A short course of cardiac rehabilitation programme is highly cost effective in improving long-term quality of life in patients with recent myocardial infarction or percutaneous coronary intervention.


Record Status
This is a critical abstract of an economic evaluation that meets the criteria for inclusion on NHS EED. Each abstract contains a brief summary of the methods, the results and conclusions followed by a detailed critical assessment on the reliability of the study and the conclusions drawn.

Health technology
A cardiac rehabilitation and prevention programme (CRPP) was considered. The CRPP consisted of four phases. Phase 1 (baseline) was an inpatient ambulating programme, which lasted from 7 to 14 days. Phase 2 was a twice-weekly outpatient education and exercise programme, lasting 8 weeks. Phase 3 was a community-based home exercise programme lasting 6 months. Phase 4 was a long-term maintenance period, which lasted until the end of the second year of recruitment. The control group received conventional therapy without undergoing the outpatient exercise training programme after the ambulatory phase.

Type of intervention
Rehabilitation.

Economic study type
Cost-utility analysis.

Study population
The study population comprised consecutive patients who were referred to a university-affiliated cardiac rehabilitation centre within 6 weeks of an AMI or PCI performed for angina pectoris. The exclusion criteria included coronary heart disease but without revascularisation procedures, significant mitral stenosis (defined as mitral valve area of \( \leq 1 \text{ cm}^2 \)) or aortic stenosis (defined as an aortic valve gradient \( \geq 50 \text{ mmHg} \)) active pericarditis or myocarditis, and severe uncontrolled hypertension (systolic blood pressure >200 mmHg and/or diastolic blood pressure >100 mmHg). Further exclusion criteria were physical problems that precluded exercise, cognitive impairment or unwillingness to join the programme, malignancies that limited life span to less than 1 year, and refusal to participate in the study. Age itself was not an exclusion criterion.

Setting
The setting was an outpatient cardiac rehabilitation and prevention centre and the community for Phase 3 of the CRPP. The economic study was carried out in Hong Kong.

Dates to which data relate
Both the resource use and effectiveness data were prospectively gathered for 2 years. Tung Wah hospital costs, official published charges, published local drug formulary and patient self-reported direct medical expenses were used to compute the costs, although no price year was reported.

Source of effectiveness data
The effectiveness evidence was derived from a single study.
Link between effectiveness and cost data
The costing was undertaken prospectively on the same patient sample as that used for the effectiveness study.

Study sample
The authors did not report power calculations to determine the sample size. A group of 269 consecutive patients who were referred to a university-affiliated cardiac rehabilitation centre were enrolled in the study. Of the 269 Chinese patients, 193 were recruited after recent AMI and 76 after selective PCI. One hundred and eighty-one were randomised to the CRPP group and 88 to the control group.

Study design
This was a prospective, unblinded, randomised, controlled trial. The patients were randomised to the CRPP group or the control group at a ratio of 2 to 1. The follow-up period was 2 years. At 2 years, 49 patients in the CRPP group and 16 in the control group discontinued treatment. Hence, the economic analysis was based on 132 patients in the CRPP group and 72 patients in the control group.

Analysis of effectiveness
The analysis was conducted on the basis of treatment completers only. The primary health outcomes considered were the Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36), the Symptom Questionnaire, the time trade-off questionnaire, mortality and hospitalisation. There was no difference in age, gender, or other clinical parameters, between the CRPP and control group at baseline (Phase 1).

Effectiveness results
In the study group, the physical functioning, physical role, vitality, social functioning, emotional role and mental health improved significantly at the end of Phase 2 of the programme. These were all maintained when reassessed at the end of Phases 3 and 4. These results were presented graphically in the paper.

Bodily pain was increased at the end of Phase 2 in the control group and remained so throughout the study period.

At the end of Phase 4, physical functioning, physical role, vitality and emotional role were all improved in the control group.

After attending the CRPP, patients became more contented and relaxed at the end of Phase 2 and were less anxious and depressed throughout the study period. However, none of these psychological improvements were observed in the control group at the end of the study. Instead, they had increased hostility scores at the end of Phases 2 and 3.

The absolute difference in net changes of mean trade-off scores between the CRPP and control groups was calculated to be 0.08 at the end of Phase 2, 0.01 at the end of Phase 3, and 0.05 at the end of Phase 4. Therefore, the mean gain in time trade-off throughout the 2-year rehabilitation programme was 0.0458 per patient.

At the end of Phase 4, there was no significant difference in mortality (3% versus 5%, log-rank chi-squared test 0.5; p non significant) or hospitalisation (26% versus 22%, log-rank chi-squared test 1.07; p non significant) between the two groups.

Clinical conclusions
The authors stated that improvements in QOL after the CRPP was maintained for at least 2 years, including the physical, mental and social aspects, and that such benefits were faster and more sustainable than those obtained with conventional therapy.

Measure of benefits used in the economic analysis

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The measure of benefit used was the quality-adjusted life-years (QALYs). The utilities were obtained using the time trade-off method on all patients in the four phases of the study.

**Direct costs**
The cost/quantity boundary adopted for the economic analysis was that of the hospital. Broad areas of expenditure included staff salary, equipment, investigations, interventions, hospitalisations, scheduled clinic visits, unscheduled clinic visits and drugs. Staff salary costs were calculated according to the hourly rates of each discipline in the rehabilitation centre, by dividing the annual midpoint salary by the total working hours in a year. The salary cost was then determined in relation to the hours devoted by staff to each patient. The equipment cost was calculated by using a straight line amortisation of 10 years and the amount of time each patient used the equipment, and then translated to a dollar value. Costs of hospitalisations, investigations, interventions and clinical visits were based on a local official publication and hospital charges. Investigations included echocardiography, 24-hour electrocardiographic monitoring, exercise tolerance test and blood test. Drug costs for each participant were estimated according to a published local drug formulary.

**Statistical analysis of costs**
The costs were treated stochastically. The cost evaluation between groups was compared using an unpaired t-test.

**Indirect Costs**
No indirect costs were included.

**Currency**
US dollars ($).

**Sensitivity analysis**
No areas of uncertainty were identified or investigated.

**Estimated benefits used in the economic analysis**
The QALYs calculated for each of the phases were presented for both groups; however, one value appears to be missing. Although not clear, it would appear that one of the QALY values for the early phases for the CRPP group has not been included. The results, as presented in the paper, were "13.1, 13.7, and 13.5 and 11.8, 11.3, 12.4 and 11.7 in the CRPP and control groups respectively".

The net QALYs of the two groups, gained in Phases 2, 3 and 4, were 0.8, 0.3 and 0.8, respectively, when adjusted for the difference at Phase 1.

The net gain in QALY at the end of the 2-year programme was 0.6.

**Cost results**
The total health care cost was $15,707 per patient for the control group and $15,292 per patient for the study group. These were not significantly different.

The incremental cost for the rehabilitation programme over the usual cost of care was -$415 per patient, which was attributed to the lower cost for subsequent PCI ($1,100 +/- 2,860) versus $2877 +/- 4,395; p=0.1) in the CRPP group after the commencement of the exercise programme.

**Synthesis of costs and benefits**
The CRPP strategy was less costly and more effective than conventional therapy. It was therefore the dominant strategy with a negative cost per QALY of -$650.

Authors’ conclusions
Patients who underwent an 8-week cardiac rehabilitation and prevention programme (CRPP) after a recent acute myocardial infarction (AMI), or after selective percutaneous coronary intervention (PCI), had an early and sustained improvement in quality of life (QOL) for at least 2 years. The CRPP was highly cost-effective, with a net gain in quality-adjusted life-years (QALYs), whereas the direct health care costs were reduced, which was primarily related to the reduction in subsequent need for PCI.

CRD COMMENTARY - Selection of comparators
Conventional therapy without the outpatient exercise training programme after the ambulatory phase was explicitly chosen as the comparator since it represented standard practice in Hong Kong. You must decide whether this is a widely used health technology in your own setting.

Validity of estimate of measure of effectiveness
This was a randomised controlled trial, which was appropriate for the study question. However, only limited details of the study design were provided. With no details about the method of randomisation, it was difficult to determine if the allocation was truly random and, therefore, minimised bias and confounding. The SF-36, the Symptom Questionnaire, the time trade-off questionnaire scores, mortality and hospitalisation were valid measures for the effectiveness analysis. The questionnaires were administered by a third party who was blind to the treatment group allocation. This will enhance the validity of the QOL data acquired. The patient groups were shown to be comparable at analysis, and appropriate statistical analyses were undertaken.

Validity of estimate of measure of benefit
QALYs were used for the economic analysis, and these would appear to be a valid measure of benefits. Moreover, the use of QALYs allows comparisons of the study results across different interventions.

Validity of estimate of costs
A hospital perspective was adopted for the study, and relevant cost categories for this perspective were included. The sources of the resource data were reported, but the price year was not. The resource quantities were reported separately, thus enhancing the reproducibility to other settings. However, patients were required to pay a nominal fee to participate in the programme and it was difficult to assess the impact of such a payment on the results obtained, particularly in terms of the generalisability to other settings where such a payment is not required.

Other issues
The authors compared their findings with those of published studies which did not show a general trend of improvement in long-term QOL due to CRPP. The cost estimates are likely to be specific to Hong Kong hospitals and may not be generalisable to other settings. The authors acknowledged that the sample size and the duration of follow-up did not allow the potential benefit of morbidity and mortality of the CRPP over conventional care to be determined. The authors also pointed out that some hidden costs might have been underestimated, although this was partially compensated for by the use of the difference in costs between the two arms rather than the actual cost itself.

Implications of the study
The results of the study support the adoption of the CRPP in addition to the contemporary regimen of managing patients with coronary heart disease.
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Other publications of related interest


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