Cost-effectiveness analysis of dialysis and kidney transplants in Japan
Kaminota M

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 either dialysis or kidney transplantation (from a living donor or a cadaveric donor transplant) to treat patients with end-stage renal disease (ESRD).

Type of intervention
Treatment.

Economic study type
Cost-utility analysis.

Study population
The study population comprised ESRD patients. Different age groups were considered at analysis, depending on whether the ESRD patients received dialysis or transplantation. For ESRD patients receiving dialysis, the age groups considered were from 0 to 9, 10 to 19, 20 to 29, 30 to 39, 40 to 49, 50 to 59, 60 to 69, 70 to 79, 80 to 89, and 90 years or older. For ESRD patients receiving transplantation, the age groups considered were from 0 to 9, 10 to 19, 20 to 29, 30 to 39, 40 to 49, and 50 years or older. Moreover, the kidney transplant patients were divided into two donor-related groups, living-related donor transplant (LRD) patients and cadaveric donor transplant (CAD) patients.

Setting
The setting was not reported, although it may have been a hospital. The economic study was performed in Tokyo, Japan.

Dates to which data relate
The effectiveness data were collected from studies published between 1993 and 2000. The direct medical costs for dialysis related to 1996. The dates to which the rest of the costs related were not reported. The price year was not given.

Source of effectiveness data
The effectiveness data were derived from a review of available statistical data and from estimates of effectiveness based on opinion.

Modelling
Survival rates were estimated using a Weibull model, on the basis of survival rates provided by The Japanese Society for Dialysis Therapy, which were adjusted using data from The Abridged Life Table for Japan (1995) in order to reflect the effect of ageing by means of age weights. To avoid overestimation of the survival for transplant patients with a rejected organ, who could benefit from dialysis in a normal situation, the author assumed that those kidney transplant patients whose organs were rejected would die just after the rejection. Several adjustments and interpolations were made in order to adapt the published statistical data to the age groups considered at analysis.
Outcomes assessed in the review
The health outcomes assessed in the review were:

the annual incidence of dialysis and the annual number of kidney transplants;

the average age of death for dialysis patients and of rejection for transplant patients;

the lost duration of life at onset;

the expected duration;

the lost duration of life at death and at rejection for dialysis and transplant patients (i.e. years of life lost due to disability for morbidity and mortality).

All these health outcomes were reported for both dialysis and renal transplant patients by groups of age (as stated in the 'Study Population' section). Some of these effectiveness outcomes were included in the Weibull model in order to estimate the expected durations.

Study designs and other criteria for inclusion in the review
The studies included in the review seemed to be statistical data studies of the Japanese situation in terms of ESRD and its survival rates.

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
At least 4 studies were included in the review.

Methods of combining primary studies
Not reported, although a narrative method seems to have been used.

Investigation of differences between primary studies
Not reported.

Results of the review
The annual incidence of dialysis in each age group was 25 patients (0 - 9 age group), 118 patients (10 - 19), 606 patients (20 - 29), 1,201 patients (30 - 39), 3,163 patients (40 - 49), 5,587 patients (50 - 59), 7,416 patients (60 - 69), 5,389 patients (70 - 79), 2,032 patients (80 - 89), and 92 patients (90 or older).

The annual number of LRD kidney transplants in each age group was 11 patients (0 - 9 age group), 49 patients (10 - 19), 131 patients (20 - 29), 160 patients (30 - 39), 59 patients (40 - 49), and 22 patients (50 or older).
The annual number of CAD kidney transplants in each age group was 2 patients (0 - 9 age group), 4 patients (10 - 19), 26 patients (20 - 29), 71 patients (30 - 39), 58 patients (40 - 49), and 11 patients (50 or older).

For dialysis patients, the lost duration of life at death in each age group was 26.9 years (0 - 9 age group), 21.3 years (10 - 19), 17.8 years (20 - 29), 19.6 years (30 - 39), 19.3 years (40 - 49), 17.4 years (50 - 59), 13.3 years (60 - 69), 8.5 years (70 - 79), 4.8 years (80 - 89), and 2.2 years (90 or older).

For LRD transplant patients, the lost duration of life at rejection in each age group was 55.1 years (0 - 9 age group), 40.3 years (10 - 19), 45.9 years (20 - 29), 31.1 years (30 - 39), 26.0 years (40 - 49), and 14.0 years (50 or older).

For CAD transplant patients, the lost duration of life at rejection in each age group was 65.9 years (0 - 9 age group), 50.5 years (10 - 19), 43.1 years (20 - 29), 33.6 years (30 - 39), 26.6 years (40 - 49), and 16.6 years (50 or older).

**Methods used to derive estimates of effectiveness**
The author's assumptions were used to derive estimates of the age distribution of kidney transplant patients in 1995.

**Estimates of effectiveness and key assumptions**
The author assumed that the age distribution for kidney transplant patients in 1995 was the same as that of patients between 1983 and 1994. It was also assumed that, for each age group, the average age of onset was equal to the midpoint of each age group.

Therefore, according to the age group of the dialysis patients, the average age of onset was 5 (0 - 9 age group), 15 (10 - 19), 25 (20 - 29), 35 (30 - 39), 45 (40 - 49), 55 (50 - 59), 65 (60 - 69), 75 (70 - 79), 85 (80 - 89), and 95 years (90 or older). The corresponding ages for kidney transplant patients were 5 (0 - 9 age group), 15 (10 - 19), 25 (20 - 29), 35 (30 - 39), 45 (40 - 49), and 55 years (50 or older).

**Measure of benefits used in the economic analysis**
The measure of benefit used in the economic analysis was the number of disability-adjusted life-years (DALYs) averted by treatment. DALYs were estimated according to the formulae proposed by Murray and Lopez (see Other Publications of Related Interest). The numbers of DALYs averted by treatment were estimated as the difference between the DALYs without treatment (assuming that ESRD patients would die just after the onset of the illness) and the DALYs with treatment. A lifetime horizon was considered for the economic analysis. Disability weights were derived from experts' opinions, on the basis of questionnaires that used the Person Trade-Off method. A total of 95 doctors involved in health-related policymaking participated. The median disability weights obtained were 0.231 for dialysis patients and 0.100 for transplant patients. Total effectiveness was estimated as the total number of DALYs averted in each one of the age groups, considering the annual incidence of dialysis and transplant patients.

**Direct costs**
The resource quantities and the costs were not reported separately. The direct costs included in the economic analysis may have been either those of the hospital or those of the health service. The direct costs of dialysis included both inpatient and outpatient medical costs, with the proportions of inpatient and outpatient dialysis being considered in calculating the total cost. The direct costs of kidney transplant also included inpatient and outpatient medical costs. However, in addition, the CAD kidney transplantation included the costs for the kidney transplant information system. The source of the direct cost data was the average health insurance payments for ESRD treatments provided by the National Sakura Hospital. Therefore, the costs were estimated from actual data. Discounting was performed using a 3% discount rate, and was relevant since the period considered was the lifetime of ESRD patients. It was not clearly established whether the price year was April 1996, or if this date related only to medical expenditures for dialysis.

**Statistical analysis of costs**
No statistical analysis of the costs was reported.
Indirect Costs
No indirect costs were reported.

Currency
Japanese yen (¥).

Sensitivity analysis
Sensitivity analyses were carried out to investigate variability in the data. The parameters varied were the discount rate, age weights and disability weights. One-way sensitivity analyses were used. Discounting of the benefits at a 3% discount rate was also performed.

Estimated benefits used in the economic analysis
For the dialysis patients, the total number of DALYs averted for each age group was 624 (0 - 9 age group), 3,023 (10-19), 13,620 (20 - 29), 20,109 (30 - 39), 34,911 (40 - 49), 34,433 DALYs (50 - 59), 23,144 (60 - 69), 7,321 (70 - 79), 825 (80 - 89), and 8 (90 or older).

The number per patient in each age group was also reported in the paper.

The total number of DALYs averted in the dialysis group was 138,019.

For the LRD transplant patients, the total number of DALYs averted for each age group was 177 (0 - 9 age group), 1,131 (10 - 19), 1,465 (20 - 29), 2,233 (30 - 39), 536 (40 - 49), and 198 (50 or older).

The number per patient in each age group was also reported.

The total number of DALYs averted in the LRD transplant group was 5,740.

For the CAD transplant patients, the total number of DALYs averted for each age group was 12 (0 - 9 age group), 67 (10 - 19), 352 (20 - 29), 865 (30 - 39), 510 (40 - 49), and 86 (50 or older).

The number per patient in each age group was also reported.

The total number of DALYs averted in the CAD transplant group was 1,892.

Cost results
For dialysis patients, the cost per patient in each age group was ¥156,355 (0 - 9 age group), ¥151,523 (10 - 19), ¥142,357 (20 - 29), ¥116,052 (30 - 39), ¥87,700 (40 - 49), ¥58,697 (50 - 59), ¥38,865 (60 - 69), ¥25,631 (70 - 79), ¥17,369 (80 - 89), and ¥14,322 (90 or older).

The total cost for the dialysis group was ¥1,317,521,706.

For LRD transplant patients, the cost per patient in each age group was ¥30,537 (0 - 9 age group), ¥35,240 (10 - 19), ¥18,668 (20 - 29), ¥25,550 (30 - 39), ¥20,437 (40 - 49), and ¥26,277 (50 or older).

The total cost for the LRD transplant group was ¥10,381,779.

For CAD transplant patients, the cost per patient in each age group was ¥21,985 (0 - 9 age group), ¥29,146 (10 - 19), ¥26,363 (20 - 29), ¥26,455 (30 - 39), ¥23,718 (40 - 49), and ¥26,401 (50 or older).

The total cost for the CAD transplant group was ¥4,392,173.
Synthesis of costs and benefits

The cost-effectiveness ratios (CERs) by age groups were calculated for each one of the alternatives, as the cost per DALY averted. The author also estimated CERs for the overall interventions.

For dialysis patients, the CERs (cost per DALY averted) were Y6,259 (0 - 9 age group), Y5,915 (10 - 19), Y6,334 (20 - 29), Y6,931 (30 - 39), Y7,946 (40 - 49), Y9,524 (50 - 59), Y12,453 (60 - 69), Y19,112 (70 - 79), Y42,755 (80 - 89), and Y170,834 (90 or older).

The CER for dialysis, in general, was Y9,546 per DALY averted.

For LRD transplant patients, the CERs (cost per DALY averted) were Y1,851 (0 - 9 age group), Y1,537 (10 - 19), Y1,675 (20 - 29), Y1,831 (30 - 39), Y2,232 (40 - 49), and Y2,913 (50 or older).

The CER for LRD transplantation, in general, was Y1,809 per DALY averted.

For CAD transplant patients, the CERs (cost per DALY averted) were Y2,992 (0 - 9 age group), Y1,852 (10 - 19), Y1,932 (20 - 29), Y2,174 (30 - 39), Y2,706 (40 - 49), and Y3,399 (50 or older).

The CER for CAD transplantation, in general, was Y2,322 per DALY averted.

The results show that the CERs by age groups were 3 to 4 times higher for dialysis patients than for the transplantation patients. The sensitivity analyses showed that there was no effect in the order of the magnitudes of the CERs among dialysis, LRD transplants and CAD transplants, although the values of the CER varied considerably with age weights.

Authors’ conclusions

The results suggested that kidney transplantation is much more cost-effective than dialysis in all age groups, although the effectiveness (in terms of the number of disability-adjusted life-years, DALYs, averted per patient) was greater for dialysis, because of the risk of rejection for the transplantation group.

CRD COMMENTARY - Selection of comparators

No comparator was explicitly reported. Dialysis and kidney transplantation were chosen because they are the available treatments for ESRD patients. You should determine whether these represent valid comparators in your own setting.

Validity of estimate of measure of effectiveness

The author did not report that a systematic review was undertaken. In addition, the effectiveness analysis appears to have been based on statistical data of practical treatments. The author reported that this might have been a limitation for the effectiveness results, as matching the patients among treatments was not considered. Differences among the patients could have affected the results, although the differences in CERs were sufficiently large to suggest that they were probably not due solely to differences in the patients' characteristics. In order to calculate survival rates by means of modelling, the author assumed that those transplant patients with a rejected organ would die just after the rejection. This assumption does not seem to be realistic although, as the author stated, it was taken in order to avoid overestimation of the survival for those patients who would benefit from dialysis in a normal situation. The Weibull model was used to estimate survival. This model does not reflect the effect of ageing. The author adjusted to correct for this error and suggested that the validity of this modification should be inspected more vigilantly.

Validity of estimate of measure of benefit

The estimation of benefits was based on methodology proposed by the World Health Organisation. The choice of the DALYs as the summary measure of benefit was justified, as stated by the author. DALYs include the patients' quality of life in addition to mortality aspects of disease. The disability weights were derived from a questionnaire answered by experts. The Person Trade-Off method was used although, as reported, this method may contain ethical problems that would never be accepted by some people.
Validity of estimate of costs
It cannot be determined whether all of the relevant direct costs were included in the economic analysis, as the perspective was not reported and the reporting of the costs was a little weak. The author used charges as a proxy for the direct costs, which may not reflect the true opportunity costs. The resource quantities and the costs were not reported separately, and the price year was not given. These factors limit reflation exercises to other settings. Moreover, sensitivity analyses on the costs were not undertaken, which introduces uncertainty into the reliability of the conclusions. The result for the LRD transplant patients may not accurately reflect the real costs of the intervention, as the time to recover required by donors after the transplant was not considered at analysis, and this cost seems to be very relevant for the estimation of CERs.

Other issues
The author did not make appropriate comparisons of his findings with those from other studies. The issue of the generalisability of the results to other settings was not addressed, although this seems difficult since the statistical data reflected the Japanese situation for ESRD patients. The author's conclusions reflected the scope of the analysis.

Implications of the study
The policy recommendation made by the author states that kidney transplantation should be promoted. The author recommends the performance of surveys in order to determine the appropriate age weighting to apply according to the society under study (because this factor influenced greatly the cost-effectiveness results). However, as already reported, the results of this study have some limitations. These relate mainly to the weak reporting of the costs, the non-consideration of some important costs, and the fact the effectiveness results were based on statistical data. An important limitation that kidney transplantation presents is the availability of donors. Therefore, even if kidney transplantation were more cost-effective, transplants would only be undertaken if there were available organs.

Source of funding
None stated.

Bibliographic details

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Other publications of related interest


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