CHOU is an internal DoH unit whose goal is 'to help secure continuing improvement in the health of the people of England through cost-effective and efficient use of resources' (Lakhani 1994). The objectives of the Unit are to:

- encourage and co-ordinate the development of health outcome assessment, particularly in respect of the development of appropriate methods, appropriate data collection systems, expertise, analytical skills, and interpretation
- encourage and support the use of health outcome assessment and information in making policy about health interventions and in the planning, delivery and monitoring of services.

A3. Several national committees have a special interest in outcomes and have been informed of progress:

- Clinical Outcomes Group
- Public Health Network
- CMO Working Group on Information Management and Technology.

Phases 1 and 2

A4. The Faculty of Public Health Medicine was commissioned to undertake a feasibility study of potential indicators which reflect health end-points for health services and which cover topics in which health care has an important contribution to make. This work (McColl and Gulliford 1993) was constrained in that the set of indicators were to:

- be based on reliable routinely collected data
- reflect health service interventions rather than the wider influences on health.

A5. The University of Surrey was commissioned to produce a package of comparative statistics based on the outcome measures recommended in the feasibility study. Forty indicators were chosen, 18 for maternal and child health, three for mental health and the rest for other topics in adult health. The publication (Department of Health 1993) contained indicator definitions, maps and scatter plots showing geographical variations, and tables presenting the rates, with corresponding observed numbers and confidence intervals when appropriate.

The Phase 3 work : ideal indicators of health outcomes

A6. In the third and current phase of the work on health outcomes a number of research institutions were commissioned to assist in developing a structured approach to identify indicators to cover a number of clinical topics. The prime contractor was the Unit of Health-Care Epidemiology, Department of Public Health and Primary Care, University of Oxford.

A7. The respective roles of the supporting organisations were as follows:

- Unit of Health-Care Epidemiology, University of Oxford, to provide epidemiological and managerial support to the Group and co-ordinate the input of the other agencies
- CASPE Research, in London, to provide technical advice with regard to indicators and their data sources, and prepare the detailed indicator specifications
- Royal College of Physicians' Research Unit, in London, to co-ordinate the clinical input.

- A8.** In the previous work a key criterion for selection of indicators was the requirement for the work to be based on routinely available data. This practical constraint has meant that the recommended indicators were selected and opportunistic rather than an ideal set. This inevitably led, as the DoH acknowledged, to a bias towards outcomes which may be measurable now but which may not necessarily be those which are most appropriate and most needed. The aim of the third phase is to advise on and develop 'ideal' outcome indicators without confining recommendations to data which have been routinely available in the past.
- A9.** The initial task of the third phase of the work was to select clinical topics for detailed study. In order to ensure that the work would be manageable, and that the NHS would have the capacity to absorb the output, the CHOU decided to limit the activity to five clinical topics a year.
- A10.** A workshop to initiate the work which was attended by over 70 individuals representing a wide range of interests was held in January 1995. A report of the proceedings has been published (Goldacre and Ferguson 1995). The main aims were:
- to identify the criteria which should be used to choose clinical topics for the Phase 3 work
 - to suggest a list of potential clinical topics which workshop participants would like to be included in the Phase 3 work.
- A11.** Following further consultation within and outside the DoH, the CHOU decided in June 1995 to include the following topics in the first two years of Phase 3 work:
- Asthma
 - Breast cancer
 - Cataract
 - Diabetes mellitus
 - Fracture of neck of femur
 - Incontinence
 - Myocardial infarction
 - Pregnancy and childbirth
 - Severe mental illness
 - Stroke.

Health outcome information

A12. The Group was influenced in its work by considering the potential uses of outcome information, as follows:

- for clinical decision-making and audit of clinical work, including:
 - management of individual patients
 - audit and management of health professionals' practice
 - research
- for informing decisions about the strategic and operational development of services
- for comparisons of organisations in the delivery of services which may be:
 - provider based
 - population based
- for assessing progress towards agreed standards or targets for health outcomes, agreed nationally or locally, which may be:
 - identified from the research literature
 - set by clinical and managerial decisions.

A13. Current managerial interests which are relevant to the use of health outcome information include:

- NHS goal 'to secure, through the resources available, the greatest improvement in the physical and mental health of people in England'
- clinical audit
- evidence-based commissioning.

A14. An important purpose of this work has been to recommend indicators which, if possible, would allow 'health gain' to be assessed alongside information used to measure health service input. Our particular focus has been to make recommendations about aggregated statistical information about people who have had a myocardial infarction which can be used to:

- enable providers of care to review outcomes of the care of their patients
- make comparisons, where appropriate, of health outcomes against locally agreed targets and/or between different places and/or over time.

A15. Information for outcome indicators may be obtained from continuous data collection systems but, when having continuously collected information is unnecessary, or when the cost or complexity of this is high, use should be made of sample survey techniques or periodic surveys.

A16. Health indicators are more likely to be successful if they fit naturally into the everyday work of health care professionals than when they have to be collected as a separate activity. The aim is to have indicators that are:

- *Relevant* because professionals use them everyday in treating their patients and will record them accurately.
- *Reliable* because they can be validated or cross checked from other sources.
- *Responsive* because they readily identify changes in the patient's state of health.
- *Research-based* because there is a plausible link between processes of care and outcome.

A17. In common with the approach taken to other types of indicators by the NHS, the Group recognise that useful outcome indicators should be capable of identifying circumstances worthy of investigation but that, in themselves, they may not necessarily provide answers to whether care has been 'good' or 'bad'. In particular it is recognised that there may be difficulties in drawing causal conclusions - say, that a particular aspect of care caused a particular outcome - from indicators derived from non-experimental clinical settings. Nonetheless the vast majority of clinical care is delivered in routine rather than experimental practice. The assessment of its outcomes entails, by definition, the use of observational rather than experimental data.

A18. To be useful, work on 'ideal' outcome aspects needs to incorporate considerations of practicability. It is a time of rapid change in information technology. What may be feasible now in some places may not be feasible everywhere. What may not be practical today may become so in a year or two.

APPENDIX B: MYOCARDIAL INFARCTION GROUP

B1. The Myocardial Infarction Working Group was formally constituted in October 1996 and met four times, completing its work in September 1997. The Report was completed in December 1997. The terms of reference were:

- To advise on indicators of health outcomes of the prevention, treatment and aftercare of myocardial infarction.
- To make recommendations about the practicalities of the compilation and interpretation of the indicators, and to advise if further work is needed to refine the indicators and/or make them more useful.

B2. The membership of the Working Group and the staff of the supporting organisations are shown below. The composition of the Group included the professional and managerial groups and representatives of patients involved with the prevention, treatment and care of the disease.

Chairman and members

Physicians	:	John Birkhead, General Hospital, Northampton (Chairman) David Gray, University Hospital, Nottingham Roger Boyle, District Hospital, York Clive Weston, Pinderfields General Hospital, Wakefield Robin Norris, Brighton Caroline Morrison, Greater Glasgow Health Board
GPs	:	Godfrey Fowler, Oxfordshire Hugh Bethell, Hampshire
Nurse	:	David Thompson, Hull
Public health	:	Robert West, University of Wales Medical School
CEOs	:	Mike Bellamy, Ealing, Hammersmith & Hounslow HA Martin Hill, Royal Alexandra Hospital NHS Trust, Paisley
Voluntary body	:	Brian Pentecost, British Heart Foundation, London
DoH	:	Peter Doyle Dawn Milner

Academic support and secretariat

Michael Goldacre, Alastair Mason and Ewan Wilkinson, University of Oxford
James Coles, Moyra Amess & Robert Cleary, CASPE Research, London
Vincent O'Brien, Central Health Outcome Unit, DoH

APPENDIX C: DEFINITION OF MYOCARDIAL INFARCTION

C1. The definition of myocardial infarction varies according to the discipline of the doctor describing it and the purposes for which the information is being collected. There are broadly three types of definition relating to:

- pathologists' perspective
- clinicians' perspective
- epidemiologists' perspective.

Pathologists' perspective

C2. In the United Kingdom Heart Attack Study the following definition was used:

'Out-of-hospital deaths were included if either they showed ischaemic heart disease as the principal cause of death at Coroners' autopsy (87%) or, in the absence of autopsy (13%), occurred in patients with a history of ischaemic heart disease who died unexpectedly and without any other apparent cause. Autopsy cases were required to have stenosis of > 75% of cross-sectional area in at least one major epicardial coronary artery, with or without recent coronary thrombus or old or recent myocardial infarction. Deaths from chronic cardiac failure due to ischaemic heart disease were recorded in one centre (Brighton) but are not included in the present analysis. They comprised 11% of all coronary deaths in Brighton, and only 29% occurred outside hospital.'

C3. Post-mortem diagnosis of the cause of death of patients who die suddenly without being clinically investigated is often imperfect. In particular (Davies 1997) :

- Visible evidence of infarction in the myocardium may not be apparent before 12 to 24 hours. Thus most cases of sudden coronary death are properly classified by the pathologist as death from ischaemic heart disease.
- The presence of fresh occlusive coronary thrombus is almost pathognomonic of developing infarction. Non-occlusive thrombus is seldom recognised at routine autopsy and its potential to lead to infarction is less certain.
- Histological examinations of serial sections of coronary arteries of victims of sudden cardiac death show plaque fissuring in 90% of cases, non-occlusive thrombus in 44% and occlusive thrombus in 30%. However, plaque fissuring is a non-specific finding, found in 9% of non-coronary deaths.

- Platelet emboli are found in the myocardium downstream of the culprit plaque in 40% of cases of sudden ischaemic death.
- Natural lysis of the thrombus may subsequently clear the vessel of thrombus within a few hours of the incident, although this is probably more common in patients who do not die.

C4. In practice, histopathologists do not perform post-mortem angiography routinely and many may limit the procedure to cursory sectioning of the coronary arteries. Histological examination is not always routine. Plaque rupture is often not recognised. If a thrombus is not found the diagnosis on death certificates is commonly 'acute on chronic myocardial ischaemia'.

Clinicians' perspective

C5. In the United Kingdom Heart Attack Study (UKHAS), the following definition for hospital cases was used:

'Hospital cases of myocardial infarction showed at least two of the following three features: typical or compatible clinical history; sequential electrocardiographic changes; and a rise in serum enzymes to at least twice the upper limit of normal for the hospital laboratory. For patients who died very soon after presentation, prolonged chest pain with one electrocardiogram showing an infarct pattern was sufficient for the diagnosis.'

C6. Outside hospital the position is more complex in that:

- up to 30% of infarction may be silent, depending on the means used to look for them
- a diagnosis of infarction may be made by a GP on the basis of history alone if it is felt hospital admission is unnecessary
- a GP may investigate a patient appropriately, treat the patient at home and the investigation results are only recorded in the GP notes and thus not easily accessible for inclusion in population based statistics
- there are issues related to the certification of sudden unexpected death.

C7. When there is a sudden unexpected death in a patient with known coronary disease and a post-mortem has not been performed, a GP in England may issue a death certificate indicating myocardial infarction as the cause of death provided that the patient has been seen alive within the last two weeks. It is highly likely that the diagnosis is correct whether or not there has been a prodromal illness.

- C8.** Sudden unexpected death in people who do not have a history of coronary disease nor a post-mortem is also frequently certified due to myocardial infarction, particularly when this occurs in the very elderly. On balance, it is likely that most of these are acute coronary deaths, but this is by no means certain.

Epidemiologists' perspective

- C9.** The epidemiological definitions of myocardial infarction depend in part on the purposes for which population-based data are being used. Denominators can be assembled of distinct groups of diagnostic probability, namely:

- standardised clinical criteria (as noted in paragraph 2.1)
- post-mortem confirmation of infarction
- prodromal symptoms in someone with known heart disease and sudden death with no autopsy
- post-mortem diagnosis of acute or chronic myocardial ischaemia
- post-mortem diagnosis of coronary artery disease but not acute syndrome.

- C10.** The Group accepted that, in view of the clinical and pathological complexities, it would not be possible to recommend an ideal denominator. In choosing the clinical criteria noted in paragraph 2.1 as the basis, it was recognised that this definition would lead to an underestimation of the true incidence of myocardial infarction. Most of the indicators specified have used the definition involving standardised clinical criteria but some have other diagnostic groups added.

APPENDIX D: METHODS FOR CHOOSING INDICATORS

- D1.** Candidate outcome indicators were identified by the Group with the help of the following:
- the health outcome model for myocardial infarction (see Section 2)
 - various classifications of the characteristics of outcome indicators.
- D2.** The Group noted that indicators may be related to:
- i. causal factors in the general population or relating to the individual
 - ii. knowledge, attitudes, behaviour in the general population
 - iii. knowledge, attitudes including satisfaction with service delivery and behaviour of individual patients with myocardial infarction
 - iv. patients' symptoms, function, health status and well-being
 - v. patients' clinical state
 - vi. patients' pathological/physiological state
 - vii. events occurring to patients as endpoints of the earlier occurrence of disease and/or interventions such as contacts with general practitioners, issuing of prescriptions, out-patients visits, in-patient admissions, death.
- D3.** The data sources for the indicator entities noted in paragraph D2 will differ. It is likely that:
- indicators for (i) and (ii) would come from population surveys
 - indicators for (iii) and (iv) would come from patients either opportunistically or when specifically called
 - indicators for (v) and (vi) would come from doctors and other health professionals
 - indicators for (vii) would come from administrative information systems.
- D4.** The Group recognised the high cost and complexity of obtaining information from continuous data collection systems. Particular consideration was given to obtaining outcome indicator data from sample survey techniques when it is not essential to have continuously collected information.
- D5.** Four characteristics of an outcome indicator have been identified and each has been classified. They are:
- measurement perspective, relating to whose perspective the indicator is most relevant (see paragraph D6)
 - specificity (see paragraph D7)
 - measurement timeframe (see paragraph D8)
 - outcome relationship, in that the indicator is either a direct or an indirect, proxy measurement of outcome (see paragraph D9).

- D6.** For the Group's purposes measurement perspective was classified as that from the patient's, the clinical, or the population's viewpoint. In the treatment of myocardial infarction, for example, a measure of quality of life may be most relevant to the patient's perspective while clinical concerns may properly focus on electrocardiogram changes. The population perspective has a broader view, best addressed by measures able to assess the burden of the condition as a whole. Of course, these perspectives are not necessarily in opposition and will often be associated with shared goals. Where possible, a set of indicators should be developed which satisfies all three measurement perspectives.
- D7.** The specificity of an indicator relates to whether it is specific or generic in application. For example, electrocardiogram changes are specific to heart disease. The measurement of general health status is much less specific and would be influenced by a number of conditions. Condition-specific indicators have the advantage that their relative insensitivity to other conditions is likely to increase their sensitivity to changes in the condition of interest. Generic measures provide outcomes relevant to a wide range of conditions. A comprehensive indicator set might contain examples of both generic and specific indicators.
- D8.** The measurement timeframe relates to whether the indicator is:
- cross-sectional, an indicator at a single point in time for an individual
 - a longitudinal measure of progression over time for any one individual.
- D9.** The Group's main task has been to develop direct indicators of health outcome although in many areas it may be difficult to identify or obtain such information. However, it is recognised that some care processes are so closely related to the production of benefits that the successful completion of the intervention might be used as a proxy measure of the actual outcome. In the absence of direct outcomes, proxy indicators have therefore been developed.
- D10.** There is increasing recognition of the importance of outcome measures derived from data generated by patients. For the purposes of the Group's work, three main areas of interest have been identified:
- impact of the condition on the patient
 - satisfaction of the patient with the care provided and/or outcome achieved
 - awareness of the patient of the management of the condition and services available.

D11. With the assistance of the check-lists and a knowledge of the condition, the Group addressed the following key questions:

- What are health professionals trying to achieve for each patient?
- What can each patient realistically expect will be achieved for him/herself?
- What should be achieved for the population as a whole in respect of the prevention, care or cure of the condition?

APPENDIX E: GUIDANCE NOTES FOR INDICATOR SPECIFICATIONS

Indicator title	A short title to identify the indicator
Intervention aim	<p>Distinguishes the level of intervention for which the indicator is primarily developed. It is assumed that, for a given condition, an ideal set of indicators would be reasonably balanced across the spectrum of health intervention stages. For myocardial infarction these stages are:</p> <ul style="list-style-type: none">- reduce the risk of a first myocardial infarction- reduce the risk of death from myocardial infarction- reduce the risk of subsequent myocardial infarction or other related cardiovascular event- improve function and well-being after myocardial infarction.
Characteristics	<p>Classifies the indicator on four dimensions:</p> <ul style="list-style-type: none">- Specificity: <i>condition-specific or generic</i>.- Perspective: <i>population, clinical or patient</i>.- Timeframe: <i>cross-sectional</i> measure or <i>longitudinal</i> assessment of change.- Outcome relationship: whether it is a <i>direct</i> measure of outcome or an <i>indirect</i> measure of structure or process, used as a proxy for outcome.
Indicator definition	<p>In addition to a definition of the variable of interest, the description specifies:</p> <ul style="list-style-type: none">- how the variable is to be aggregated across cases, e.g. definitions of both a numerator and a denominator- if a variable is to be reported with respect to a set of denominators, e.g. mortality broken down by age and sex- if appropriate, how longitudinal change in the variable is to be represented, e.g. over what time interval and whether absolute difference or proportional change.
Rationale	<p>A brief statement of the reasons and objectives behind the indicator, both in terms of the issues it addresses and its selection from a range of potential alternatives.</p>
Condition definition	<p>The definitions used in the specifications are shown in paragraphs 2.1 and 2.3.</p>
Potential uses	<p>The following classification has been used:</p> <ul style="list-style-type: none">- local management of practice- local audit- provider based comparisons- population based comparisons- assessment of regional/national trends or progress towards targets.

Potential users	<p>The following classification has been used:</p> <ul style="list-style-type: none">- national/regional policy makers- provider management- commissioners- clinicians- consumers/public.
Possible confounders	<p>This section has attempted to identify the population risk factors likely to influence the outcome indicator, and therefore useful in its interpretation. Where such factors are well defined and have a clear or potential association with the outcome of interest, they may be used to specify denominators to be included in the indicator definition itself.</p>
Data sources	<p>Where possible, existing sources of data have been identified for deriving the indicator and the degree to which complete coverage of the population of interest would be obtained has been noted. Where data are not widely available from existing systems, suggestions for new methods of data collection, capable of wide implementation have been made.</p>
Data quality	<p>While the theoretical capabilities of existing and proposed information systems are outlined above, the actual or expected limitations of those systems - in terms of their completeness and accuracy etc. - are noted in this section.</p>
Comments	<p>General comments regarding the indicator's definition, validity, practicality etc.</p>
Further work required	<p>Suggestions about the additional research and development work required to complete the indicator's specification to a level appropriate for large scale piloting.</p>
Conclusions & priority	<p>A statement indicating the Working Group's assessment of the priority for implementation.</p>
References	<p>Appropriate references used in the construction of the indicators.</p>

APPENDIX F: REFERENCES

AIRE study investigators (1993). Effect of ramipril on mortality and morbidity of survivors of acute myocardial infarction with clinical evidence of heart failure. Acute Infarction Ramipril Efficacy (AIRE) Study. *Lancet*, **8875**, 821-828.

AIREX study investigators (1997). Follow-up study of patients randomly allocated to ramipril or placebo for heart failure after acute myocardial infarction: AIRE extension study (AIREX). *Lancet*, **349**, 1493-1497.

Anderson, K.M., Odell, P.M. Wilson, P.W.F., and Kannel, W.B. (1991a). Cardiovascular disease risk profiles. *American Heart Journal*, **121**, 293-298.

Anderson, K.M., Wilson, P.W.F., Odell, P.M., and Kannel, W.B. (1991b). An updated coronary risk profile: a statement for health professionals. *Circulation*, **86**, 858-869.

Antiplatelet Trialists Collaboration (1994). Collaborative overview of randomised trials of platelet therapy : prevention of death, myocardial infarction, and stroke by prolonged anti-platelet therapy in various categories of patients. *British Medical Journal*, **308**, 81-106.

ASPECT (1994). Anticoagulants in the Secondary Prevention of Events in Coronary Thrombosis Group: effect of long term oral anticoagulant treatment on mortality and cardio-vascular morbidity after myocardial infarction. *Lancet*, **347**, 499-503.

Birkhead, J.S. on behalf of the Joint Audit Committee of the British Cardiac Society and a Cardiology Committee of the Royal College of Physicians of London (1992). Time delays in provision of thrombolytic treatment in six district hospitals. *British Medical Journal*, **305**, 445-448.

Birkhead J.S. on behalf of the Myocardial Infarction Audit Group (1997). Thrombolytic treatment for myocardial infarction; an examination of practice in 39 United Kingdom hospitals. *Heart*, **78**, 28-35.

Boersma, E., Maas, A. C. P., Deikers, J. W., and Simoons, M. L. (1996). Early thrombolytic treatment in acute myocardial infarction: re-appraisal of the golden hour. *Lancet*, **348**, 771-775.

Capewell, S., Kendrick, S., Boyd, J., Cohen, G., Juszek, E., and Clarke, J. (1996). Measuring outcomes: one month survival after acute myocardial infarction in Scotland. *Heart*, **76**, 70-75.

CASS (1983). Coronary artery bypass surgery study: a randomised trial of coronary artery bypass surgery. *Circulation*, **68**, 939-950.

Chambers, L.W. (1984). The McMaster Health Index Questionnaire. In *Assessment of quality of life in clinical trials of cardiovascular therapies* (ed: N. Wenger, M. Mattson, and C. Furberg). Le Jacq Publications, New York.

Cleary, P.D., Epstein, A.M., Oster, G., Morrissey, G.S., Stason, W.B., Debussey, S., Plachetka, J. and Zimmerman, M. (1991). Health-related quality of life among patients undergoing percutaneous transluminal coronary angioplasty. *Medical Care*, **29**, 939-950.

Clinical Outcomes Working Group of the Clinical Resource and Audit Group (1995). *Clinical outcome indicators*. The Scottish Office, Edinburgh.

Cobbe, S.M., Redmond, M.J., Watson, J.M., Hollingworth, J., and Carrington, D.J. (1991). 'Heartstart Scotland': initial experience of a national scheme for out of hospital defibrillation. *British Medical Journal*, **302**, 1517-1520.

Colhoun, H., and Prescott-Clarke, P. (1996). *Health Survey for England*. Joint Health Surveys Unit, SCPR and Department of Epidemiology and Public Health, University College, London.

Collins, R., Peto, R., MacMahon, S., Hebert, P., Fiebach, N.H., Eberlein, K.A., Godwin, J., Qizilbash, N., Taylor, J.O., and Hennekens, C.H. (1990). Blood pressure, stroke and coronary heart disease. Part 2, short-term reductions in blood pressure: overview of randomised drug trials in their epidemiological context. *Lancet*, **335**, 827-838.

Davies, M. J. (1997). The pathology of ischaemic heart disease. In *Recent advances in histopathology* (ed. P. Anthony and R. Macsween). Churchill Livingstone, London.

Department of Health (1992). *The health of the nation: a strategy for health in England*. HMSO, London.

Department of Health (1993). *Population health outcome indicators for the NHS : a consultation document*. Department of Health, London.

Department of Health (1994). *Coronary heart disease - an epidemiological overview*. HMSO, London.

Department of Health (1995). *Public health common data set 1994*. Institute of Public Health, University of Surrey.

Department of Health (1998). *Our healthier nation*. The Stationery Office, London.

Erhardt, L.R., Sjogren, A., Sawe, U., and Theorell, T. (1974). Pre-hospital phase of patients admitted to a coronary care unit. *Acta Medica Scandinavica*, **196**, 41-46.

European Myocardial Infarction Group (1993). Pre-hospital thrombolytic therapy in patients with suspected myocardial infarction. *New England Journal of Medicine*, **329**, 383-389.

Fridlund, B., Hogstedt, B., Lidell, E., and Larsson, P.A. (1991). Recovery after myocardial infarction: effects of a caring rehabilitation programme. *Scandinavian Journal of Caring Science*, **5**, 23-32.

General Medical Services Committee (1993). *The new health promotion package*. BMA, London.

Goldacre, M., and Ferguson, J. (1995). *Health outcome indicators for the NHS : report of a workshop held at the Royal Society of Medicine*. Unit of Health-Care Epidemiology, University of Oxford.

Goldman, L., Hashimoto, B., Cook, E.F.L., and Loscalzo, A. (1981). Comparative reproducibility and validity of systems for assessing cardiovascular functional class: advantages of a new specific activity scale. *Circulation*, **64**, 1227-1234.

GREAT Group (1992). Feasibility, safety, and efficacy of domiciliary thrombolysis by general practitioners: Grampian region early anistreplase trial. *British Medical Journal*, **305**, 548-553.

Grover, S.A., Lowensteyn, I., Esrey, K.L., Steinert, Y., Joseph, L., and Abrahamowicz, M. (1995). Do doctors accurately assess coronary risk in their patients? Preliminary results of the coronary health assessment study. *British Medical Journal*, **310**, 975-978.

Hackett, T.P., and Cassem, N.H. (1969). Factors contributing to delay in responding to the signs and symptoms of acute myocardial infarction. *American Journal of Cardiology*, **24**, 651-658.

Haq, I.U., Jackson, P.R., Yeo, W.W., and Ramsey, L.E. (1995). Sheffield risk and treatment table for cholesterol lowering for primary prevention of coronary heart disease. *Lancet*, **346**, 1467-1471.

Hartford, M., Herlitz, J., Karlson, B.W., and Risenfors, M. (1990). Components in delay time in suspected myocardial infarction with particular emphasis on patient delay. *Journal of Internal Medicine*, **228**, 519-523.

Hilliers, T.K., Guyatt, G.H., Oldridge, N., Crowe, J., Willan, A., Griffith, L., and Feeny, D. (1994). Quality of life after myocardial infarction. *Journal of Clinical Epidemiology*, **47**, 1287-1296.

Hunt, S.M., McEwan, J., and McKenna, S.P. (1984). Perceived health: age and sex comparisons in a community. *Journal of Epidemiology and Community Health*, **34**, 281-287.

ISIS (1986). Randomised trial of atenolol among 16,027 cases of suspected acute myocardial infarction: ISIS-1, First International Study of Infarct Survival Collaboration Group. *Lancet*, **8498**, 57-66.

ISIS-2 (Second International Study of Infarct Survival) and Collaborative Group (1988). Randomised trial of intravenous streptokinase, oral aspirin, both or neither among 17,187 cases of suspected acute myocardial infarction. *Lancet*, **ii**, 349-360.

Kenyon, L.W., Ketterer, M.W., Gheorghiadu, M., and Goldstein, S. (1991). Psychological factors related to pre-hospital delay during acute myocardial infarction. *Circulation*, **84**, 1969-1970.

Lakhani, A. (1994). *Central Health Outcome Unit*. Department of Health, London.

Langham, S., Norman, C., Piercy, J., and Rose, G. (1994). Coronary heart disease. In *Health care needs assessment* (ed. A. Stevens and J. Raftery) pp.341-378. Radcliffe Medical Press, Oxford.

Lim, L.L., Valenti, L.A., Knapp, J.C., Dobson, A.J., Plotnikoff, R., Higgenbotham, N., and Heller, R.F. (1993). A self-administered quality of life questionnaire after acute myocardial infarction. *Journal of Clinical Epidemiology*, **46**, 1249-1256.

MacMahon, S., Peto, R., Cutler, J., Collins, R., Sorlie, P., Neaton, J., Abbott, R., Godwin, J., Dyer, A., and Stamler, J (1990). Blood pressure, stroke and coronary heart disease. Part 1, prolonged differences in blood pressure: prospective observational studies corrected for the regression dilution bias. *Lancet*, **335**, 765-774.

McCull A., and Gulliford, M. C. (1993). *Population health outcome indicators for the NHS : a feasibility study*. Faculty of Public Health Medicine of the Royal College of Physicians, London.

Moher, M. (1995). *Evidence of the effectiveness of interventions for secondary prevention and treatment of coronary heart disease in primary care*. Anglia and Oxford Health Authority, Milton Keynes.

Moher, M., Schofield, T., Weston, S., and Fullard, E. (1997). Managing established coronary heart disease. *British Medical Journal*, **315**, 69-70.

More, R., Moore, K., Quinn, E., Perez Avila, C., Davidson, C., Vincent, R., and Chamberlain, D. (1995). Delay times in the administration of thrombolytic therapy: the Brighton experience. *International Journal of Cardiology*, **49**, Suppl: S39-46.

NHS Centre for Coding and Classification (1996). *The Read Codes October 1996 Demonstrators*. NHS Executive, Leeds.

NHS Centre for Coding and Classification (1997). *The Read Codes March 1997 Demonstrators*. NHS Executive, Leeds.

NHS Executive (1996). GP health promotion. FHSL (96) 35. NHS Executive, Leeds.

Norris, R. M. (1997). After the infarction: current evidence-based practice. *General and Elderly Medicine*, **1**, 4-7.

Prescott-Clarke, P., and Primatesta, P. (1997). *Health Survey for England 1995*. Joint Health Surveys Unit, SPCR and Department of Epidemiology and Public Health, University College.

Pyörälä, K., De Backer, G., Graham, I., Poole-Wilson, P., and Wood, D. on behalf of the Task Force (1994). Prevention of coronary heart disease in clinical practice. Recommendations of the Task Force of the European Society of Cardiology, European Atherosclerosis Society and European Society of Hypertension. *European Heart Journal*, **15**, 1300-1331.

Rowley, J.M., Mounsey, P., Harrison, E.A., Skene, A.M., and Hampton, J.R. (1992). Management of myocardial infarction: implications for current policy derived from the results of the Nottingham Heart Attack Register. *British Heart Journal*, **67**, 255-262.

Royal College of General Practitioners, Office of Population Censuses and Surveys and Department of Health (1995). *Morbidity statistics from general practice, fourth national study 1991-1992*. HMSO, London.

Salonen, J.T. (1980). Stopping smoking and long term mortality after acute myocardial infarction. *British Heart Journal*, **43**, 463-469.

Shaper, A.G., Pocock, S.J., Phillips, A.N., and Walker, M. (1985a). Identifying men at high risk of heart attacks: strategy for use in general practice. *British Medical Journal*, **293**, 474-479.

Shaper, A.G., Pocock, S.J., Walker, M., Phillips, A.N., Whitehead, T.P., and Macfarlane, P.W. (1985b). Risk factors for ischaemic heart disease: the prospective phase of the British Regional Heart Study. *Journal of Epidemiology and Community Health*, **39**, 197-209.

Shaper, A.G., Pocock, S.J., Phillips, A.N., and Walker, M. (1987). A scoring system to identify men at high risk of a heart attack. *Health Trends*, **19**, 37-39.

Task Force on the management of acute myocardial infarction of the European Society of Cardiology (1996). Acute myocardial infarction : pre-hospital and in-hospital management. *European Heart Journal*, **17**, 43-63.

Trent, T.J., Rose, E.L., Adams, J.N., Jennings, K.P., and Rawles, J.M. (1995). Delay between the onset of symptoms of acute myocardial infarction and seeking medical assistance is influenced by left ventricular function at presentation. *British Heart Journal*, **73**, 125-128.

Tunstall-Pedoe, H. (1991). *The Dundee coronary risk-disk-manual and technical description*. Dundee University.

Tunstall Pedoe, H., Morrison, C., Woodward, M., Fitzpatrick, B., and Watl, G. (1996). Sex differences in myocardial infarction and coronary deaths in the Scottish MONICA population of Glasgow 1985 to 1991. *Circulation*, **11**, 1981-1992.

Tunstall-Pedoe, H., Kuulasmaa, K., Amouyel, P., Arveiler D., Rajakangas, A.M., and Pajak, A. (1994). Myocardial infarction and coronary deaths in the World Health Organisation MONICA Project. Registration procedures, event rates, and case-fatality rates in 38 populations from 21 countries in four continents. *Circulation*, **90**, 583-612.

UKHAS Collaboration Group (1998). Effect of time from onset to coming under care on fatality of patients with acute myocardial infarction: effect of resuscitation and thrombolytic treatment. *Heart*, **80**, 114-120.

Ware, J.E., Snow, K.K., Kosinski, M., and Gandek, B. (1993). *SF-36 Health Survey: manual and interpretation guide*, The Health Institute, Boston, MA.

Wenger, N.K., Mattson, M.E., Furberg, C.D., and Elison, J. (1984). Assessment of quality of life in clinical trials of cardiovascular therapies. *American Journal of Cardiology*, **54**, 908-913.

Wilcox, R.G., and Rowley, J.M. (1990). Pre-hospital management of acute myocardial infarction: patient and general practitioner interactions. In *The management of acute ischaemia* (ed. D. Chamberlain, D. Julian, and P. Sleight) pp.133-138. Current Medical Literature, London.

Yusuf, S., Peto, R., Lewis, J., Collins, R. and Sleight, P. (1985). Beta-blockade during and after myocardial infarction: an overview of the randomised trials. *Progress in Cardiovascular Diseases*, **17**, 335-371.

Reports in the Series on Health Outcome Indicators

Asthma	ISBN 1840750073
Breast Cancer	ISBN 1840750081
Cataract	ISBN 18407509X
Diabetes Mellitus	ISBN 1840750103
Fractured Proximal Femur	ISBN 1840750111
Myocardial Infarction	ISBN 1840750138
Normal Pregnancy and Childbirth	ISBN 1840750146
Severe Mental Illness	ISBN 1840750154
Stroke	ISBN 1840750162
Urinary Incontinence	ISBN 1840750170

Additional copies of the reports listed above are available from
P.O. Box 777, London SE1 6XH.

Fax: 01623 724 524