Cost-effectiveness of pediatric heart transplantation

Dayton J D, Kanter K R, Vincent R N, Mahle W T

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
Paediatric heart transplantation, both primary transplantation and re-transplantation, was examined. The medication administered after transplantation was cyclosporine (Neoral, 3 mg/kg per day), mycophenolate mofetil (CellCept, 60 mg/kg per day) and amlodipine (Norvasc, 10 mg/day).

Type of intervention
Treatment.

Economic study type
Cost-effectiveness analysis and cost-utility analysis.

Study population
The study population comprised a hypothetical cohort of paediatric patients with end-stage heart failure.

Setting
The study setting was secondary care. The economic study was carried out in the USA.

Dates to which data relate
The effectiveness data were derived from studies published between 1997 and 2005. Resource use was derived from a study conducted between 1997 and 2004. The price year was 2004.

Source of effectiveness data
The effectiveness data were derived from published studies, supplemented by the authors' own assumptions.

Modelling
A decision analytic model was used to compare heart transplantation with no transplantation. However, the authors did not provide any details as to the sort of model used. The time horizon considered appears to have been lifetime.

Outcomes assessed in the review
The outcomes assessed were:

the life expectancy and quality of life for patients without transplantation;

the post-transplant life expectancy for primary transplant and for re-transplantation; and

the quality of life for patients receiving a heart transplant.
Study designs and other criteria for inclusion in the review
Not reported.

Sources searched to identify primary studies
Not reported.

Criteria used to ensure the validity of primary studies
Not reported.

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

Number of primary studies included
Approximately four primary studies were included in the review.

Methods of combining primary studies
Not relevant.

Investigation of differences between primary studies
Not relevant.

Results of the review
The median survival for paediatric patients listed for heart transplantation was 6 months.

The number of quality-adjusted life-years (QALYs) gained for adults without transplantation was 0.12.

The post-transplant life expectancy was 13.2 years for primary transplant and 5.6 years for re-transplantation.

The quality of life for patients with a heart transplant was 0.87.

Methods used to derive estimates of effectiveness
The authors supplemented the results of the review with their own assumptions.

Estimates of effectiveness and key assumptions
Based on the results from the literature, the authors assumed that quality-adjusted survival time for children with end-stage heart failure not offered transplantation would be negligible. Consequently, the authors effectively compared no heart transplantation with death.

Measure of benefits used in the economic analysis
The measures of benefits used were the life-years and QALYs gained. These were obtained through modelling. Utility values for transplantation were calculated on the basis of a published assessment of quality of life, the Visual Analogue Quality of Life scale in adolescents (Pollock-BarZiv et al. 2003, see 'Other Publications of Related Interest' below for bibliographic details). The health benefits were discounted at an annual rate of 3%.
Direct costs
The direct costs included in the analysis were those to the health care provider. These included the initial transplant and follow-up costs. The initial transplant costs covered hospital admission, pre-transplant costs, organ procurement, hospital stay and 90-day post-transplant costs. They were derived from hospital charges for all admissions to hospital for which a patient received a heart transplant. The initial inpatient charges were then converted to cost based on a hospital cost-to-charge ratio of 0.5625. The annual follow-up costs covered hospital re-admissions, outpatient physician charges, immunosuppressants, endomyocardial biopsy, catheterisation, echocardiography, and laboratory services. To determine the follow-up costs, the authors estimated the number of procedures a patient would be expected to undergo based on the protocol for post-transplant care at the authors’ institution. Since the costs could be incurred over the lifetime of the patient, all future costs were appropriately discounted at an annual rate of 3%. The study reported the average costs. All costs were adjusted for inflation and reported in 2004 prices.

Statistical analysis of costs
The costs were treated as point estimates (i.e. the data were deterministic).

Indirect Costs
The indirect costs were not included.

Currency
US dollars ($).

Sensitivity analysis
The authors undertook a series of one-way sensitivity analyses to evaluate the sensitivity of the model to variations in key assumption over various ranges. Life expectancy after primary transplantation was varied from 12 to 15 years and after re-transplantation from 5 to 8 years. The utility score after transplantation was varied from 0.75 to 0.95, and the cost-to-charge ratio was varied between 0.45 and 0.70.

Estimated benefits used in the economic analysis
After discounting, primary transplant recipients had 9.37 QALYS and re-transplant recipients had 4.42 QALYS.

The total number of life-years gained was not reported separately.

Cost results
The total costs for primary transplantation were $465,494.

The total costs for re-transplantation were $388,445.

The authors assumed the costs of no transplantation to be 0.

Synthesis of costs and benefits
The costs and benefits were combined using an incremental cost-effectiveness ratio (additional cost per life-year gained) and an incremental cost-utility ratio (additional cost per QALY gained). Compared with no transplantation, the additional cost per life-year gained was $43,221 with primary transplantation and $76,465 with re-transplantation, while the incremental costs per additional QALY gained were $49,679 (primary transplantation) and $87,883 (re-transplantation), respectively.

The results of the sensitivity analysis showed that the cost-effectiveness of primary heart transplantation was most sensitive to changes in utility scores, and least sensitive to changes in life expectancy. Re-transplant cost-effectiveness
was most sensitive to the cost-to-charge ratio used and least sensitive to utility scores.

**Authors' conclusions**
The costs of primary paediatric heart transplantation were within the accepted range of cost-effectiveness, whereas re-transplantation had a higher cost relative to the benefits gained but was still comparable to other interventions.

**CRD COMMENTARY - Selection of comparators**
No explicit justification was given for using no heart transplantation as the comparator. As the authors reported, there are alternatives to heart transplantation that were not considered in this study (such as ventricular assist devices), although they present some limitations and their use in children has yet to be determined. You should decide if the comparator used represents current practice in your own setting.

**Validity of estimate of measure of effectiveness**
The authors did not state that a systematic review of the literature had been undertaken to identify relevant research and minimise biases. Further, they provided no details of the methods used to identify, select and assess the studies included in the review, thus it was difficult to assess the validity of the estimates. The authors supplemented the results of the review with their own assumptions. Estimates of effectiveness derived from the authors' assumptions were appropriately backed up by the literature. As a limitation, the authors reported that the natural history of patients without transplantation is not fully understood, and that their assumptions were simplistic.

**Validity of estimate of measure of benefit**
The estimation of benefits was modelled. The authors provided very few details of the model used to derive the benefits. In addition, although the authors' assumption that no transplantation was associated with negligible life expectancy and quality of life was justified, based on the results of studies presented by the authors, such assumptions should have been tested in the sensitivity analysis.

**Validity of estimate of costs**
The perspective adopted in the economic analysis was not explicitly stated, but it appears to have been that of the health care provider. All the categories of cost relevant to this perspective appear to have been included in the analysis. However, the authors do not appear to have included the costs of no transplantation, and assumed them to be zero without providing any details. These omissions would bias against primary and re-transplantation. The costs were derived from published sources and from the authors' settings. Overall, the resource quantities appear to have been reported separately from the unit costs, which would enhance future reflation exercises to other settings. Appropriate sensitivity analyses of the costs were undertaken. Since the costs were incurred over the lifetime of a patient, discounting was relevant and was therefore appropriately performed. Charges were used to proxy prices in some instances. However, the authors used appropriate cost-to-charge ratios to convert charges into costs. The costs were adjusted for inflation. The price year was reported, which will aid any possible inflation exercises.

**Other issues**
The authors reported that there were limited data on the cost-effectiveness of heart transplantation in children, although other studies have found heart transplantation to be cost-effective in adults. The issue of generalisability to other settings was partly addressed in the sensitivity analysis. The authors highlighted that the cost data used in the study may not be generalisable to centres predominantly performing infant heart transplants, as less than 20% of the heart transplants performed at the authors' centre were performed in infants. The authors do not appear to have presented their results selectively and their conclusions reflected the scope of the analysis. However, based on the authors' results, it would appear that re-transplantation is not cost-effective as the cost-utility ratio is well above $50,000 per QALY, the often-mentioned willingness to pay threshold in the USA.
Implications of the study
Although the authors made no explicit recommendations, they would appear to recommend paediatric primary heart transplantation. They mentioned that further research, in the form of a multi-centred study, would be useful to assess infants and re-transplanted recipients since data on these patient groups are limited.

Source of funding
None stated.

Bibliographic details

PubMedID
16563970

DOI
10.1016/j.healun.2005.11.443

Other publications of related interest


Indexing Status
Subject indexing assigned by NLM

MeSH
Adolescent; Age Factors; Child; Child, Preschool; Cost-Benefit Analysis; Costs and Cost Analysis; Decision Support Techniques; Health Care Costs; Heart Failure /surgery; Heart Transplantation /economics; Humans; Infant; Infant, Newborn; Life Expectancy; Quality of Life

AccessionNumber
22006000772

Date bibliographic record published
31/08/2006

Date abstract record published
31/08/2006