Cardiac resynchronization therapy (CRT) in heart failure: a model to assess the economic value of this new medical technology

Banz K

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 use of cardiac resynchronisation therapy (CRT) in patients with heart failure was evaluated.

Type of intervention
Treatment.

Economic study type
Cost-utility analysis.

Study population
The target population comprised adult patients with heart failure.

Setting
The setting appears to have been either secondary or tertiary care. The economic study was carried out in Switzerland.

Dates to which data relate
The effectiveness data were gathered between 2000 and 2004. Country-specific resource use data were used. For the German illustrative examples, resource use data were gathered between 1997 and 2003. The price year for the German analysis was 2002.

Source of effectiveness data
The effectiveness data were derived from a review of medical literature augment, when necessary, by expert opinion.

Modelling
A decision tree with a short- and a long-term component was developed to compare the clinical and economic effects of a CRT-treated cohort with that of a cohort treated with OPT alone. The short-term outcomes of patients treated with CRT were assessed over a 30-day timeframe, and then the two compared treatment groups were compared over a longer period of time. The time horizon of the illustrative analysis was 1 year. However, the software was designed to compute acute and long-term results for 6, 12 and 18 months, and 2, 3, 4 and 5 years. A graphical representation of the model structure was provided in the paper. The author used Microsoft Visual Basic, Access and Excel software.

Outcomes assessed in the review
The main outcomes estimated from the review of the literature were:

the percentage of patients with successful left ventricular (LV) lead implantation;
the percentage of perioperative mortality;
the probability of complications with CRT;
the probability of death (all causes), hospital admission (due to heart failure) and heart transplantation during the follow-up period for patients treated by CRT and OPT alone; and
the utility values according to severity level (4 NYHA classes).

The model inputs presented are for the German illustration only.

**Study designs and other criteria for inclusion in the review**
Although the author stated that the highest priority was given to randomised controlled trials, no explicit inclusion criteria were reported.

**Sources searched to identify primary studies**
Not stated.

**Criteria used to ensure the validity of primary studies**
Not stated.

**Methods used to judge relevance and validity, and for extracting data**
Not stated.

**Number of primary studies included**
Approximately 9 studies were included in the review.

**Methods of combining primary studies**
It appears that a narrative method has been used to combine the studies.

**Investigation of differences between primary studies**
Not stated.

**Results of the review**
The percentage of patients with successful LV lead implantation was 92.5%.

The percentage of perioperative mortality was 0.3%.

For the CRT strategy:
the probability of death from all causes was 0.049 at 6 months and 0.15 at 12 months;
the probability of hospital admission due to heart failure was 0.079 at 6 months and 0.13 at 12 months; and
the probability of heart transplantation was 0 at 6 months and 0.03 at 12 months.

For the OPT alone strategy:
the probability of death was 0.063 at 6 months and 0.19 at 12 months;

the probability of hospitalisation was 0.151 at 6 months and 0.25 at 12 months; and

the probability of transplantation was 0.009 at 6 months and 0.04 at 12 months.

These data formed the principal effectiveness and outcome parameters used in the German analysis.

**Measure of benefits used in the economic analysis**
The measure of benefits used was the quality-adjusted life-years (QALYs). The utility estimates were gathered from a study published in 2001 (Lewis et al. 2001, see 'Other Publications of Related Interest' below for bibliographic details). Patient preferences were elicited to assess the different health states, but the method of valuation was not reported in this paper.

**Direct costs**
The direct costs reported were those of the health service. The key resource use categories included were the CRT procedure, hospital care-related costs, outpatient visits, drug treatment and diagnostic examinations. Resource use was reported separately from the costs. Discounting was not performed as the costs for the case study presented were estimated over a 1-year period. The price year for the German case study was reported. Types of medications and dosages for the treatment of heart failure were obtained primary from clinical trial studies, supplemented with expert opinion in the absence of published data. Other direct costs were based on national databases, published literature and expert opinion.

**Statistical analysis of costs**
The costs were treated deterministically. No statistical analysis of the costs was reported in the paper.

**Indirect Costs**
The indirect costs were not considered in the illustrative case study, although the model had the flexibility of also adopting a societal perspective, including productivity losses attributable to the disease and due to temporary morbidity and premature death.

**Currency**
Euros (EUR).

**Sensitivity analysis**
Best- and worst-case scenarios were conducted by making assumptions about the values of the most sensitive parameters that were superior or inferior to the base-case values. Such parameters included length of hospital stay, unit cost per hospital day, reduction in the probability of hospitalisation after CRT, CRT implantation costs and the distribution of patients amongst the NYHA severity classes. Assumptions seem to have been used in the selection of ranges.

**Estimated benefits used in the economic analysis**
The mean number of QALYs per average patient over one year was 0.70 for the CRT strategy compared with 0.54 for OPT alone. This translated into a 0.16 QALY gain. These values were based on one year of follow-up.

**Cost results**
The total direct medical costs per patient per year were EUR 10,090 for the CRT strategy compared with EUR 4,210
for the OPT strategy.

The CRT strategy resulted in an average per-patient net cost of EUR 5,880 by the end of the first year after the procedure.

The key category contributing to this difference was the cost of the CRT implantation procedure.

**Synthesis of costs and benefits**
Incremental cost-effectiveness ratios were estimated as the extra cost per QALY gained from CRT implantation plus OPT compared with OPT alone. The results of the German case study showed a resulting cost per QALY gained of EUR 36,600.

The results of the sensitivity analysis showed the preliminary results of the German case study to be fairly robust.

**Authors' conclusions**
The results of the German case study showed a resulting cost per quality-adjusted life-year (QALY) gained of EUR 36,600. This incremental cost-effectiveness ratio is below the current equivalent in euros of the conventional threshold used in the context of the UK National Health Service so, on these terms, the implantation of a cardiac resynchronisation therapy (CRT) system should be considered cost-effective.

**CRD COMMENTARY - Selection of comparators**
An OPT alone option was used as the comparator, which seems appropriate for this type of analysis. You should decide whether this could be a valid comparator in your own setting.

**Validity of estimate of measure of effectiveness**
A comprehensive review of the published literature was carried out to identify relevant clinical data. In addition, nine medical experts were consulted to obtain complementary effectiveness data. However, the author did not report any of the methods used to identify and select those studies from which the input parameters were obtained. Given this, it is difficult to ascertain whether the best available evidence has been used to populate the model.

**Validity of estimate of measure of benefit**
A generic outcome measure was used for the analysis. The reason why the author differentiated utilities by different severity levels when the short- and long-term outcome parameters seemed to refer to an “average” patient with heart failure was not clear.

**Validity of estimate of costs**
The author explicitly identified the perspective adopted in the analysis and all of the appropriate costs appear to have been included. Substantial efforts were undertaken to populate the model with relevant country-specific resource use data, although the only details provided in this paper were those of the German analysis. The price year for the German case study was reported which will aid any future reflation exercises. Discounting was not required, given the time horizon of the study, and was appropriately not conducted. Although the indirect costs were not included for the German analysis reported here, the model had the flexibility of adopting a societal perspective when required.

**Other issues**
A more detailed explanation of the type and structure of the complete model would have been helpful. The fact that the time horizon used for the German illustrative example was only one year is confusing, and the reason why the author reported results only for the short term was unclear. The author appropriately discussed the main limitations of the study.
Implications of the study
The European CRT model is an important tool to assess the economic value of CRT in patients with moderate to severe heart failure.

Source of funding
Supported by Biotronik, ELA Medical, Guidant, Medtronic Europe, and St. Jude Medical Europe.

Bibliographic details
Banz K. Cardiac resynchronization therapy (CRT) in heart failure: a model to assess the economic value of this new medical technology. Value in Health 2005; 8(2): 128-139

PubMedID
15804321

DOI
10.1111/j.1524-4733.2005.03092.x

Other publications of related interest

Indexing Status
Subject indexing assigned by NLM

MeSH
Cardiac Pacing, Artificial /economics; Cost-Benefit Analysis; Decision Support Techniques; Defibrillators, Implantable /economics; Health Care Costs; Heart Failure /drug therapy /economics /therapy; Humans; Models, Econometric; Outcome Assessment (Health Care) /economics /methods; Prognosis; Quality-Adjusted Life Years; Technology Assessment, Biomedical /economics /methods

AccessionNumber
22005007704

Date bibliographic record published
30/09/2006

Date abstract record published
30/09/2006