Cost-effectiveness analysis of long-term moderate exercise training in chronic heart failure

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
The study evaluated a long-term moderate exercise training (ET) programme in patients with heart failure. During the first stage of the programme, patients exercised for one hour at 60% of peak oxygen consumption, three times per week for 8 weeks. This was followed by a 12-month maintenance programme where training was carried out at the same intensity but twice a week.

Type of intervention
Treatment and secondary prevention.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised patients in New York Heart Association (NYHA) class II and III with stable heart failure. The age of the group assessed was between 55 and 64 years.

Setting
The setting was the community.

Dates to which data relate
The effectiveness evidence was derived from a trial published in 1999 (see Other Publications of Related Interest). The resource use estimates and prices were also from 1999. The indirect costs related to 1998 values.

Source of effectiveness data
A single study was used to estimate the effectiveness of the programme.

Link between effectiveness and cost data
The authors estimated the cost of the programme from the details of the training provided in the trial. This was done retrospectively.

Study sample
Details of the study sample were not provided in the current paper. It is therefore not possible to outline details of the sample size, power calculation and demographic or clinical data for the two patient groups. The related publication may provide these details (see Other Publications of Related Interest).
Study design
This was a randomised controlled trial. ET was performed in two phases. Initially, patients exercised at 60% of peak oxygen consumption, three times per week for 8 weeks. This protocol was followed by a 12-month maintenance programme of the same intensity but with only 2 sessions per week. Each session lasted approximately 1 hour, beginning with a warm-up phase of stretching exercises (15 to 20 minutes) followed by cycling on an electronically braked cycle ergometer (40 minutes). Each patient in the ET group received 128 sessions totalling 128 hours. The period of follow-up in the trial was 14 months. Details of the loss to follow-up were not reported in the present study (see Other Publications of Related Interest).

Analysis of effectiveness
The method of analysis (intention to treat or treatment completers only) was not stated. The health outcome assessed was mortality. It is not possible to assess from this paper whether the patient groups were comparable at baseline (see Other Publications of Related Interest).

Correspondence with the authors indicates that groups were, in fact, comparable.

Effectiveness results
The patients in the study used as the basis for the clinical outcomes were followed-up for 1,214 days, in addition to the 14-month exercise programme. Survival at the end of follow-up was 82% in the exercise group and 59% in the control group, (p<0.05).

Clinical conclusions
ET offered significant reductions in mortality rates when compared with usual care.

Modelling
A model was used to extrapolate survival data at the end of 1,639 days of follow-up to an additional 10 years. The hazard of death was assumed to be identical for the training and control groups after the first 1,639 days.

Measure of benefits used in the economic analysis
The health benefit used in the economic analysis was the life-years gained.

Direct costs
The costs were for the intervention (equipment and rental of land), the trained staff to assist with the training (trainer’s salary and fringe benefits) and averted hospitalisations. The costs were expressed in 1999 US dollars and discounted at a rate of 3%. The hospitalisation rates were taken from the trial, whereas costs for the intervention were based on the authors’ assumptions about intervention costs.

Statistical analysis of costs
A statistical analysis of the costs was not carried out.

Indirect Costs
The indirect costs included wages lost due to the ET programme. This was calculated using data from the US Census Bureau. The wages lost due to the ET programme were calculated by multiplying the weighted (by gender ratio in the effectiveness trial) average earnings for workers aged 55 to 64 years by the length of the programme (128 hours). This resulted in a figure of $2,509 per person. Discounting was not applied to the indirect costs as they were incurred over the period of the trial, which was less than 2 years. The authors made the assumptions that all ET participants were full-time workers, and that patients did not gain extra utility from the exercise programme. If this latter point had been the
case, the findings would not have reflected true opportunity costs. The price year was 1998.

**Currency**

US dollars ($).

**Sensitivity analysis**

One-way sensitivity analyses were conducted to examine the effect of altering three variables in the incremental cost-effectiveness analysis of the training programme. The variables investigated were the survival probabilities (based on 95% confidence intervals), the rate of improvement due to the use of angiotensin-converting enzyme (ACE) inhibitors in the follow-up phase, and the reduction in the rate of hospitalisation (based on 95% confidence intervals).

**Estimated benefits used in the economic analysis**

At 10 years, the projected life expectancy was 10.24 years in the exercise group and 7.96 years in the control group. The undiscounted incremental life expectancy was therefore estimated at 2.28 years per patient. At 15.5 years, the incremental life expectancy was 1.82 years per patient.

**Cost results**

The reduction in the hospitalisation rate was 19%. The incremental total cost of the exercise programme was $3,227 per patient. The costs were discounted at a rate of 3%.

**Synthesis of costs and benefits**

The authors divided the incremental costs by the incremental benefits to estimate an incremental cost-effectiveness ratio (ICER) of $1,773 per life-year saved, which was attributable to the ET programme. The upper and lower estimates of survival (95% confidence interval) at 1,639 days were $8,274 per life-year saved and $1,012 per life-year saved. In order to control for additional survival due to the use of ACE inhibitors in the follow-up period, the authors reduced the estimate of mortality by 23%, reflecting survival in the follow-up studies of ACE inhibitors. The ICER ranged from $1,698 to $1,855 per life-year saved when accounting for the effect of ACE inhibitors. Finally, the authors explored ICER when hospitalisation was at the lower (3%) and upper (34%) estimate of reduced hospitalisation. The ICER ranged from $4,317 to $2,178 under these estimates.

**Authors' conclusions**

The exercise programme for patients with heart failure had an attractive cost-effectiveness ratio when compared with other interventions that are considered cost-effective.

**CRD COMMENTARY - Selection of comparators**

No exercise programme was a relevant comparator to the exercise programme in this cost-effectiveness analysis, as this represents current practice in most settings.

**Validity of estimate of measure of effectiveness**

The effectiveness analysis used the results of a randomised, controlled trial of ET in heart failure. The authors did acknowledge that other studies existed, but in correspondence with this organisation, subsequent to this abstract being written, they have indicated that their choice of this particular study was justified as it was the only available study that reported the required long-term follow-up. Little information was provided on the details of the study. This made it difficult to judge the validity of the trial results, as well as the validity in selecting that trial as the sole basis for the effectiveness measure. The reader should consult the original randomised controlled trial for more detailed information (see Other Publications of Related Interest).
Validity of estimate of measure of benefit
The benefit measure was appropriate for the study. The benefits gained by the ET programme, based on the randomised controlled trial, were extrapolated to a longer time period using a piece-wise exponential survival model, which was appropriate. A number of adjustments were made to improve the validity of the survival rates for each group. These adjustments were made for age, gender, and treatment with ACE inhibitors.

Validity of estimate of costs
The costs were estimated partly from hospitalisation rates in the trial, and partly from assumptions about the cost of the ET programme. These seem to have included the most relevant costs to the evaluation. The unit costs of hospitalisation were derived from hospital charges, which is a crude approximation to long-term marginal programme costs. Further, the cost of the exercise programme were assumed rather than measured prospectively. It is difficult to assess whether these costs are over- or under-estimations of the real costs associated with the training. The authors included productivity losses due to the ET programme, which introduces relevance to a societal perspective. However, other indirect costs, such as travel expenses associated with the programme and the loss of income due to disability, were not included.

Other issues
The authors stated that no similar cost-effectiveness studies have been conducted and that comparisons were therefore irrelevant. Some limitations of the study were outlined by the authors. For example, the results may not be generalisable to heart failure patients in NYHA class IV, and may have limited generalisability to women. Further, only those patients aged between 55 and 64 years were included in the study, which prevents generalisation of the results to other age groups. Finally, the hospitalisation costs estimated by the authors were collected in major New York hospitals. These costs may be as much as 20% higher than other hospitals.

Implications of the study
The authors estimate that 1.69 million people in the USA could benefit from ET. The authors also estimated, from Census information and prevalence data, that 1.69 million class II or III heart failure persons could benefit from ET. The data provided in the paper would enable a decision-maker to assess the budgetary impact of such a nationwide scheme.

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None stated.

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Other publications of related interest

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