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Effective Health Care

Bulletin on the effectiveness of health service interventions for decision makers

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Cardiac rehabilitation

- Cardiac rehabilitation can promote recovery, enable patients to achieve and maintain better health, and reduce risk of death in people who have heart disease.
- A combination of exercise, psychological and educational interventions is the most effective form of cardiac rehabilitation.
- Exercise improves physical aspects of recovery at no additional risk, but as a sole intervention it is not sufficient to reduce risk factors, morbidity or mortality.
- Current provision is growing rapidly but there is wide variation in practice, management and organisation of services. Many patients who might benefit do not receive cardiac rehabilitation.
- Many of the problems experienced by people with heart disease are not due to physical illness but to anxiety and misconceptions about their health. Health professionals should provide adequate, consistent and accurate information that can be understood by patients.
- Services should meet the needs of all groups – including women, the elderly, ethnic minorities and people with all types of heart disease.
- Commissioners and providers of services should monitor access to cardiac rehabilitation in order to promote equity.

The contents of this bulletin are likely to be valid for around one year, by which time significant new research evidence may have become available.

A. Background

Cardiac rehabilitation services are aimed at patients with established heart disease, especially those who have suffered acute damage to the heart or had surgical procedures carried out on the coronary vessels (see Box 1). The aim of a cardiac rehabilitation programme is to facilitate physical, psychological and emotional recovery and enable patients to achieve and maintain better health. Some patients may require advice and encouragement to achieve a healthy lifestyle, whilst others have psychological problems which must be addressed.

Cardiac rehabilitation services aim to achieve these benefits through exercise, patient education, help for patients with psychological sequelae, or any combination of these elements.

Drug treatment is an integral part of the treatment of coronary heart disease (CHD). Existing systematic reviews have demonstrated the effectiveness of drugs such as the statins, aspirin, ACE inhibitors and beta-blockers for secondary prevention of CHD.[14–16]

This bulletin summarises the research evidence on the effectiveness of cardiac rehabilitation in terms of lifestyle modification and psychosocial aspects of recovery, in addition to clinical endpoints such as morbidity and mortality.

Current provision in the UK

The overall level of provision in the UK has increased rapidly over the last 10 to 15 years[2–7] and current data from the British Association for Cardiac Rehabilitation puts the number of cardiac rehabilitation programmes at almost 300.[8] The total cost of cardiac rehabilitation in the UK is estimated to be up to £34 million per year.[9] There is wide variation in practice and in the organisation and management of cardiac rehabilitation services; there is evidence that current service provision fails to meet the national guidelines for cardiac rehabilitation,[10,11] and that secondary prevention measures are under-applied.[12,13]

Most programmes are outpatient, hospital-based,[5,6,10] concentrating on low-risk patients who have had myocardial infarction (MI), although many also include some who have had coronary bypass surgery (CABG) or angioplasty.[5,10] Although women account for over one third of CHD patients,[1] they are less likely to receive cardiac rehabilitation than men; a recent survey of 244 programmes in the UK found that only 15% of enrolees were women.[10]

The majority of programmes are exercise-based, usually providing group aerobic exercise sessions once a week for an average of 6 to 10 weeks.[5,10] Patient education is provided in 70–80% of programmes,[10,107] either using informal discussion or formal lesson plans,[10] on a one-to-one basis or in group sessions.[107] The majority of centres also provide relaxation training, either as a single session or more frequently.[107] Other forms of psychological intervention are provided in 13% of centres. In a survey of 22 programmes, half dealt with perceived psychological problems by prescribing medication, 10 offered some form of 'counselling' and four referred patients to a psychologist;[10] only three of the 22 centres formally assessed psychological status. A survey of all cardiac rehabilitation programmes in the UK found that 21% involved a psychologist in some way and around a quarter used validated assessments of anxiety and depression.[7]

The disparity in the provision of cardiac rehabilitation in England and Wales is reflected in the costs incurred.[108] A survey found that annual staffing costs across 16 centres ranged from £10,000 to £62,000; the median cost per patient enrolled was £223.[108] There was little difference between teaching hospitals and district hospitals; the largest influence on cost variation was the number of patients attending the centre. This highlights the potential role of economies of scale in the provision of cardiac rehabilitation services; the more patients attend, the lower the cost per patient and the greater the potential cost-effectiveness.

Given the need to maintain lifestyle changes, the importance of long-term maintenance cannot be underestimated. A recent survey of patients with documented coronary artery disease revealed that the majority were not receiving appropriate medication for their condition; were not taking regular exercise; were overweight; and were not eating an appropriate diet.[13] 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.[13]

Box 1

Categories of patients who might benefit from cardiac rehabilitation	Estimated number per year in the UK[1]
Myocardial infarction survivors (MI)	150,000
Coronary artery bypass graft (CABG)	22,056
Coronary angioplasty (PTCA)	13,822
Angina	1,400,000
Heart failure	500,000
Heart transplantation	
heart only	258
heart and lung	46
Total	2,086,182

In general, rehabilitation programmes tend to be highly regimented, with all patients receiving the same components as part of a fixed programme, regardless of their individual needs, yet there is still a great deal of disparity between programmes.

B. Research methods and the nature of the literature

This bulletin is based on a review of existing systematic reviews of acceptable quality, supplemented with reference to key randomised controlled trials (RCTs) when it was judged that no adequate systematic reviews were available. In those areas where there were few RCTs, other study designs have been included (see Appendix).

The evaluation of the cardiac rehabilitation literature is difficult, due to the variability of interventions and patient populations studied, methodological problems and poor quality reporting. There is very little detail of randomisation procedures or of the interventions provided, and study sample sizes have tended to be 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 MI patients and exclude, or enrol only a small number of, women, the elderly, ethnic minorities, and other cardiac patient groups such as those following cardiac surgery, heart failure or heart transplantation, thereby limiting the generalisability of the results. The standard of the economics literature was variable, and few studies were specific to the UK. Several of the studies were conducted around badly designed trials with no randomisation and/or small numbers, with a consequent potential for bias. Often the source of the cost data was not stated, or costs were based on hospital charges which may bear little relation to the true cost of provision.

C. 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,[17] symptoms of anxiety and depression are common and have been shown to be associated with prolonged disability, re-infarction and death.[18–22] In a US study, psychological distress was found to be the most important predictor of hospitalisation costs following a cardiac event: psychologically distressed cardiac patients accrued more than four times the costs for non-psychiatric medical interventions than non-distressed patients (mean of $9,504 versus $2,146).[23]

Major depression has been reported in 15–30% of post-MI patients[24,25] and up to 50% of patients have anxiety levels above those seen in the general population six months after their MI.[26] Less is known about anxiety and depression in patients following cardiac surgery, or those with angina, heart failure or who have undergone heart transplantation.

Psychological problems are largely unrelated to the severity of the disease or to the level of residual damage to the heart.[28] Perceived health status, level of misconception about the heart condition, and anxiety and depression are the major predictors of return to normal activity.[29] Many patients who have suffered an MI fear and avoid activity;[30–34] and up to 50% report reduced social and leisure activities four years later.[34] Return to work rates are fairly high, however a substantial number of patients retire early or become unemployed.[34–36]

D. Is cardiac rehabilitation effective?

On the whole, studies tend to fall into two main categories: those which are mainly exercise-based and those which have attempted to evaluate the additional impact of psychological and educational interventions.

D1. Exercise: A systematic review conducted in 1995, which formed the basis of a US guideline on cardiac rehabilitation, provides detailed information on RCTs of exercise alone. Exercise was found to have a positive impact on patients' physical ability to exercise, and on physiological measures of cardiac disease. There was not enough evidence to evaluate the effects of different intensities of exercise.[56]

Exercise alone was not found to have any effect on blood lipid levels, with the possible exception of triglycerides. There was not enough evidence to evaluate the effect of exercise in this setting on body weight or blood pressure.[56]

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 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.[56] These conclusions have largely been supported by additional trials examining the effects of exercise alone.[69–71]

Overall, exercise as a sole intervention has a positive impact on the physical aspects of recovery at no additional risk to the patient, but effects on the psychosocial aspects of recovery are unclear. More research is required to evaluate risk stratification of patients and varying intensities of exercise.

D2. Psychosocial and educational interventions: Patients have identified their main need as practical, honest advice about their condition and how to modify their life in order to avoid further problems.[72,73] Many patients appear to give more weight to the information provided by family and friends than by health professionals.[74] There is a widespread misconception amongst the general public and some health professionals that people should considerably limit their activity following MI in order to avoid a recurrence.[75,76]

Two meta-analyses[77,78] and two systematic reviews[24,73] have evaluated the individual effect of psychosocial and educational interventions. The other major systematic review of this field used a mixture of trials of psychosocial interventions and multifactorial rehabilitation to support its conclusions regarding the effects of psychosocial interventions.[56]

Psychosocial interventions may include patient education, counselling and behavioural interventions. These have been shown to affect risk factors including blood pressure and cholesterol levels.[77,78] They also produce significant improvements in psychosocial well-being[24,77] and in patient knowledge, especially concerning the benefits of activity.[73]

Psychosocial interventions may significantly reduce morbidity and mortality in patients with coronary artery disease.[77,78] 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).[77] However, this study was methodologically flawed (see Table 1), and its results should therefore be treated with some caution.

Additional RCTs[79–84] were identified which were not covered by these four systematic reviews,[24,73,77,78] one of which provided further follow-up to an earlier trial.[84] On the whole, these trials support the conclusions of the systematic reviews, particularly regarding risk factor modification,[81,82] psychosocial well-being,[81] morbidity[79,81,84] and mortality.[79,84]

Two studies with particularly large sample sizes found no effects for mortality or morbidity, nor indeed for measures of psychological morbidity.[80,83] However, the interventions in these studies were mainly targeted at reducing patients' stress levels, one by monthly telephone contact with further interventions where necessary,[80] which would not meet any generally accepted definition of cardiac rehabilitation, and the other through sessions with a psychologist or health visitor for an unspecified period of time.[83]

Increases in knowledge may not be sufficient to produce changes in behaviour or lifestyle, but in-patient education has been shown to produce significant improvements in smoking behaviour, activity levels, and overall compliance with action to improve health.[73] In one RCT over half the patients were shown to be following advice one year after an acute event.[85] Education of both patients and their partners can result in improved knowledge, decreased disability, and changes in health behaviours.[64]

The communication of information by health professionals may be inadequate. It has been estimated that 30–78% of people do not fully understand patient education material,[73] and there is evidence that in routine clinical practice, current information-giving procedures are often inadequate, inconsistent and inaccurate.[74,76,86] For example, advice on the resumption of sexual activity is frequently overlooked, and when information is given, it is often inaccurate.[87]

D3. Combined exercise and psychological or educational interventions: The majority of cardiac rehabilitation programmes are multifactorial in nature, combining an exercise programme with some form of patient education or counselling. The traditional emphasis, both in the literature and in practice, has been on the provision of exercise and the potential improvements in mortality or morbidity which may result.

When exercise is combined with a multifactorial programme including patient education and counselling, there is some evidence for improvements in 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.[56]

Multifactorial rehabilitation may have some impact on exercise levels following the programme, at least in the short term.[56] The effect of a multifactorial rehabilitation programme on psychological well-being is not clear, but it has not been shown to have an effect on return to work or on angina.[56] Only one RCT of multifactorial rehabilitation has demonstrated a clear reduction in mortality among post-MI patients.[88] Others are too small to show any significant impact on morbidity or mortality.[56]

Data from three published meta-analyses[89–91] involving over 4000 post-MI patients, two of which were of high quality,[89,90] provide a more reliable estimate of the effectiveness of cardiac rehabilitation following MI. These suggest a reduction in cardiac mortality of about 20–25% (see Table 1). No significant effect on non-fatal re-infarctions was found.[89–91] 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 trials examining the effects of a

Table 1 Systematic reviews of cardiac rehabilitation

Authors	Objective	Search strategy	Inclusion criteria for trials	Results	Notes
Bobbio, 1989[91]	To evaluate the effect of post-MI rehabilitation on total mortality, cardiac mortality, and recurrence of non-fatal myocardial infarction	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	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	8 RCTs (2,260 patients) Pooled relative risk Total mortality: 0.68 (95% CI, 0.53 to 0.86 p= 0.002) 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)	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
Bucher, 1994[122]	To estimate the effect of social support on prognosis following a first MI	Electronic search of Medline (keywords provided)	Required: an inception cohort with complete report of follow-up; objective outcomes (e.g. re-infarction, mortality); adequate adjustment for confounding factors; intervention studies required adequate randomisation and reporting of all 'relevant clinical outcomes'	7/9 cohort studies found association between lack of social support and increased mortality 2 RCTs of increased support from health professionals appear to show reduced mortality/morbidity, but methodologically flawed	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 vs. living with someone'
Duryee, 1992[73]	To establish whether in-patient education increases MI patients' knowledge and produces lifestyle change	Electronic search of Medline 1975–1989 (no keywords provided); search of 'reference lists'	Required: post-MI and/or cardiac surgery patients; clear description of research design; data collection using an 'objective instrument'; presentation of data	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	Narrative review, limited search, limited study detail provided and little comment on quality of studies, precise measure of knowledge of behaviour change varies between studies
Hill et al., 1992[24]	To determine whether psychosocial interventions can minimise psychological distress and psychiatric morbidity in CHD and cancer patients	Electronic searches of Medline & PsychLit (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	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	MI: 6/7 studies showed general improvements in distress (mainly anxiety or depression). 2 were reports of same study (male patients and spouses), 5/6 were RCTs CABG: 4/5 studies suggest reductions in self-reported anxiety. 3/5 were RCTs	Narrative review with some methodological detail given, however sample sizes were small, and not enough study details were provided to judge their quality. No detail of author's quality assessment provided
Linden et al., 1996[77]	To review the evidence for the efficacy of psychosocial interventions for patients with CAD	Electronic search of Medline (no keywords or years given); references lists of retrieved papers and review articles	Required: documented CAD; at least one control group; the evaluation of the additional impact of a psychosocial intervention over usual care; randomisation	23 RCTs (3180 patients) Pooled odds ratios at ≤ 2 years follow-up Total mortality (10 RCTs): 1.70 (95% CI, 1.09 to 2.64, p=.02) Non-fatal MI (8 RCTs): 1.84 (95% CI, 1.12 to 2.99, p=.02) Pooled odds ratios at > 2 years follow-up Total mortality (3 RCTs): 1.35 (95% CI, 0.83 to 1.53, p=.13) Non-fatal MI (3 RCTs) 1.64 (95% CI, 1.06 to 2.54, p=.02) Psychosocial interventions also produced greater reductions in psychosocial distress, systolic BP, heart rate, cholesterol levels	Meta-analysis, very limited literature search, no detail regarding validity or quality assessment, limited study details provided, duplicate publications included in the analysis NB ORs represent additional risk for not receiving psychosocial intervention

Table 1 Continued

Authors	Objective	Search strategy	Inclusion criteria for trials	Results	Notes
Mullen et al., 1992[78]	To assess the effects of patient education on cardiac morbidity and mortality	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	Required: English language; published and unpublished reports; evaluation of a psycho-social 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	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 (0 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)	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, i.e. 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
O'Connor et al., 1989[90]	To determine whether cardiac rehabilitation has a significant effect on total and cardiovascular mortality, sudden death and fatal or nonfatal re-infarction in post-MI patients	Formal computer aided searches; informal search for studies known to the research group	Required: patients to be randomised individually; post-MI only; follow-up over 1 year; intervention to include a structured exercise component; published data	22 RCTs (4554 patients) Pooled odds ratios at > 36 months FU Total mortality: 0.80 (95% CI, 0.66 to 0.96) Cardiovascular mortality: 0.78 (95% CI, 0.63 to 0.96) Sudden death: 0.92 (95% CI, 0.69 to 1.23) Fatal MI: 0.75 (95% CI, 0.59 to 0.95) Non-fatal MI: 1.09 (95% CI, 0.88 to 1.34)	Meta-analysis, difficult to evaluate due to limited description of methodology, although data pooling appears to have been adequate. NB 14/22 RCTs are part of one large WHO trial, not referenced individually in other meta-analyses
Oldridge et al., 1988[89]	To examine the effect of cardiac rehabilitation after MI on total mortality, cardiac mortality, and recurrent MI	Electronic search of Medline search (key words provided); review of relevant English language publications; suggestions from colleagues for published and unpublished data	Required: RCTs only; adequate randomisation; myocardial infarction only; rehabilitation with exercise for at least 6 weeks; follow-up at least 24 months; outcome had to include at least two of all causes of death, cardiovascular mortality or non-fatal MI	10 RCTs (4347 patients) Pooled odds ratios All cause death: 0.76 (95% CI, 0.63 to 0.92 P =.004) Cardiovascular mortality 0.75 (95% CI, 0.62 to 0.93 P = .006) Non-fatal MI 1.15 (95% CI, 0.93 to 1.42)	Meta-analysis, limited search, blinded quality assessment of trials, good description of data pooling methods, probably used intention-to-treat analysis of individual studies
Wenger et al., 1995[56]	To evaluate the scientific evidence pertaining to the various components of cardiac rehabilitation	Electronic search of Medlars (Grateful Med, Psych, ERIC, CINAHL) and NLM database; searches in the psycho-social and professional nursing literature; citations from experts	Required: any study design; any manifestation of CHD; any aspect of cardiac rehabilitation including exercise training, education and counselling, psychosocial and behavioural interventions, medical therapies, surveillance and transition planning or adherence	Exercise alone: improves exercise tolerance and pathophysiologic outcomes; no significant effect on morbidity or mortality; effect on risk factors, psychosocial outcomes and return to work is unclear, but may help improve symptoms. Did not evaluate individual effect of psychosocial interventions. Multifactorial programmes are required in order to achieve beneficial effects on risk factors, psychosocial outcomes, morbidity and mortality	Narrative review of vast amount of literature, methodology unclear especially regarding quality assessment and data extraction; conclusions do not always accord with the evidence presented. Combination of single modality and multifactorial rehabilitation studies used to evaluate outcomes in each section, therefore no true picture of effects of different interventions is given. Study details provided in technical report

combination of exercise and psychological or educational interventions.[92–94]

The majority of trials of cardiac rehabilitation have delivered structured programmes to all patients, with smoking cessation advice or cholesterol lowering drugs provided only to those patients who need them. Two trials were identified which may have prescribed other interventions such as exercise or dietary advice at a more individual level, but the details were not clear.[95,96] Recent UK national guidelines recommend a menu-based approach with individual assessment of patients' needs and audit of outcomes.[11] Further research is required to evaluate this approach.

D4. Target population: Current provision of the service tends to concentrate on low-risk, white, male, post-MI patients. There is no evidence of lack of benefit for other groups, such as women, the elderly, ethnic minorities and patients with other types of heart disease.

When women attend cardiac rehabilitation programmes, the outcomes are as good as or better than for men.[37–41] Their need appears to be greater since they tend to suffer from greater loss of function in relation to return to work, activity and sexuality, and experience higher levels of anxiety and depression.[42–46]

Although special precautions are usually recommended in prescribing exercise for patients over 60 years of age,[47] observational studies have documented a response to exercise similar to that in younger patients,[48–50] and a reduction in re-hospitalisation among elderly patients who attend rehabilitation programmes.[51]

Ethnic minority groups appear to have been neglected in the cardiac rehabilitation literature, despite a possible greater risk of re-infarction or recurrence due to lower levels of activity[52] and higher levels of morbidity.[53] Observational studies in the US have demonstrated no significant racial differences in response to cardiac rehabilitation.[54,55]

Although most research has been on patients who have had an MI or undergone CABG or angioplasty, there is some evidence that other groups may also benefit. A few small RCTs of patients with heart failure suggest improvements in physical aspects of the disease similar to those seen in patients post-MI.[56] It is possible that increasing fitness and physical ability in patients with heart failure[57–60] or angina[61–63] may provide worthwhile benefits including reduced symptoms, reduced disability, and improved quality of life. No RCTs have been identified which evaluated patients following heart transplantation.[56]

There is some evidence that the inclusion of partners and other close family members in the rehabilitation process can improve patient outcomes.[3,64,65] Levels of anxiety and depression in spouses may be equal to or even exceed those seen in patients.[66–68]

E. Organisation of services

E1. Frequency and duration: Little research has evaluated the optimal frequency and duration of cardiac rehabilitation programmes. The majority of RCTs provided three to five supervised exercise sessions per week, in combination with a patient education and/or psychosocial intervention, for a period of approximately 12 weeks.[56] One trial compared two exercise sessions per week with a more conventional frequency of three sessions per week;[97] no significant differences were found.

Significant improvements in lifestyle, symptoms, health status and hospital re-admission rates over two years have been achieved by interventions designed to initiate and maintain lifestyle change in patients with established CHD or angina. Two RCTs have demonstrated 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.[109,110]

E2. Location: Although most cardiac rehabilitation programmes are conducted in a hospital out-patient setting, several studies have examined home-based programmes. Studies comparing home exercise programmes with hospital-based ones have demonstrated improved cardiovascular fitness in both settings, with no increased risk of cardiac arrest in the home-based programme.[98,99]

Several RCTs have compared the effects of home exercise with a no-exercise control group.[95,96,100–102] Each study demonstrated greater improvement in the rehabilitation group, in either risk factors,[96] anxiety and quality of life,[100,101] or ability to exercise.[95,96] A home-based walking programme for high risk patients following cardiac surgery found no additional cardiovascular complications in the exercise group, however, neither were there improvements in functional capacity or ability to exercise.[103] Too few studies are available to allow unsupervised home-based exercise programmes to be evaluated.[103–105] Telephone-based educational interventions with no prescribed rehabilitation programme are not effective.[80,85,106]

Home-based rehabilitation may be as effective and safe as hospital-based programmes, especially when a prescribed rehabilitation programme and some form of supervision are provided, but more research is needed.

F. Access, uptake and adherence

Reported rates of uptake of cardiac rehabilitation range from 15%[111] to 59%.[112] Approximately 20–25% of patients drop out of exercise programmes within the first three months and about 40–50% at between 6 and 12 months.[113]

Poor uptake rates relate mainly to either service or patient factors. Service factors centre around the invitation to participate and logistical factors such as availability of services. Elderly[37,112] and female[37,46,112] 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. There is also some evidence that 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.[112] The patients' perception of the strength of a physician's recommendation to attend[37,114] and the availability and accessibility of the programme[115] are among the strongest predictors of whether patients attend.

Uptake following invitation is much lower in women[38,46] and in the elderly.[38,116] This may be connected to beliefs that cardiac rehabilitation is inappropriate or fears that they will feel out of place.[46,72] Other socio-demographic characteristics including deprivation,[112] level of education[116] and spouse involvement[117] 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.[46,114,118]

It has also been suggested that dropouts from exercise programmes occur more frequently in high-intensity and poorly organised programmes, and amongst smokers and patients who have had more than one MI.[70,113,119] Convenience of access to facilities also influences participation.[115,116] Women are more likely than men to drop out.[46,120]

G. Cost-effectiveness

An American cost-effectiveness and cost-utility analysis was based on the costs incurred and quality of life gained in an RCT of cardiac rehabilitation and the estimated survival benefit determined from a meta-analysis.[89,121] Assuming that cardiac rehabilitation produces other savings to the health service, the cost per life year gained over three years from cardiac rehabilitation was estimated at $21,800, or $35,900 with no allowance for savings. The cost per quality adjusted life year (QALY) was estimated to be $6,800.[121]

Table 2 Estimated cost-effectiveness and cost-utility of cardiac rehabilitation[121]

	Minimum cost estimate	Best cost estimate	Maximum cost estimate
Cost-effectiveness[a]			
Cost/life year gained	$16,800	$35,900	$95,500
Cost/life year gained allowing for savings to health service	$10,500	$21,800	$58,200
Cost-utility[b]			
Cost/QALY gained	$3,200	$6,800	$18,000

a based on estimated life years gained over 3 years of 0.022
b based on estimated quality adjusted life years gained over 3 years of 0.071

In 1997, these results were recalculated to reflect the UK situation. The results suggest a cost per QALY of £6,900, and a cost per life year gained at three years of £15,700.[9]

Although it has been concluded that cardiac rehabilitation is cost-effective,[121] it is clearly not a homogeneous 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 possibly 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.

H. Implications

H1. Target population: Current service provision concentrates on low-risk, white, male, middle-aged post-MI patients, however there is no evidence 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.

H2. Exercise alone: Exercise has a positive impact on physical aspects of recovery at no additional risk to the patient, but has no effect on risk factors, morbidity or mortality. The effect of exercise on the psychosocial aspects of recovery are unclear.

H3. Psychosocial and educational interventions: 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.

However, in practice, the information provided is often inadequate, inconsistent and inaccurate and is frequently misunderstood by patients. The public and health professionals should understand that activity need not be significantly reduced after a cardiac event.

H4. Combined exercise, psychological and educational interventions: Whilst some benefits from single modality interventions have been demonstrated, a combined approach of exercise, psychological and educational interventions appears to be more beneficial.

H5. Organisation of services: The majority of RCTs have provided a structured programme of three to five supervised exercise sessions per week, in combination with a patient education or psychosocial intervention, for a period of approximately 12 weeks, but little research has evaluated the optimal frequency, intensity or duration of sessions.

Home-based rehabilitation can be as effective and safe as hospital-based programmes when a prescribed rehabilitation programme and some form of supervision is provided, but more research is needed.

Although there is significant variation between existing programmes, in almost all centres, a standard programme is delivered over a set time. Patients are expected to take part in all aspects, regardless of their actual health needs. Recent UK national guidelines recommend a menu-based approach with individual assessment of patient need and audit of outcomes.

Given the need to maintain improvements in lifestyle and the problems with continuing compliance, the importance of long-term maintenance programmes cannot be underestimated.

H6. Access, uptake and adherence:
Uptake of cardiac rehabilitation varies widely and can be very poor with high drop-out rates. Patients are more likely to attend when doctors strongly recommend that they should, when access is convenient, and when partners or spouses are involved.

H7. Implications for research:
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, home-based and community-based services with current hospital-based programmes. Important questions remain to be answered as to the optimal mix of components and the frequency and duration of the programme. Greater benefits may accrue to patients who do not generally receive rehabilitation at present, such as those with heart failure and angina. Groups with more serious medical problems may be excluded because of concern about safety; more research is required to design safe and effective programmes to meet the needs of different patient groups. Research is required to identify reasons for, and strategies to improve, the current low levels of uptake in groups such as women and the elderly.

Appendix on research methods

A search of Medline, Embase, ASSIA, Cinahl, PsychLit, AMED, SIGLE and the Cochrane Library identified 215 potential systematic reviews. An initial screening was undertaken by two reviewers in accordance with CRD criteria for systematic reviews (see CRD's WWW pages: http://nhscrd.york.ac.uk/brsgateway/manual.htm). This identified 20 reviews which were then further evaluated in more detail. Nine systematic reviews were included,[24,56,73,77,78,89–91,122] although three were of borderline quality.[73,77,90]

It was found that reviews of psychosocial interventions had included a mixture of trials of psychosocial interventions and multifactorial rehabilitation. Therefore a further search was conducted to identify RCTs of cardiac rehabilitation, with a particular focus on those which evaluated psychosocial interventions or cardiac rehabilitation as a multifactorial package. The titles and abstracts of 500 papers were screened by two reviewers and 175 RCTs were selected for further evaluation. These studies were assessed for inclusion independently by two reviewers and any discrepancies discussed. Forty six trials met our inclusion criteria. Eighteen of these were duplicate reports of previous studies, leaving 28 separate trials. Subsequently, two reviewers extracted data on the results, following the same procedure.

A search of Medline, Embase, HEED and the NHS Economic Evaluations Database for economic literature relating to cardiac rehabilitation identified 19 papers for review comprising one cost-benefit analysis, one cost-utility analysis, and six partial economic evaluations. The remainder were review or discussion articles.

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