Cardiac rehabilitation services aim to facilitate physical, psychological, and emotional recovery in patients with heart disease (table 1) and enable them to achieve and maintain better health through exercise, education, help with psychological sequelae, or any combination of these elements.

Drug treatment is an integral part of the secondary prevention and treatment of coronary heart disease; existing systematic reviews have already shown the effectiveness of drugs such as the statins, aspirin, angiotensin converting enzyme (ACE) inhibitors, and β blockers. This review is therefore focused specifically on rehabilitation interventions as opposed to drug treatments.

Current provision in the United Kingdom
The overall level of provision in the United Kingdom has increased rapidly over the past 10–15 years and there are currently almost 300 cardiac rehabilitation programmes in existence. The total cost of cardiac rehabilitation is estimated to be up to £34m each year. There is wide variation in practice and in the organisation and management of services; evidence exists that current service provision fails to meet the standards set in national guidelines for cardiac rehabilitation, and that secondary prevention measures are under-applied.

Disparities in provision are reflected in the resulting costs incurred. Annual staffing costs across 16 centres have been shown to range from £10 000 to £62 000; with a median cost per patient enrolled of £223.

Most programmes are outpatient, hospital based, concentrating on low risk patients with myocardial infarction (MI), although many also include patients who have had coronary artery bypass surgery or angioplasty. Women are less likely to receive cardiac rehabilitation than men; a recent survey of 244 cardiac rehabilitation programmes in the UK found that only 15% of enrollees were women, although they account for over one third of patients with coronary heart disease.

A recent survey of patients with coronary heart disease found that the majority were not receiving appropriate medication for their condition; were not undertaking regular exercise; were overweight; and were not eating an appropriate diet. Up to 90% of these patients would have benefited from further changes in lifestyle, and only 7% were receiving optimal medical management for prevention of heart disease.

Recovery after an acute cardiac event
The needs of people recovering from an acute cardiac event vary. Some have psychological problems or misconceptions about their condition which may make it difficult for them to return to a normal life. Some require help in modifying pre-existing risk factors such as smoking, poor diet, or lack of exercise. Most are likely to benefit from lifestyle changes such as increasing physical activity.

Although 12 weeks after MI up to 30% of patients report that their quality of life has returned to previous levels, symptoms of anxiety and depression are common and have been shown to be associated with prolonged disability, re-infarction, and death.

Perceived health status, level of misconception about the heart condition, and anxiety and depression are the major predictors of return to normal activity. Many patients who have suffered a MI fear and avoid activity; up to 50% report reduced social and leisure activities four years later. Return to work rates are fairly high, however a substantial number of patients retire early or become unemployed.

Methods
This paper is based on existing systematic reviews of acceptable quality, supplemented with reference to key randomised controlled trials (RCTs). In those areas where there were few RCTs, other study designs were also included. Studies were identified by a search of computerised databases, including Medline, Embase, CINAH and PsycLit, using keywords such as cardiac rehabilitation, rehabilitation, MI, angioplasty, and coronary artery bypass (a copy of the full search strategy is available on request). The computerised searches were supplemented with a review of the reference lists of retrieved papers and contact with experts. All retrieved studies were assessed for inclusion independently by two reviewers and any discrepancies discussed.
Table 2  Systematic reviews of cardiac rehabilitation

<table>
<thead>
<tr>
<th>Authors</th>
<th>Objective</th>
<th>Search strategy</th>
<th>Inclusion criteria for trials</th>
<th>Results</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bobbio, 1989(*)</td>
<td>To quantitatively evaluate the effect of post myocardial infarction rehabilitation on total mortality, cardiac mortality, and recurrence of non-fatal MI</td>
<td>Electronic search of Medline 1980–86 (keywords given); bibliographies of text books; trials analysed in 5 review articles; papers presented at previous 2 conferences of the World Congress on Cardiac Rehabilitation; reference sections of all articles retrieved.</td>
<td>Required: controlled or randomised controlled trials with at least 2 years follow up; reporting of total death, cardiac death, non-fatal MIs; intention to treat analysis; publication in peer reviewed journals.</td>
<td>8 RCTs (2260 patients) Pooled relative risk Total mortality: 0.68 (95% CI, 0.53 to 0.86, p=0.001) Cardiac mortality: 0.62 (95% CI, 0.48 to 0.82, p=0.001) Non-fatal MI: 1.12 (95% CI, 0.84 to 1.49, p=0.45) 7/9 cohort studies found association between lack of social support and increased mortality.</td>
<td>Meta-analysis, limited search strategy, independent, blinded data extraction, relatively detailed description of methodology used but method used to pool data not completely clear, non-significant test for heterogeneity, unclear why relative risk used rather than odds ratio. Narrative review with limited search and no stated validity assessment. Only 4/7 cohort studies used detailed measures of social support, other three used “living alone = living with someone”.</td>
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<tr>
<td>Bucher, 1994(**)</td>
<td>To estimate the effect of social support on prognosis after a first MI</td>
<td>Electronic search of Medline (keywords provided)</td>
<td>Required: an inception cohort with complete report of follow up; objective outcomes (for example, re-infarction, mortality); adequate adjustment for confounding factors; intervention studies required adequate randomisation and reporting of all “relevant clinical outcomes.</td>
<td>10/13 studies (9 controlled trials) showed increased knowledge 6/8 studies (7 controlled trials) showed some lifestyle change especially for increasing activity and smoking cessation.</td>
<td>Narrative review, limited search, limited study detail provided and little comment on quality of data studies, precise measure of knowledge of behaviour change varies between studies.</td>
</tr>
<tr>
<td>Durkey, 1992(*)</td>
<td>To establish whether impatient education increases patients with MI’s knowledge and produces lifestyle change</td>
<td>Electronic search of Medline 1975–89 (no keywords provided); search of “reference lists”</td>
<td>Required: post MI and/or cardiac surgery patients; clear description of research design; data collection using an “objective instrument”; presentation of data.</td>
<td>Myocardial infarction: 6/7 studies showed general improvements in distress (mainly anxiety or depression). 2/2 reports of same study (male patients and spouses), 5/6 were RCTs.</td>
<td>Narrative review with some methodological detail given, however sample sizes in all studies were small, and not enough study details were provided to judge their quality. No detail of author’s quality assessment provided.</td>
</tr>
<tr>
<td>Hill et al, 1992(*)</td>
<td>To determine whether psychosocial interventions can minimise psychological distress and psychiatric morbidity in coronary heart disease and cancer patients</td>
<td>Electronic searches of Medline and PsycLit (keywords provided); searches of “individual issues of relevant journals” in the fields of psychiatry, nursing, psychology and social work “for the past five years”; citations from experts, from reviews and from government documents.</td>
<td>Required: replicable global psycho-social intervention; standardised mental health outcome; control or comparison group. Excluded: non-cardiac, non-cancer patients; focus on Type A behaviour in cardiac patients; hypnosis based or pharmacological interventions.</td>
<td>Myocardial infarction: 6/7 studies showed some lifestyle changes especially for increasing activity and smoking cessation.</td>
<td>Narrative review with some methodological detail given, however sample sizes in all studies were small, and not enough study details were provided to judge their quality. No detail of author’s quality assessment provided.</td>
</tr>
<tr>
<td>Linden et al, 1996(*)</td>
<td>To quantitatively evaluate the efficacy of psychosocial interventions for patients with coronary artery disease</td>
<td>Electronic search of Medline (no keywords or years given); references lists of retrieved papers and review articles</td>
<td>Required: documented coronary artery disease; at least one control group; the evaluation of the additional impact of a psychosocial intervention over usual care; randomisation.</td>
<td>23 RCTs (3180 patients) Pooled odds ratios at 2 years follow up Total mortality (10 RCTs): 1.70 (95% CI, 1.39 to 2.64, p=0.02) Non-fatal MI (8 RCTs): 1.84 (95% CI, 1.12 to 2.99, p=0.02) Pooled odds ratios at &gt;2 years follow up Total mortality (3 RCTs): 1.35 (95% CI, 0.83 to 1.53, p&lt;13) Non-fatal MI (3 RCTs): 1.64 (95% CI, 1.06 to 2.54, p=0.02) Psychosocial interventions also produced greater reductions in psychosocial distress, systolic blood pressure, heart rate, cholesterol concentrations.</td>
<td>Meta-analysis, very limited literature search, no detail regarding validity or quality assessment, limited study details provided, duplicate publications included in the analysis.</td>
</tr>
<tr>
<td>Mullen et al, 1992(*)</td>
<td>To quantitatively review the evidence for the efficacy of psychosocial interventions for patients with coronary artery disease</td>
<td>Electronic search of several databases (years and terms provided); bibliographies of retrieved studies; database of the National Heart, Lung and Blood Institute and the Veterans Administration Health Services Research and Development Section.</td>
<td>Required: English language; published and unpublished reports; review of a psychosocial or educational intervention with adult patients diagnosed with coronary artery disease; sample size of ≥10 per arm; randomised, quasi-experimental comparison group design or a one group pre-test post-test design.</td>
<td>28 Cts* (4512 patients) Weighted average effect sizes: Exercise (12 Cts): 0.18 (95% CI, 0.07 to 0.29) Diet (9 Cts): 0.19 (95% CI, 0.05 to 0.34) Smoking (9 Cts): 0.07 (95% CI, −0.08 to 0.22) Stress (9 Cts): Drug adherence (3 Cts): −0.09 (95% CI, −0.39 to 0.22) Morbidity (9 Cts): 0.05 (95% CI, −0.04 to 0.13) Return to work (6 Cts): 0.08 (95% CI, −0.11 to 0.27) Death (7 Cts): 0.24 (95% CI, 0.14 to 0.33) Blood pressure (5 Cts): 0.51 (95% CI, 0.24 to 0.77)</td>
<td>Meta-analysis—substantial literature search, good description of methodology; blinded validity assessment using Sackett and Haynes coding scheme; considerable diversity between studies. Data pooling: WAESs calculated for homogeneous groups of trials—that is, with any outliers removed. Descriptions of outliers and reasons for removal given in text, but could introduce significant bias. Effects difficult to interpret as the basis on which the average effect sizes were calculated for each outcome measure is unknown.</td>
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</table>
Nine systematic reviews (table 2) and 28 separate trials met the inclusion criteria. Subsequently, two reviewers extracted data on the results following the same procedure.

### Results

Overall the quality of the literature in this field is poor and its evaluation difficult due to the variability of interventions and patient populations studied, methodological problems, and poor quality reporting. There is little reporting of randomisation procedures, little detail of the interventions provided, and study sample sizes are often small. In addition, the use of care “packages” complicates the evaluation of individual interventions as it is difficult to identify the impact of the specific components. The majority of studies include only low risk, male, white, middle aged patients with MI, and exclude or enrol only a small number of women, the elderly, ethnic minorities, and other cardiac patient groups such as those having had cardiac surgery, heart failure, or heart transplantation, thereby limiting the generalisability of the results. Table 2 summarises the systematic reviews on which some of the key conclusions of this paper are based, and further details are available elsewhere.³³

### Exercise

Exercise alone has a positive impact on patients’ physical ability to exercise, and on physiological measures of cardiac disease. It does not have any effect on smoking cessation or reduction of cholesterol concentrations. Not enough evidence exists to evaluate its effect on body weight or blood pressure.³³

Exercise alone had no significant effect on morbidity (usually evaluated by non-fatal re-infarctions) or overall mortality rates, however a trend towards a beneficial effect on symptoms (angina) has been shown. It should be emphasised that exercise has not been found to do any harm to patients. Not enough evidence was found to evaluate the effect of exercise alone on psychological or social outcomes, or return to work.³³ These conclusions have largely been supported by additional identified trials.³³³³

### Psychological and educational interventions

Psychosocial interventions include patient education, counselling, and behavioural interventions. These have been shown to affect risk factors including blood pressure and cholesterol concentrations,³⁵³⁶ and to produce significant improvements in psychosocial wellbeing³⁵³⁶ and in patient knowledge.³⁶

Psychosocial interventions may significantly reduce morbidity and mortality in patients with coronary artery disease.³⁵ It has been estimated that psychosocial interventions could produce a 46% reduction in non-fatal cardiac events and a 41% reduction in mortality at two
years follow up. The effect on mortality was not found to be significant after two years (although patient numbers were small).37 However, this study was methodologically flawed (table 2), and its results should therefore be treated with some caution.

Additional RCTs largely support these conclusions,41–46 although two studies with particularly large sample sizes found no effects for mortality or morbidity, nor indeed for measures of psychological morbidity.42 47 However, the interventions used were mainly targeted at reducing patients’ stress levels. In one trial this was done by monthly telephone contact with further interventions where necessary, which would not meet any generally accepted definition of cardiac rehabilitation.45 The other trial, aiming at psychological improvements, had seven weekly sessions with a psychologist or health visitor and did not include interventions aimed at risk factor modification.45

Increases in knowledge may not necessarily be sufficient to produce changes in behaviour or lifestyle, but inpatient education has been shown to produce significant improvements in smoking behaviour, activity levels, and overall compliance with action to improve health.48 In one RCT over half the patients were shown to be following advice one year after an acute event.49 There is a widespread misconception among the general public and some health professionals that people should considerably limit their activity after MI to avoid a recurrence.50 51

Combined exercise and psychological or educational interventions

When exercise is combined with patient education and counselling, it may improve cardiac risk factors, particularly reduced lipids and blood pressure. An intensive approach with specific anti-smoking advice may also help to improve smoking cessation rates.52 Multifactorial rehabilitation can have an impact on exercise levels after the rehabilitation programme, at least in the short term.53 Its effect on psychological wellbeing is not clear, but it has not been shown to have an effect on return to work or on angina.54

Only one RCT of multifactorial rehabilitation has shown a clear reduction in mortality among patients who have had a MI.55 Other studies are too small to show any significant impact on morbidity or mortality.56 Data from three published meta-analyses,51–53 two of which were of high quality,51 53 suggest a reduction in cardiac mortality of about 20–25% (table 2). No significant effect on non-fatal re-infarction was found.51–55 However, since the studies in these meta-analyses focused on patients at low risk of recurrence, the scope for demonstrating benefit is small. It is likely that the benefits of appropriate cardiac rehabilitation would be greater in patients with more severe cardiac disease, but caution should be used when generalising these results to other populations. These conclusions have been largely supported by additional identified trials.54 56

TARGET POPULATION

Current provision of the service tends to concentrate on low risk, white, male, post-MI patients. No evidence exists of lack of benefit for other groups, such as women, the elderly, ethnic minorities, and patients with other types of heart disease.

There is some evidence that when women or the elderly attend cardiac rehabilitation programmes, the outcomes are as good as or better than for men57–61 and for younger groups of patients.62–65 Ethnic minority groups may have a greater risk of re-infarction or recurrence due to lower levels of activity66 and higher levels of morbidity.67 Observational studies in the United States have shown no significant racial differences in response to cardiac rehabilitation.68 69 The involvement of partners and other close family members in the rehabilitation process may improve patient outcomes.68 70 71

A few small RCTs of patients with heart failure suggest improvements in physical aspects of the disease similar to those seen in patients after MI.33 It is possible that increasing fitness and physical ability in patients with heart failure72–75 or angina76–78 may provide worthwhile benefits including reduced symptoms, reduced disability, and improved quality of life. No RCTs have been identified which evaluated patients after heart transplantation.73

Organisation of services

FREQUENCY AND DURATION

Little research has evaluated the frequency and duration of cardiac rehabilitation programmes. Most studies provided three to five supervised exercise sessions each week, in combination with a patient education or psychosocial intervention, for approximately 12 weeks.33

Significant improvements in lifestyle, symptoms, health status, and hospital readmission rates over two years have been achieved by interventions designed to initiate and maintain lifestyle change in patients with established coronary heart disease or angina. Two RCTs have shown that personal health education or visits to a secondary prevention clinic every two to six months can be more effective than routine care from general practitioners.79 80

LOCATION

Although most cardiac rehabilitation programmes are conducted in a hospital outpatient setting, several studies have examined home based programmes. Studies comparing home exercise programmes with hospital based ones have shown improved cardiovascular fitness in both settings, with no increased risk of cardiac arrest in the home based programme.81 82

RCTs comparing the effects of supervised home exercise with a no exercise control group have shown greater improvement in the rehabilitation group, in either risk factors, anxiety and quality of life,83 84 or ability to exercise.85 86 Not enough studies are available to allow unsupervised home based exercise programmes to be evaluated.86–89

Telephone
based educational interventions with no prescribed rehabilitation programme are not effective.42 47 91

Access, uptake, and adherence
Reported rates of uptake of cardiac rehabilitation range from 15%52 to 59%.53 Approximately 20–25% of patients drop out of exercise programmes within the first three months and about 40–50% at between six and 12 months.94

Poor uptake rates relate mainly to either service factors, such as the invitation to participate, or availability of services or patient factors. Elderly57 93 and female57 93 95 patients are significantly less likely to be invited to attend cardiac rehabilitation programmes although it is not clear from these studies why this should be the case. Patients receiving acute treatment at specific hospitals or from cardiologists are more likely to be invited to cardiac rehabilitation programmes than patients treated at other, similar hospitals or by general physicians.93 The patients’ perception of the strength of a physician’s recommendation to attend42 96 and the availability and accessibility of the rehabilitation programme52 are among the strongest predictors of whether patients attend once invited.42

Uptake following invitation is much lower in women53 95 and in the elderly.52 94 This may be connected to personal beliefs either that cardiac rehabilitation is inappropriate for them or fears that they will feel out of place.95 99 Other sociodemographic characteristics including deprivation,57 level of education,52 and spouse involvement99 are also significant predictors of uptake. Other reasons for not participating have included feelings that the wrong information or inadequate information is given or lack of motivation.97

Dropouts from exercise programmes may occur more frequently in high intensity and poorly organised programmes, and among smokers and patients who have had more than one MI.35 41 102 Convenience of access to facilities also influences participation.97 98 Women are more likely than men to drop out.93 103

Cost effectiveness
An American economic evaluation104 has shown that under the assumption that cardiac rehabilitation produces other savings to the health service, the cost for each life year gained over three years from cardiac rehabilitation was $21,800, or $35,900 with no allowance for savings. The cost for each quality adjusted life year (QALY) was estimated to be $6800.104 In 1997, these results were recalculated to better reflect the situation in the United Kingdom. The results suggest a cost for each QALY of £6900, and a cost for each life year gained at three years of £15,700.102

Although it has been concluded that cardiac rehabilitation is cost effective,91 it is clearly not a homogenous service and there are a range of factors that influence the costs and cost effectiveness of the process including: scale of the programme, location, components and intensity of the process, the patient population, and compliance. Cardiac rehabilitation may not be cost effective in all formats for all patients. It may be more effective and therefore cost effective to provide specific interventions only to those patients who have a need for them, but this would require more adequate assessment of individual patients’ needs.

Conclusions
Current service provision concentrates on low risk, white, male, middle aged post MI patients, however no evidence exists that other groups such as women, the elderly, ethnic minorities, or high risk cardiac patients do not benefit. There appears to be no basis for the exclusion of these groups from cardiac rehabilitation programmes and more research is required to identify reasons for, and strategies to improve, the current low levels of uptake and to design safe and effective programmes to meet the needs of different patient groups.

Although some benefits from single modality interventions have been shown, a combined approach of exercise and psychological and educational interventions appears to be more beneficial. Exercise has a positive impact on physical aspects of recovery at no additional risk to the patient, but no effect on risk factors, morbidity, or mortality. The effect of exercise on the psychosocial aspects of recovery are unclear. Trials have established that psychological and educational interventions can reduce risk factors, improve psychosocial well-being, and patient knowledge and may reduce morbidity and mortality. In practice, however, the information provided is often inadequate, inconsistent, and inaccurate and is frequently misunderstood by patients. The public and health professionals need to understand that activity should not be significantly reduced after a cardiac event.

Important questions remain to be answered as to the optimal mix of components and the frequency and duration of the programmes. Home based rehabilitation may be as effective and safe as hospital based programmes when a prescribed rehabilitation programme and some form of supervision is provided, but further evaluation is required. Given the need to maintain improvements in lifestyle and the problems with continuing compliance, there is an existing need for long term maintenance programmes.

Further research is required to identify the optimal method of delivering the service. In particular, it is important to compare the clinical and cost benefits of menu driven systems, and home based and community based services with current hospital based programmes.

This paper is based on Effective Health Care volume 4, no 4 which is a systematic review of the evidence on the effectiveness of cardiac rehabilitation.

5 Cardiac rehabilitation.
Cardiac rehabilitation


