Hemodialysis for end-stage renal disease: a cost-effectiveness analysis of treatment options

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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**
Three types of haemodialysis (HD) for the management of end-stage renal disease (ESRD) were studied.

Hospital HD (HospHD) was provided in specialty units within large district or teaching hospitals, where patients usually received three treatments per week, each lasting for 3 to 5 hours, by specialised nursing staff.

Satellite HD (SatHD) was delivered in small district general hospitals by specialised nursing staff.

With home HD (HomeHD), the patients received HD at home and the presence of a carer was often required during treatment.

**Type of intervention**
Treatment.

**Economic study type**
Cost-utility analysis.

**Study population**
The study population comprised a hypothetical cohort of patients with ESRD requiring HD.

**Setting**
The setting was a hospital and the community. The economic study was carried out in the UK.

**Dates to which data relate**
The effectiveness evidence came from studies published between 1984 and 2003. Some resource use and costs were estimated from sources published from 1998 to 2003. The costs were presented using 2001-02 prices.

**Source of effectiveness data**
The effectiveness evidence was derived from a synthesis of published studies and one authors' assumption.

**Modelling**
A Markov model was constructed to examine the costs and benefits of the three alternative types of HD in patients with ESRD. Two time horizons were considered, 5 and 10 years. The patients started in one of the three states (HomeHD, HospHD, SatHD) then moved between health states. Transitions between health stated included the three types of HD and the following absorbing states: continuous peritoneal ambulatory dialysis (CPAD), transplantation, or death. The cycle length was not explicitly reported but might have been one year.
Outcomes assessed in the review
The outcomes estimated from the literature were the transition probabilities across health states, quality of life weights, and mortality rates.

Study designs and other criteria for inclusion in the review
A systematic review of the literature appears to have been undertaken to identify relevant studies (the search methods were based on a published health technology assessment). Most of the evidence came from a published systematic review of 27 studies (4 systematic reviews, one clinical trial, and 22 comparative observational studies). No details on the other sources of evidence were given.

Sources searched to identify primary studies
The authors stated that an electronic search was carried out in the published review of the literature.

Criteria used to ensure the validity of primary studies
In the published review of the literature, the methodological quality of the primary sources was validated using standard checklists.

Methods used to judge relevance and validity, and for extracting data
In the published review of the literature, two independent reviewers extracted the data.

Number of primary studies included
Four primary studies were the main source of evidence.

Methods of combining primary studies
No details on the methods used to combine the primary studies were provided.

Investigation of differences between primary studies
Not stated.

Results of the review
The transition probabilities from HomeHD were 0.03 to transplant, 0.06 to CAPD, 0.85 - 0.91 to HomeHD, 0 to SatHD and to HospHD, and 0 - 0.11 to death.

The transition probabilities from HospHD were 0.03 to transplant, 0.06 to CAPD, 0.78 - 0.89 to HospHD, 0 to SatHD and to HomeHD, and 0.02 - 0.13 to death.

The transition probabilities from SatHD were 0.03 to transplant, 0.06 to CAPD, 0 to HomeHD, 0.78 - 0.89 to SatHD, 0 to HospHD, and 0.02 - 0.13 to death.

The quality of life values were 0.81 for HomeHD and SatHD, and 0.66 for HospHD.

Older patients and those with diabetes tended to have higher mortality rates. The relative risk for patients older than 65 years of age was between 1.8 and 2.4 times greater than the risk of death for patients aged 40 to 45 years.

Methods used to derive estimates of effectiveness
The authors made an assumption about the mortality rates for SatHD, owing to the lack of published evidence.
Estimates of effectiveness and key assumptions
The mortality rate for SatHD was assumed to have been equivalent to that for HospHD. It was also assumed that HomeHD had the same utility as SatHD.

Measure of benefits used in the economic analysis
The summary benefit measure was the number of quality-adjusted life-years (QALYs). This was estimated using a modelling approach. The QALYs were discounted at an annual rate of 1.5%.

Direct costs
Discounting was relevant only for the predicted life span of capital items, and an annual rate of 6% was applied. The unit costs were not presented separately from the quantities of resources used. All dialysis-related services were considered in the economic evaluation. These included access, home conversion, training, equipment (including dialysis machine), building, consumables, clinical and nursing staff, and the treatment of complications due to dialysis (including hospitalisation, whenever relevant). Transport costs were not included. The cost/resource boundary of the study was unclear. The estimation of costs came from one UK hospital in Aberdeen and published studies. Staff time was estimated using questionnaires, while other resource use data came from published studies. Some assumptions were also made. For example, it was assumed that consumable and capital costs were the same for SatHD as they were for HospHD. The costs were expressed using 2001-02 prices.

Statistical analysis of costs
The costs were treated deterministically.

Indirect Costs
The indirect costs were not considered.

Currency
UK pounds sterling (€).

Sensitivity analysis
Sensitivity analyses were carried out to consider the impact of variations in base-case assumptions on the estimated cost per QALY. The following changes were made:

short daily HomeHD (6 sessions per week of 1.5- to 2-hour length);
a utility value of 0.92 for HomeHD;
the use of a paid assistant for HomeHD;
clinical cover for SatHD similar to that provided in a hospital unit;
minimal cover for SatHD (similar to that of HomeHD);
same mortality rates for HomeHD as for SatHD and HospHD; and
same mortality rates for SatHD and HospHD as for HomeHD.

The analysis was also carried out for sub-groups of patients (those over 65 years of age and patients with diabetes). Univariate sensitivity analyses were performed. The source of alternative values was mainly based on authors’ assumptions.
Estimated benefits used in the economic analysis
At 5 years, the estimated QALYs were 2.08 with SatHD, 2.32 with HomeHD, and 1.69 with HospHD. The corresponding values at 10 years were 3.03 (SatHD), 3.45 (HomeHD), and 2.47 (HospHD), respectively. Thus, HomeHD was associated with higher QALYs in comparison with the other two alternatives.

Cost results
At 5 years, the estimated costs were 46,001 with SatHD, 47,657 with HomeHD, and 48,254 with HospHD. The corresponding values at 10 years were 62,054 (SatHD), 63,539 (HomeHD), and 65,131 (HospHD), respectively. Thus, SatHD was the least costly alternative, although the costs of the three strategies were quite similar.

Synthesis of costs and benefits
Incremental cost-utility ratios (cost per QALY) were calculated to combine the costs and benefits of the alternative HD strategies.

The incremental cost per QALY with HomeHD relative to SatHD was 6,665 at 5 years and 3,493 at 10 years. The incremental analysis showed that HomeHD dominated HospHD, which was both less effective and more costly, at both timeframes.

The sensitivity analysis showed that HomeHD dominated HospHD under almost all scenarios. The incremental cost per QALY with HomeHD relative to SatHD was sensitive to the utility value used for HomeHD (2,938 at 5 years and 1,661 at 10 years, when the utility of HomeHD was 0.92), the use of a paid carer (21,377 at 5 years and 15,394 at 10 years), and the minimal clinical cover for SatHD (41,764 at 5 years and 31,460 at 10 years). HomeHD dominated SatHD in the other scenarios.

In the sub-group analysis, the incremental cost per QALY with HomeHD versus HospHD was 18,325 at 5 years for patients over 65 years, while HomeHD dominated HospHD for patients with diabetes and less than 50 years of age. For patients with diabetes and older than 65 years, the incremental cost per QALY with HomeHD was 36,007 versus SatHD and 6,597 versus HospHD.

The incremental cost per QALY with short daily HomeHD was 30,188 at 5 years and 22,515 at 10 years versus SatHD, and 7,586 at 5 years and 6,696 at 10 years versus HospHD.

Authors' conclusions
Satellite haemodialysis (SatHD) was less costly than HD at home (HomeHD), which in turn was less costly than HD at the hospital (HospHD). In general, HomeHD dominated HospHD, and the incremental cost per quality-adjusted life-year (QALY) for HomeHD compared with SatHD was modest. HomeHD could be used for patients at low risk (i.e. those with few co-morbidities), while SatHD should be reserved for older patients with co-morbidities. Due to the limitations of the effectiveness data used in the model, caution is required when interpreting the results of the analysis.

CRD COMMENTARY - Selection of comparators
The selection of the comparators was appropriate, as the health interventions considered in the study represented the three types of HD available for patients with ESRD. A detailed description of each approach was provided. You should decide whether they are valid comparators in your own setting.

Validity of estimate of measure of effectiveness
Most of the effectiveness evidence came from a published systematic review of the literature. The authors reported details of the methods and conduct of the review (quality of the studies, use of independent reviewers, and design of the studies). Other model inputs were derived from other published studies, the designs of which were not provided. Thus, it is not possible to assess the validity of these sources. Some assumptions were also made. The issue of uncertainty was
partially addressed in the sensitivity analysis.

**Validity of estimate of measure of benefit**
The use of QALYs as the summary benefit measure was appropriate as they capture the impact of the intervention on life expectancy and quality of life, which are relevant aspects of care in the case of patients with ESRD. The source of the utility values was reported, but details on the methods used to elicit patient preferences were not provided. Discounting was applied, as recommended in prior UK guidelines. QALYs are comparable with the benefits of other health care interventions.

**Validity of estimate of costs**
The perspective adopted in the study was unclear. Only the costs strictly related to the use of dialysis were included in the analysis. The unit costs were not presented separately from the quantities of resources used, as the costs were presented using macro-categories. This reduces the possibility of replicating the study. Some costs came from published estimates, while other costs were estimated from local sources. The authors made some assumptions to derive the costs for SatHD. Transport costs were not included because the authors stated that there was no nationally agreed policy for such costs. However, the authors noted that the inclusion of such costs would have favoured HomeHD. The price year was clearly reported, which will facilitate reflation exercises in other settings. The costs were treated deterministically, but some key costs were appropriately varied in the sensitivity analysis.

**Other issues**
The authors compared their findings with those from the published study that was the main source of evidence for the clinical data. Overall, the results were observed were comparable. The issue of the generalisability of the study results was not explicitly addressed, but the authors noted that both the cost estimates and the organisation of HD modalities could differ between settings. Some other issues were explicitly addressed in the discussion. First, the efficiency of HomeHD required patients to remain on this modality for a reasonable timeframe. Second, the quality of the data was limited as some estimates were taken from old studies. Further, the utility weights were derived from studies conducted outside of the UK. Third, the technology available for HD varies constantly, which could reduce complication rates and the need for carer involvement in HomeHD.

**Implications of the study**
The study results supported a shift from HospHD to SatHD and HomeHD. The analysis showed which sub-groups of patients are more likely to benefit from the two HD modalities. The authors stressed that further research should be carried out to derive unbiased estimates for the relative effectiveness of the three HD modalities, and to examine how these services could be organised.

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**Other publications of related interest**


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