Procuring organ donors as a health investment: how much should we be willing to spend?
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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
Organ donor procurement was evaluated. In particular, the three more common types of solid organ transplant (kidney, heart and liver).

Type of intervention
Other: Organ transplant.

Economic study type
Cost-effectiveness analysis.

Study population
No target population was specified.

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

Dates to which data relate
Estimates of life expectancy for the three main types of organ transplant were gathered between 1999 and 2003. Estimates of life expectancy without transplant for end-stage renal disease patients and heart and liver patients were gathered between 1997 and 2001. Resource use data were not presented. The price year was not stated.

Source of effectiveness data
The effectiveness data were derived from a review of the medical literature.

Modelling
The authors presented the incremental cost per quality-adjusted life-year (QALY) gained for transplanting particular organs (kidney, liver and heart) compared with the no transplant option. Based on these results, the authors calculated the overall incremental cost per QALY gained from an additional organ donor. The time horizon of the model was unclear, but it appears to have been the patient's lifetime.

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

- the average patient survival at 1, 3, 5 and 10 years for kidney, liver and heart post-transplant; and
- the average survival of patients on the liver and heart transplant waiting list and those on dialysis.
Study designs and other criteria for inclusion in the review
Not stated.

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
A narrative method was used to combine the studies.

Investigation of differences between primary studies
No differences between the primary studies were investigated.

Results of the review
The average patient survival for kidney post-transplant was 94.0% at 1 year, 88.4% at 3 years, 79.9% at 5 years and 59.4% at 10 years.

The average patient survival for heart post-transplant was 85.1% at 1 year, 78.6% at 3 years, 69.8% at 5 years and 50.0% at 10 years.

The average patient survival for liver post-transplant was 86.4% at 1 year, 79.5% at 3 years, 72.4% at 5 years and 59.4% at 10 years.

The average survival of patients on the liver and heart transplant waiting list and those on dialysis were reported at different time-periods, and in the case of liver patients, for different health status.

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

Methods used to derive estimates of effectiveness
The authors also made assumptions to derive estimates of effectiveness.

Estimates of effectiveness and key assumptions
The authors examined two alternatives for hearts after 18 years of survival. One alternative was that the survival rate continued to fall at an absolute 3.5% per year, while the other was that survival decreased each year by 15%.

For patients without transplants for livers, the authors assumed that all Status 1 patients, and the great majority of Status 2A patients, would die within one month. They also assumed that 25% of Status 2B patients and 10% of Status 3 patients die by the end of the first year.
Measure of benefits used in the economic analysis
The measure of benefit used was the QALYs. Utility values for patients before and after transplant of the three organs of interest (kidney, heart and liver) were obtained from a variety of sources, including two cohort studies (kidney), assumptions (heart) and personal communication on an ongoing study (liver). The utility values for kidney transplants were obtained using time trade-off methods. The benefits were discounted at a rate of 3%.

Direct costs
The authors did not state the perspective of the analysis, but it appears that that of a health service has been adopted. The authors did not state the main resource use categories included, referring instead to only hospital costs. They relied on estimates of the average charges per transplantation (first year post-transplantation) and maintenance costs from unpublished work. For the no transplant option, the cost for patients with end-stage renal disease was estimated on the basis of published literature, whilst for patients who did not get a heart and liver transplant they were based on assumptions. The costs and the quantities were not reported separately. The costs were discounted at a rate of 3%. The price year was not explicitly stated.

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

Indirect Costs
The indirect costs were not considered in the economic study. A rationale for their exclusion was not provided.

Currency
US dollars ($).

Sensitivity analysis
The authors stated that a series of sensitivity analyses were carried out on highly uncertain estimates, such as the graft survival estimates for liver transplant, death rates, and the average first-year and maintenance costs for heart and liver patients who do not receive transplants. The results for best- and worst-case scenarios for transplants were reported.

Estimated benefits used in the economic analysis
The number of QALYs generated by an additional organ donor was 13.23 for the base-case, 18.14 under the best-case scenario, and 8.47 under the worst-case scenario.

Cost results
The costs analysis revealed that for the base-case, the incremental cost per an additional organ donor was $213,865.

For the best-case scenario, organ donor procurement represented a saving of $62,928 compared with the option of no transplant. For the worst-case analysis, the estimated incremental cost was $485,415.

Synthesis of costs and benefits
Incremental cost-effectiveness ratios were estimated as the extra cost per additional QALY gained for transplanting particular organs (kidney, liver and heart) versus the no transplant option.

Based on these results, the authors estimated the overall incremental cost per QALY gained from an additional organ donor, multiplying the incremental QALYs and incremental costs from transplanting each organ type by the number of organs transplanted from the typical organ donor (1.55 kidneys, 0.37 hearts and 0.76 livers).
The results of the base-case analysis showed that the incremental cost per QALY gained was $16,163.

For the best-case scenario, organ donor procurement was the dominant option. For the worst-case analysis, the results showed an incremental cost per QALY gained of $57,328.

Except for the best-case and worst-case scenarios, the results for the series of sensitivity analyses were not reported.

**Authors' conclusions**

From the base-case analysis, the incremental cost per quality-adjusted life-year (QALY) gained was about $16,000 for an additional organ donor. This figure is below the range of $50,000 to $100,000 per QALY that is conventionally used as an acceptable cost for medical procedures. Thus, it appears plausible that the procurement of an additional organ donor would constitute a good health investment.

**CRD COMMENTARY - Selection of comparators**

The choice of the option of no transplant as a comparator seems rational for this type of analysis.

**Validity of estimate of measure of effectiveness**

A systematic review of the literature was not undertaken. Instead, the authors appear to have selected those accounts that provided data relevant to their model. They highlighted a great lack of available, published data to inform the patient survival estimates for patients with and without transplant; this made it difficult to estimate inputs with certainty. As a systematic review was not undertaken, there were few details on the search strategy or how data were elicited. The methods used to extrapolate survival beyond 10 years were unclear, and the estimates for both the intervention and comparator seem to have been chosen in a selective way. The authors reported that uncertainty around the outcome parameters was investigated in sensitivity analyses, although the results were generally not reported (the best- and worse-case scenarios remained the exceptions).

**Validity of estimate of measure of benefit**

Limited published data were available to inform the utility estimates for patients with and without transplant, with most of them based on the authors' judgement and unpublished work. The authors recognised that the assumption that quality of life remains constant over time was a major limitation of the analysis.

**Validity of estimate of costs**

The authors did not explicitly state the perspective adopted in the analysis. It was unclear whether all the categories of cost relevant to the perspective adopted were included in the analysis. Charges were used as a proxy for transplantation costs. The use of charges to proxy costs has the limitation of not reflecting true opportunity costs, thus restricting the external validity of the results. The costs and the quantities were not reported separately, which would make it difficult to replicate the calculations or to gauge the accuracy of the estimation of quantities. Most of the maintenance costs for both patients with and without transplant were based on assumptions or unpublished work. The costs were treated deterministically, but comprehensive sensitivity analyses were performed to assess the robustness of the estimates used. Discounting was appropriately conducted. The price year was not reported, which will hinder future reflation exercises.

**Other issues**

The authors did not compare their findings with those from other studies. The assumptions and the range of values used for the best- and worst-case sensitivity analysis should have been reported. The interpretation and implications of the reported results for the sensitivity analyses were unclear. A more detailed discussion of the limitations of the study would have been useful. The authors did not state clearly the time horizon of the analysis. The issue of generalisability to other settings was not addressed.
Implications of the study
The authors remarked that, based on their analysis and using the conventional threshold of $100,000 per QALY, the investment of about $1 million to $2 million to obtain a donor could potentially be justified. However, the relevant issue remains the cost to obtain additional donors, not the average cost for current donors. The authors also commented on the need for further research on life expectancy and cost estimates related to the absence of transplants.

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