The long-term cost-effectiveness of cardiac resynchronization therapy with or without an implantable cardioverter-defibrillator

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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 considered cardiac resynchronisation therapy (CRT-P) in addition to medical therapy, and cardiac resynchronisation with an implantable cardioverter-defibrillator (CRT-ICD) in addition to medical therapy, for the treatment of heart failure.

Type of intervention
Treatment.

Economic study type
Cost-utility analysis.

Study population
The study population comprised a hypothetical cohort of patients aged 65 years, with evidence of heart failure for at least 6 weeks, who were in New York Heart Association Class III or IV despite standard pharmacological therapy.

Setting
The clinical setting was inpatient and outpatient care in a tertiary hospital. The economic study was carried out in the UK.

Dates to which data relate
The clinical effectiveness and resource use data were taken from sources published between 2005 and 2006. The price year was not reported.

Source of effectiveness data
The clinical data included in the model were transition rates between the New York Heart Association classes and mortality rates from worsening heart failure, sudden death and death from other causes.

Modelling
A Markov model, using Monte Carlo simulation and with a lifetime horizon, was developed to identify the health benefits and costs of the three treatment options. The health state and transition probabilities were presented in the paper, but the cycle length was not stated. Model assumptions were fully justified. A survival analysis was conducted on the CARE trial to determine mortality rates.

Sources searched to identify primary studies
The majority of the model parameters were taken from a randomised controlled trial with a sample size of 813 (CARE-
HF, see 'Other Publications of Related Interest' below for bibliographic details). The additional impact of ICD on sudden death was taken from another clinical trial (COMPANION, Carson et al. 2005, see 'Other Publications of Related Interest' below for bibliographic details). Data on mortality from other causes were taken from official data for the UK population.

Methods used to judge relevance and validity, and for extracting data
The authors did not report the methods used to identify relevant data sources.

Measure of benefits used in the economic analysis
The measure of health benefit used was the quality-adjusted life-years (QALYs). Health state valuations were taken from a published randomised controlled trial (Carson et al. 2005). The benefits were discounted at an annual rate of 3.5%.

Direct costs
The direct costs to the NHS were identified in this study. The costs of the implantation procedure and the device, inpatient stays, outpatient visits, primary care visits, time spent in nursing or rehabilitation homes, and medical costs were included. The resource use data were taken from the model detailed above, whereas the unit costs were detailed in the paper but their source was not specified. Future costs were discounted at a rate of 3.5%. No price year was reported.

Statistical analysis of costs
No statistical analysis of the cost data was undertaken.

Indirect Costs
No productivity costs were included in this study.

Currency
Euros (EUR). Pounds sterling () were converted to EUR using an exchange rate of 1 = EUR 1.47

Sensitivity analysis
A probabilistic sensitivity analysis was performed to examine the impact of uncertainty in the cost and health benefit data. The distributions of the model parameters were reported in the paper. One-way sensitivity analyses that varied the age of the model cohort, length of follow-up and the battery life of ICD implants were also undertaken.

Estimated benefits used in the economic analysis
The mean QALYs was 4.08 (95% confidence interval, CI: 3.23 to 4.82) for medical therapy alone, 6.06 (95% CI: 5.19 to 6.87) for CRT-P plus medical therapy, and 6.75 (95% CI: 5.76 to 7.72) for CRT-ICD plus medical therapy.

Cost results
The mean total lifetime cost was EUR 39,060 (95% CI: 35,510 to 43,222) for medical therapy alone, EUR 53,996 (95% CI: 50,127 to 58,092) for CRT-P plus medical therapy, and EUR 87,350 (95% CI: 82,052 to 92,521) for CRT-ICD plus medical therapy.

Synthesis of costs and benefits
In the base-case analysis, the incremental cost-utility of CRT-P plus medical therapy compared with medical therapy...
alone was EUR 7,538 per QALY (95% CI: 5,325 to 11,784). Comparing CRT-ICD plus medical therapy with medical therapy alone resulted in an incremental cost-utility of EUR 18,017 per QALY (95% CI: 14,500 to 25,070). When CRT-ICD plus medical therapy was compared with CRT-P plus medical therapy, the incremental cost-utility was EUR 47,909 per QALY (95% CI: 35,703 to 79,438).

Varying the length of follow-up and the age of the cohort altered the results, with younger patients and longer follow-up periods giving the most cost-effective results. Reducing battery life to 4 years increased the cost per QALY when comparing CRT-ICD plus medical therapy with CRT-P plus medical therapy to EUR 75,091. Conversely, increasing battery life reduced this to EUR 43,506.

**Authors' conclusions**
Cardiac resynchronisation therapy (CRT-P) is cost-effective compared with medical therapy alone. If a lifetime perspective were to be adopted, cardiac resynchronisation with an implantable cardioverter-defibrillator (CRT-ICD) plus medical therapy may also be cost-effective in comparison with CRT-P plus medical therapy.

**CRD COMMENTARY - Selection of comparators**
This study compared CRT-P plus medical therapy and CRT-ICD plus medical therapy with medical therapy alone. No explicit rationale for the choice of the comparators was included in the paper. You should consider how these options compare with usual practice in your own setting before applying the results of this study.

**Validity of estimate of measure of effectiveness**
The model parameters identified in this study were taken from published sources. The authors did not report the methods used to identify the data sources or any inclusion criteria, so it is not possible to tell whether there was any selection bias.

**Validity of estimate of measure of benefit**
The measure of health benefit used in the economic analysis was the QALYs. The use of QALYs enables the results of this study to be compared directly with those from other interventions for the treatment of heart disease and other conditions. Health state valuations were taken from a published randomised controlled trial, but details of the methods used to elicit these values were not reported. The clinical parameters were taken from randomised controlled trials, which have a high level of internal validity.

**Validity of estimate of costs**
The economic perspective of the study was that of the UK NHS and, as such, all appropriate costs appear to have been included. Uncertainty around the cost data was explored using probabilistic sensitivity analysis. Future costs were appropriately discounted and a breakdown of the unit costs was given in the paper. These factors add to the generalisability of the study findings. Costs in pounds sterling were converted to euros using a clearly identified conversion rate. No clear price year was reported, which will prevent any future reflation exercises.

**Other issues**
The authors do not appear to have presented their results selectively and their conclusion reflected the scope of the analysis. The authors concluded that CRT-ICD may be cost-effective. You should judge if the incremental cost-effectiveness ratio falls within your willingness-to-pay. The authors did not compare their findings with those from other similar studies. The study was designed to reflect the situation in the NHS, thus the authors did not consider the likely impact of the interventions in other countries.

**Implications of the study**
The authors did not make any recommendations for changes to practice or for further research.
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Other publications of related interest
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MeSH
Adolescent; Adult; Aged; Cardiac Pacing, Artificial /economics /mortality; Cost-Benefit Analysis; Death, Sudden, Cardiac /prevention & control; Defibrillators, Implantable /economics; Heart Failure /economics /mortality /therapy; Humans; Middle Aged; Quality-Adjusted Life Years; Survival Analysis; Treatment Outcome

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