Is B-type natriuretic peptide-guided heart failure management cost-effective
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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 use of B-type natriuretic peptide (BNP)-guided heart failure management in patients with symptomatic chronic heart failure (CHF) was examined. BNP measurement was carried out every 3 months.

Type of intervention
Secondary prevention.

Economic study type
Cost-utility analysis.

Study population
The study population comprised a hypothetical cohort of symptomatic (New York Heart Association Class II-IV) CHF patients aged 35 to 85 years after hospital admission because of CHF with impaired left ventricular systolic function (left ventricular ejection fraction less than 40%).

Setting
The setting was an outpatient setting. The economic study was carried out in the USA.

Dates to which data relate
The effectiveness, resource use and cost data were derived from studies published between 1991 and 2000. The price year was 2002.

Source of effectiveness data
The effectiveness evidence was derived from a synthesis of published studies.

Modelling
A Markov model was constructed to examine the costs and benefits of the alternative preventive strategies under evaluation. The patients started in the state of no additional hospitalisation for CHF and were followed for 9 months. The cycle length was 3 months. Patients moved across health states, which referred to additional hospitalisations or death. A simplified structure of the model was reported.

Outcomes assessed in the review
The outcomes assessed in the review were:

the probabilities used in the decision model, which included the rate of death among patients hospitalised or not for CHF, and the rate of hospitalisation for first, second, third, fourth or more readmissions; and
the hazard ratio (BNP versus standard care) for hospitalisation for CHF, death from CHF, frequency of ambulatory care, dose of angiotensin-converting enzyme (ACE) inhibitors, and dose of diuretics.

The utility associated with symptomatic CHF with a left ventricular ejection fraction of less than 40% was also estimated from the literature.

**Study designs and other criteria for inclusion in the review**
It appears that a systematic review of the literature was not undertaken to identify the primary studies, which were identified selectively. Randomised trials provided the clinical data and details of the patient samples and outcomes were reported in an appendix. The utility data were derived from a study that used the time trade-off method.

**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**
Four primary studies provided evidence.

**Methods of combining primary studies**
The primary studies were not combined.

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

**Results of the review**
The rate of death per month was:

0.203 (range: 0.1015 - 0.3045) among those hospitalised for CHF, and

0.007 (range: 0.0035 - 0.0105) among patients not hospitalised for CHF.

The rate of hospitalisation per month was:

0.052 (range: 0.026 - 0.078) for first readmission for CHF,

0.106 (range: 0.053 - 0.159) for second readmission for CHF,

0.121 (range: 0.0605 - 0.1815) for third readmission for CHF, and

0.18 (range: 0.09 - 0.27) for fourth or more readmission for CHF.

The hazard ratio (BNP versus clinical) was:
0.343 (range: 0.1715 - 0.5145) for hospitalisation for CHF,

0.147 (range: 0.0735 - 0.2205) for death from CHF,

1.5 (range: 1 - 2) for frequency of ambulatory care,

1.4 (range: 1 - 2) for dose of ACE inhibitors, and

1.4 (range: 1 - 2) for dose of diuretics.

The utility associated with symptomatic CHF with a left ventricular ejection fraction of less than 40% was 0.77 (range: 0.6924 - 0.8476).

**Measure of benefits used in the economic analysis**

The summary benefit measure used was the expected number of quality-adjusted life-years (QALYs). This was obtained by combining survival and quality of life data derived from the literature. A modelling approach was used. It was unclear whether the QALYs were discounted.

**Direct costs**

Discounting was not relevant and it was unclear whether it was carried out. The unit costs were not presented separately from the quantities of resources used. The health services included in the economic evaluation were BNP measurement, drugs for CHF (digoxin, diuretics, ACE inhibitors and beta-blockers), dispensing fees, ambulatory care for CHF, inpatient care for CHF and non-CHF related care. The cost/resource boundary adopted in the study was not explicitly stated. Charges for BNP measurement were derived from a price list at a university hospital in the USA, and then converted to costs using a cost-to-charge ratio. All of the other costs and resources use data were derived from a published study. The costs were adjusted to 2002 values using the Consumer Price Index for medical care in the USA.

**Statistical analysis of costs**

The costs were treated deterministically.

**Indirect Costs**

The indirect costs were not considered.

**Currency**

US dollars ($).

**Sensitivity analysis**

Extensive sensitivity analyses were carried out to examine the robustness of the base-case results (cost-utility ratios) to variations in the model inputs. The time horizon of the analysis was also varied. The ranges of values were derived from the literature or set by the authors.

**Estimated benefits used in the economic analysis**

Over an observation period of 6 months, the expected QALYs were 0.38 with BPN and 0.38 with standard care.

Over an observation period of 9 months, the expected QALYs were 0.57 with BPN and 0.55 with standard care.

Over an observation period of 12 months, the expected QALYs were 0.74 with BPN and 0.70 with standard care.

Over an observation period of 15 months, the expected QALYs were 0.91 with BPN and 0.83 with standard care.
Over an observation period of 18 months, the expected QALYs were 1.07 with BPN and 0.94 with standard care.

**Cost results**
Over an observation period of 6 months, the expected costs were $5,577 with BNP and $6,230 with standard care.

Over an observation period of 9 months, the expected costs were $9,577 with BNP and $10,131 with standard care.

Over an observation period of 12 months, the expected costs were $13,436 with BNP and $13,670 with standard care.

Over an observation period of 15 months, the expected costs were $17,155 with BNP and $16,861 with standard care.

Over an observation period of 18 months, the expected costs were $20,737 with BNP and $19,723 with standard care.

**Synthesis of costs and benefits**
An incremental cost-utility ratio was calculated to combine the costs and benefits. The analysis showed that BNP dominated standard care at 6, 9 and 12 months. The incremental cost per QALY gained with BNP over standard care was $3,491 at 15 months and $7,787 at 18 months.

The sensitivity analysis showed that when the probability of first readmission for CHF in the control group and the costs for inpatient CHF care were varied simultaneously (and both went to the lowest values), the incremental cost per QALY with BNP over standard care could exceed $50,000 (i.e. when the cost for CHF hospitalisation was $4,500 and the first readmission probability was 0.03).

**Authors' conclusions**
Brain natriuretic peptide (BNP)-guided heart failure management was cost-effective in symptomatic patients, as it improved the quality-adjusted life-years (QALYs) and reduced costs in comparison with the standard care of no BNP measurement. Further, the cost-effectiveness of BNP measurement compared favourably with that of other widely accepted treatment strategies for chronic heart failure (CHF).

**CRD COMMENTARY - Selection of comparators**
The rationale for the selection of the comparator was clear, as no BNP measurement represented standard care for patients who had experienced CHF. You should decide whether this is a valid comparator in your own setting.

**Validity of estimate of measure of effectiveness**
The effectiveness evidence came from published studies, which were identified selectively. In fact, a systematic review of the literature does not appear to have been undertaken to gather the relevant evidence. Extensive details on the design and results of the studies used to provide the clinical data were provided. The validity of the studies used was high since clinical trials were selected. However, there was limited information on the study used to derive the utility values.

**Validity of estimate of measure of benefit**
The use of QALYs as the summary benefit measure was appropriate as they are easily comparable with the benefits of other health care interventions. The method used to derive the utility values was reported. However, it was not stated whether such values were elicited from patients, physicians, or the general population. Discounting would have been relevant, but it was not stated whether a discount rate was applied.

**Validity of estimate of costs**
The perspective adopted in the study was not stated and it was unclear whether all the relevant categories of costs were
considered. It appears that only direct medical costs have been taken into consideration. The costs were presented as macro-categories, and details of the quantities of resources used were not presented separately from the unit costs. This reduces the possibility of replicating the analysis. Most of the cost data were derived from a published study. The costs were treated deterministically, but some key inputs were varied in the sensitivity analysis. The price year was reported, which aids reflation exercises in other settings.

Other issues
The authors did not compare their findings with those from other studies. They also did not explicitly address the issue of the generalisability of the study results to other settings, although sensitivity analyses were carried out on key inputs. This partially enhances the external validity of the analysis. The authors noted some limitations of their analysis, such as the use of indirect clinical and economic data.

Implications of the study
The study results supported the use of BNP measurement for the secondary prevention of CHF in symptomatic patients. However, the authors suggested that further studies should be carried out to corroborate their findings.

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Other publications of related interest


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