Socio-economic evaluation of kidney transplantation in Germany  
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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 health technology studied was kidney transplantation (KT) for patients with end-stage renal disease (ESRD).

Type of intervention
Treatment.

Economic study type
Cost-utility analysis.

Study population
The study population comprised patients with ESRD who were not in need of multiple organ transplant.

Setting
The setting was hospital. The economic study was performed at the Medical School of Hanover, Germany.

Dates to which data relate
The effectiveness and cost data were collected between June 1993 and some time in 1995 (the authors reported that patients were enrolled on a waiting list between June 1993 and September 1994, and during this period, some patients received a transplant and were followed up for one year). The price year appears to have been 1993.

Source of effectiveness data
Effectiveness data were derived from a single study.

Link between effectiveness and cost data
The authors reported that the resource consumption data for the KT inpatient treatment were obtained from a sub-sample of 77 patients chosen randomly from the study sample used in the effectiveness analysis. These data appear to have been collected prospectively. The method of randomisation was not reported.

Study sample
The sample size was not reported to have been determined in the planning phase of the study to assure a certain power. The study sample comprised 1,149 patients who were enrolled on the waiting list for KT in the centre where the study was performed. Patients were included if they had attained majority age and had no need for multiple organ transplant. In total 199 of these patients received KT, of these 169 fulfilled the inclusion criteria. The effectiveness evidence was drawn from the 1,149 patients enrolled on the waiting list; from this group 1,023 (89%) completed the quality of life questionnaire at least once: 150 received KT, and 873 did not receive KT during the study period. The authors did not show evidence that the study sample was representative of the study population. However, they reported that the
percentage of employed patients within the study sample (58.7%; not including housewives/husbands, pensioners and the unemployed) was very similar to that of the total population in the authors' setting (with 4% more people employed when compared to the study sample).

**Study design**
This appears to have been a before and after study, were the group considered for the period before the intervention seems to have been composed of all patients who completed a questionnaire while on the waiting list, and the group considered after the intervention consisted of patients who received KT. The study was performed at a single centre. The duration of follow-up appears to have been 15 months. The authors reported that the 150 KT patients considered in the effectiveness analysis were chosen randomly from those who met the study criteria; the method of randomisation was not reported. One patient was lost to follow up due to death.

**Analysis of effectiveness**
The basis for the analysis of the clinical study was not reported, but only those patients who completed at least one questionnaire were considered in the effectiveness analysis. The primary health outcomes used in the analysis of effectiveness were: the number of patients on the waiting list assessing their quality of life at least once during the study period; the number of patients who received transplantation and assessed their quality of life at 14 days, 1 month, 3 months, 6 months and 1 year after the intervention; the average duration between questioning and transplant for those patients receiving transplant; the quality of life values before (for the waiting list patients) and after KT (14 days, 1 month, 3 months, 6 months, 12 months and 15 months after the intervention), in terms of morbidity, pain, energy, sleep, social isolation and emotional reaction. The authors also assessed the increase in the risk of dying for those patients undergoing KT in comparison with those receiving dialysis for the first year. The Nottingham Health Profile (NHP) was used to measure the change in the quality of life of patients. This questionnaire was administered while patients were on the waiting lists, and later, to those patients who received KT, at several times after the intervention. Lower values reflected a higher level of quality of life. Patients receiving KT were shown not to differ considerably from those who did not receive it, in terms of education and income, although the percentage of women was higher in the group of KT patients compared to the patients on the waiting list. No statistical analyses for these comparisons were reported.

**Effectiveness results**
The effectiveness results were as follows:

The number of patients on the waiting list who completed at least one NHP questionnaire was 1,023 (89%).

The numbers of patients receiving KT who answered the NHP questionnaire were:

at 14 days 99, at 1 month 105, at 3 months 98, at 6 months 96, at 1 year 58, and more than one year after the intervention 26.

The average duration between questioning and transplant was 6.5 months.

The NHP values were:

for waiting list patients: morbidity 18, pain 15, energy 38, sleep 32, social isolation 9, and emotional reaction 19; and

for patients receiving KT:

at 14 days after the intervention: morbidity 25, pain 13, energy 26, sleep 34, social isolation 6, and emotional reaction 16;

at 1 month after the transplant: morbidity 19, pain 7, energy 19, sleep 22, social isolation 3, and emotional reaction 12;

at 3 months after the transplant: morbidity 16, pain 12, energy 19, sleep 13, social isolation 4, and emotional reaction 9;

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at 6 months after the transplant: morbidity 15, pain 13, energy 17, sleep 13, social isolation 5, and emotional reaction 8;
at 12 months after the transplant: morbidity 16, pain 11, energy 20, sleep 9, social isolation 3, and emotional reaction 6; and
at 15 months after the transplant: morbidity 11, pain 8, energy 17, sleep 5, social isolation 2, and emotional reaction 6.

There was a 5% increase in the risk of dying during the first year for those patients undergoing KT when compared to those receiving dialysis.

Clinical conclusions

One month after the intervention, patients receiving KT improved their quality of life with regard to the baseline values of those patients in the waiting list in terms of pain, energy, sleep, social isolation and emotional reaction (according to the NHP scores). Additionally, in the subsequent periods all the indicators of quality of life used in the effectiveness analysis showed improvement.

Methods used to derive estimates of effectiveness

The authors’ assumptions seem to have been used to derive some estimates of effectiveness. Although the authors reported that some of the effectiveness data were obtained from published data, the source was not reported.

Estimates of effectiveness and key assumptions

The authors assumed that KT and dialysis patients did not differ with regard to mortality rates when a long-term period was considered. Moreover, they stated that some data on survival rates of patients and transplants were obtained from Eurotransplant, which is, as stated by the authors, the organisation responsible for organ distribution in Germany. The source of these data was not reported in the study.

The following survival rates for patients undergoing KT were considered for the estimation of the measure of health benefit used in the study:

14 days after KT: 97%;
1 month after KT: 96%;
3 months after KT: 89%;
6 months after KT: 86%;
1 year after KT: 84%;
2 years after KT: 78%;
3 years after KT: 73%;
4 years after KT: 67%;
5 years after KT: 64%;
6 years after KT: 59%;
7 years after KT: 55%;
8 years after KT: 53%;
9 years after KT: 49%;
10 years after KT: 48%;
11 years after KT: 43%;
12 years after KT: 38%;
13 years after KT: 33%;
14 years after KT: 29%;
15 years after KT: 24%;
16 years after KT: 19%;
17 years after KT: 14%;
18 years after KT: 10%;
19 years after KT: 5%; and
20 years after KT: 0%.

It was not entirely clear whether these values corresponded to the survival rates of the transplant or of the patient, although it seemed that they were related to the survival of the transplantation (percentage of patients for whom the transplant was still working at the time considered).

Measure of benefits used in the economic analysis
The authors used the number of quality-adjusted life-years (QALYs) gained by patients as the summary measure of health benefit. The justification stated for this choice was based on the assumption made by the authors that, on a long-term basis, there are no changes in the mortality rates between patients undergoing KT and dialysis patients and therefore, there is no change in the number of life years gained. The period of time considered for the estimation of the number of QALYs gained was 20 years. A value of 0.76 was used for the quality of life of the dialysis patients, while the following values were considered for the quality of life of the KT patients:

14 days after KT: 0.73;
1 month after KT: 0.78;
3 months after KT: 0.82;
6 months after KT: 0.83;
1 year after KT: 0.86; and
for years 2 to 20 after KT a value of 0.88 was considered.

The authors did not report the source of the values used. The EuroQol index value, the visual analogue scale (VAS) and the NHP values were reported to have been used to estimate the QALYs gained, although it was not reported which of these measures was finally used for the calculation of the health benefits.

Direct costs
Resource quantities and costs were not reported separately. The direct costs related to KT included in the analysis were those of the hospital, and considered the personnel costs (including medical-technical service, function service and surgery physicians and nurses), the general administrative expenses, medical goods (drugs, catheters and others), and building and equipment costs. For KT the authors reported average costs (and minimum and maximum values) of the
following: phase-independent costs, evaluation costs, costs of organ acquisition, costs of pre-operative phase, costs of operation, costs of treatment in intensive care, costs of treatment on normal ward, and costs of subsequent operations. In order to calculate the allocation of work time for surgery physicians and nurses, the authors used a questionnaire completed by the members of the transplant medical team at the hospital where the study was carried out. The medical goods used were obtained from the medical records of the patients; the rest of the medical needs costs were obtained from each individual ward. The building and equipment costs were estimated, although the authors did not report how. The authors also included the costs of the subsequent immunosuppression and any regular medical care (i.e. laboratory tests and ambulatory care) that patients receiving KT required in the long term. The source of these data was not reported.

The costs included for haemodialysis were: medical treatment costs, non-personnel lump sum costs (including depreciation of the dialysis equipment, rinsing solution, filter, hose system, needles and dressings). Additional costs for routine studies, such as electrocardiogram (ECG), laboratory tests and additional drugs (e.g. antiallergic drugs, lipid-lowering drugs or erythropoietin), which may be needed in some cases, were also included. It was considered that the average number of treatments per patient would be 120. The authors did not report the source of the costs related to dialysis. The price year seems to have been 1993. In order to calculate the long-term costs, the authors assumed that those patients whose transplanted kidney no longer functioned would receive dialysis, and therefore, would have costs equal to the dialysis treatment. A discount rate of 5% was used in the estimation of the long-term costs.

**Statistical analysis of costs**
No statistical analysis was reported.

**Indirect Costs**
The indirect costs of KT included the average mortality-related costs (i.e. the lost productivity related to the person who died in the KT group when compared with the patients in the waiting list), and the number of days lost from work because of the hospital stay and subsequent recovery period after the intervention. The indirect costs considered for dialysis were related to lost productivity because of missing work among employed patients. The indirect costs for dialysis included the lost productivity of those patients in employment or running their own business, and the lost productivity caused annually by early retirement. The indirect costs for dialysis were obtained from German published statistics (1992). Although indirect costs were reported for both alternatives, it was not clear whether these costs were included in the total costs considered in the study.

**Currency**
German marks (DM).

**Sensitivity analysis**
Some sensitivity analyses were performed regarding the discount rates applied to costs and health benefits, and the quality of life measure used. The discount rate for costs was varied between 0 and 10%. The benefits were also estimated without applying a discount rate. The authors stated that three alternative measures of quality of life were considered: the NHP, the EuroQol, and the VAS. The area of uncertainty investigated was variability in data, and the type of analysis used may have been a one-way sensitivity analysis.

**Estimated benefits used in the economic analysis**
The number of QALYs gained by KT patients when compared to dialysis patients was 0.76, considering a period of 20 years of follow-up and discounting health benefits at a 5% discount rate.

**Cost results**
The direct cost per patient receiving KT during the first year was DM 59,980. In the subsequent years, the cost per patient per year was DM 15,000 (including immunosuppression and subsequent care).
The direct cost per patient per year for dialysis was DM 55,200.

The total indirect costs per KT patient during the first year were DM 5,150. The total indirect costs per patient receiving dialysis were DM 4,100 per year.

**Synthesis of costs and benefits**

The cost-effectiveness ratio for dialysis was DM 147,800 per QALY gained, while that for KT was DM 38,300 per QALY gained (considering a period of follow-up of 20 years).

The authors reported that the estimation of the number of QALYs gained by KT patients when compared to dialysis patients was highly dependent of the quality of life measure used and the discount rate applied to health benefits. The discount rate used for costs did not affect the results obtained.

**Authors’ conclusions**

Patients receiving KT achieve, on average, a higher quality of life when compared to waiting list patients, as shown by the NHP values. The cost of KT is balanced by the higher cost of long-term dialysis. Two years after the KT intervention the costs of dialysis outweighed those of KT plus the post-operative care costs. Therefore, KT seems to be a dominant strategy when compared to dialysis because it implied lower costs and higher quality of life for the patients.

**CRD COMMENTARY - Selection of comparators**

A justification was given for the comparator used, namely that it was the current practice in the authors’ setting, and moreover, it is the practice widely used nowadays, besides kidney transplantation. However, haemodialysis was the type of dialysis used in the study, and you, as a user of the database, should decide what type of dialysis (haemodialysis or peritoneal dialysis) is most used in your own setting.

**Validity of estimate of measure of effectiveness**

The analysis was based on a before and after study design, which is known to be subject to bias because of confounding variables that cannot be controlled. The basis for the effectiveness analysis was not reported and it was not clear how individuals in the waiting list were considered (if all of them were considered, including those who would later receive KT, or only those who did not undergo any intervention). The authors did not report how the patients considered in the effectiveness analysis were chosen from among the total group of patients who met the study criteria. Moreover, it was not known whether those patients who did not answer the questionnaire differed significantly from those who did. Furthermore, the number of patients answering the questionnaire varied considerably from one period to another. No statistical analyses of the effectiveness results were reported to take account of the potential biases and confounding factors. The authors did not report evidence that the study sample was representative of the study population. Patient groups were shown not to differ significantly in terms of education and income, although the percentage of women was higher in the group of KT patients compared to the patients in the waiting list. Some effectiveness results were derived from assumptions made by the authors, and these assumptions were not justified with reference to the medical literature. All these factors introduce uncertainty into the reliability of the conclusions.

**Validity of estimate of measure of benefit**

The authors justified the use of QALYs gained as the summary measure of health benefit based on the assumption that the mortality rates were very similar independently whether an individual was a KT or a dialysis patient. However, no evidence for this assumption was provided. The estimation of the QALYs gained was not derived from the same study sample used in the effectiveness analysis. Moreover, the authors did not report the sources of the values assigned to KT and dialysis patients. It was not clear how the authors obtained the final number of QALYs gained by KT patients.

**Validity of estimate of costs**

The perspective used in the analysis was not clearly specified. The authors commented on the indirect costs that both
health technologies implied, but did not state whether they included these indirect costs in the final estimation of the long-term total costs. As a result, it is difficult to assess whether all the relevant categories of costs were included. As the perspective from which the study was undertaken was not clear, and nor was it clear whether indirect costs were included in the totals, it is not possible to say whether all relevant costs were included. Resource quantities and costs were not reported separately and some of the sources used to estimate the costs were not reported at all. Furthermore, no statistical analyses of costs were performed. These facts introduce uncertainty into the reliability of the conclusions. The price year was given. The use of a kidney from a living donor may imply different costs than those arising from the use of a cadaveric kidney, and the authors did not consider this fact in the analysis.

Other issues
The study findings were not compared to those from other studies. The issue of the generalisability of the results to other settings was not addressed. The authors seemed to have presented the results selectively, although they reported that they used several measures to estimate the effectiveness and health benefits of the alternatives under study (EuroQol, VAS and NHP), they did not report the results for each of them.

Implications of the study
The authors commented that it would be a positive outcome if the number of KT increased. However, an objective conclusion about the implications of the study cannot be reached because of the uncertainty surrounding some aspects of the study. Moreover, a degree of caution should be taken when interpreting the results due to the limitations reported previously.

Source of funding
None stated.

Bibliographic details

Other publications of related interest


Indexing Status
Subject indexing assigned by CRD

MeSH
Costs and Cost Analysis; Drug Costs; Female; Germany; Health Care Costs; Humans; Immunosuppressive Agents /therapeutic use /economics; Insurance, Health; Kidney Failure /drug therapy /economics /surgery /epidemiology; Kidney Transplantation; Male; Quality of Life; Questionnaires