HAEMODIALYSIS MODELLING: CHALLENGES IN RAPID REVIEWING

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Introduction

Health care decision makers require that information on health care interventions be of high quality and available to them as quickly as possible. If such decisions are to be based on evidence of cost-effectiveness as well as effectiveness, an unavoidable part of this process will be the development of an economic model and the identification of relevant data to populate it.[1]

Modelling cost-effectiveness requires: the identification of the main event pathways that have distinct resource or outcome implications; the estimation of probabilities associated with the main pathways for both resource use and outcomes; sufficient information to allow resource consequences and outcomes of each pathway to be measured and valued.[2] Consequently, the provision of estimates of cost-effectiveness requires information on the relative effectiveness, utilities and resource use and cost of the alternatives considered.[3] Such data should be obtained using systematic and reproducible methods. While there are established techniques to obtain these parameters, such as the Cochrane review process for evidence on relative effectiveness, the scope for researchers to use these methods is constrained by the need to provide information for decision-makers in a timely fashion. When the time available to conduct the economic evaluation is limited, this places restrictions on the time available to develop the model and to identify and synthesise data on its input parameters. These time constraints also restrict the nature and extent of the analysis performed.

Limited time for the economic evaluation is particularly acute in the conduct of rapid technology assessments for the NHS Research and Development Health Technology Assessment Programme (NHS R&D HTA). Typically, only six months and a limited budget (£40,000) is available to conduct the assessment of effectiveness and cost-effectiveness. Whilst there is a trend to increase the scope of these projects, and subsequently the time (and resources) available for their completion, they still represent a considerable challenge to the health economists (and the health service researchers) involved.

This paper reports the challenges associated with the use of data from a recent rapid review of the effectiveness and cost-effectiveness of home versus satellite and hospital haemodialysis (HD) for the treatment of end stage renal disease (ESRD). In particular, the approaches adopted as a result of the short period of time for the review are highlighted.

Background

ESRD is a chronic condition, where individuals have an irreversible loss of kidney function and require expensive lifelong high-technology care. Funding the treatment is of growing concern to policy makers. Despite the low prevalence of ESRD, compared to other diseases, such as cancer, its consumption of health care resources is relatively high. Indeed less than 0.1% of the UK population has ESRD, yet consume over 2% of the health care budget.[4] There are various explanations for this including, the resource intensive nature of the treatments, the chronic nature of the disease and the morbidity of the increasingly elderly population of patients accepted onto renal replacement therapy (RRT).

There are two forms of RRT, transplantation and dialysis. Transplantation is usually the favoured option, however, the number of donor kidneys is limited. Therefore, many patients require long-term and often life-long dialysis. Dialysis relies on the principle that small molecules such as urea and creatinine (usually excreted by the kidney), can pass across membranes, down a concentration gradient and be filtered out of the body. The principal types of dialysis are peritoneal dialysis (PD) and HD. During PD, fluid (dialysate) is instilled into the peritoneal cavity via a catheter and it remains there for several hours. Dialysis occurs by diffusion and ultrafiltration across the patient's peritoneal membrane. The dialysate is then drained out of the peritoneal cavity and fresh fluid instilled to continue the process.

The focus for this paper is on variations of HD, where an artificial kidney (dialyser) containing a semi-permeable membrane is used. This procedure requires the patient to have permanent easy access to the circulation, usually obtained by creating an arterio-venous fistula in the arm and is carried out through the aid of a machine. In England and Wales 59.4% of patients receiving HD are treated in a specialist unit in a large district general hospital (DGH) or teaching hospital receiving tertiary referrals.[4] These patients receive their treatment on an out-patient basis and typically have three treatments per week, with the length of sessions varying from two to six hours.

A smaller proportion of patients (6.3% of HD patients) receive home HD.[4] The presence of a carer (e.g. spouse, parent) is normally considered necessary during home HD and whilst this treatment uses equipment and consumables identical to hospital HD, the requirement for NHS staff is minimal. Home HD offers a number of potential advantages over hospital HD. Notably, patients do not have to travel to hospital or wait for treatment once there. Home HD also provides the opportunity to tailor the dialysis regime more closely to patients requirements by changing the timing, the length and/or the frequency of dialysis sessions. As the patient has sole use of the home dialysis machine, it may be possible to adopt a regime of short frequent HD sessions, where HD is performed for 1.5 to 2 hours, five to seven times per week, or slow nocturnal HD, where the individual dialyses whilst sleeping for six to ten hours from three to seven times per week. More frequent and/or longer HD may improve an individual's physical well-being, albeit at the cost of the extra consumables and increased work for the patient and carer.

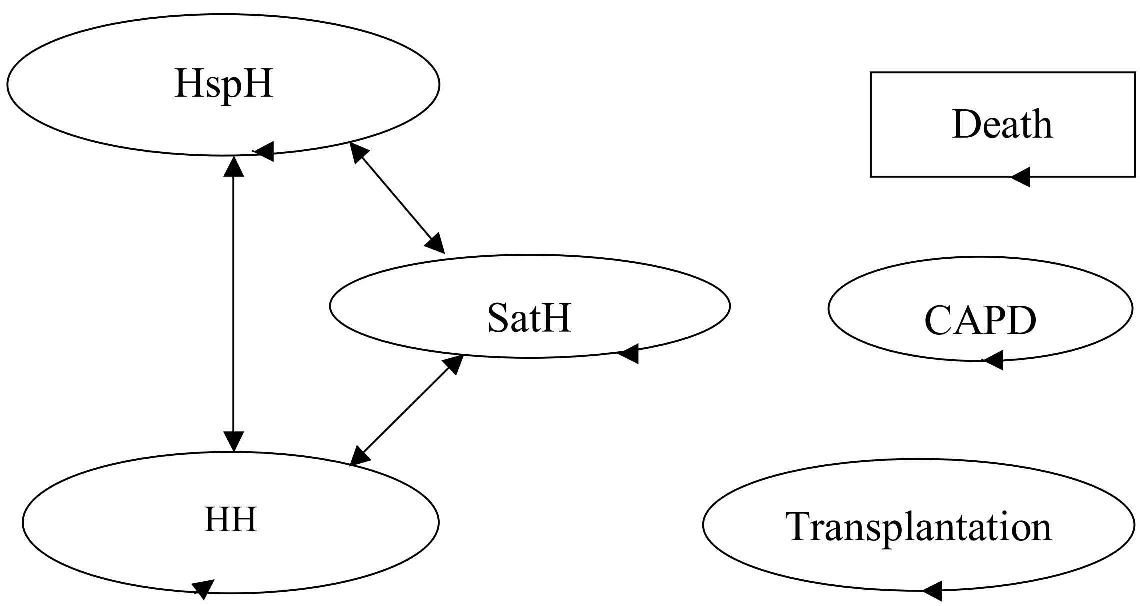
The remaining HD patients receive treatment in satellite units. These units tend to be located in smaller DGHs and are attached to a main renal unit. Nursing staff on the satellite unit are specialised, with onsite medical cover being limited.

Methods

Development of the model

The aim of the model used for the dialysis rapid review was to assess whether home HD was more cost-effective than hospital or satellite unit HD. As ESRD is a chronic condition requiring continuous treatment, a Markov model was considered appropriate to model longer term costs and outcomes (Figure 1). In addition, given that patients with ESRD may, over their lifetime, use a number of different RRT modalities, it was deemed necessary to include potential changes in dialysis modality. A deterministic model was initially developed and a probabilistic model was only developed following the rapid review to explore the implications of variation in the data in a more appropriate away than deterministic sensitivity analysis. As such the results of both approaches are presented in this paper to assess if sufficient time had allowed a probabilistic model to be developed in the first instance, whether it would have actually influenced the results or not.

Figure 1 Structure of the Markov model



Data

Clinical effectiveness data for the model were obtained from a review performed by colleagues in the Health Services Research Unit. Electronic searches were conducted to identify published and unpublished studies. All titles and abstracts identified by the reviewers were assessed. Full text papers were obtained for all potentially relevant studies and formally assessed for inclusion. A data abstraction form was developed to record details of study designs, participants, intervention and outcomes. The methodological quality of the included systematic reviews and primary studies was assessed by checklists designed for this purpose. Two reviewers independently extracted data and assessed study quality.[5-7]

Twenty seven published studies met the inclusion criteria on effectiveness, in terms of types of study design, participants, interventions, and outcomes. There were four systematic reviews, one randomised crossover trial and 22 comparative observational studies.

The main findings indicated that home HD is more effective than in-centre dialysis, and also more effective than satellite HD. Whilst this second difference was not large, there was some concern regarding patient selection effects and the date of the studies.

Costs

The model included the direct health service costs in 2001/2 UK pounds sterling associated with the treatment options. Costs were calculated by measuring the resources used for each patient or per event in the case of complications. The costs included in the study are those of access surgery/set up, training, dialysis, consumables, capital, staffing costs and complication costs. Most of the cost data were derived from the European Dialysis and Cost-Effectiveness study (EURODICE), which compares two dialysis modalities, hospital HD and continuous ambulatory peritoneal dialysis (CAPD). One of the two Scottish centres in the project, Aberdeen was the source for most of the cost data for the rapid review. Hospital HD costs were only adjusted for inflation, and for home HD additional information was collected on staff, and capital costs, as the consumable costs were the same as for hospital HD. For satellite HD the equipment costs were assumed to be the same as hospital HD and labour costs were estimated from data provided by Drey and colleagues on staffing levels in satellite units.[8]

Transition probabilities

The transition probabilities (e.g. the probability of starting on home HD and switching to, for example, to satellite HD or CAPD) required to populate the model are listed in Table 1.

Table 1 Transition Probabilities for the Haemodialysis Review

A - Starting on home HD
P1 = probability of starting in home HD and staying in home HD P2 = probability of starting in home HD and transferring to hospital HD P3 = probability of starting in home HD and transferring to satellite HD P4= probability of starting in home HD and transferring to CAPD P5 = probability of starting in home HD and transferring to transplant P6 = probability of starting in home HD and transferring to death
B - Starting on hospital HD
P7 = probability of starting in hospital HD and transferring to home HD P8 = probability of starting in hospital HD and staying in hospital HD P9 = probability of starting in hospital HD and transferring to satellite HD P10= probability of starting in hospital HD and transferring to CAPD P11=probability of starting in hospital HD and transferring to transplant P12= probability of starting in hospital HD and transferring to death
C - Starting on satellite HD
P13 = probability of starting in satellite HD and transferring to home HD P14 = probability of starting in satellite HD and transferring to hospital HD P15 = probability of starting in satellite HD and staying in satellite HD P16= probability of starting in satellite HD and transferring to CAPD P17 = probability of starting in satellite HD and transferring to transplant P18 = probability of starting in satellite HD and transferring to death

Not all the probabilities required were retrieved directly from the literature. Some were estimated by using the requirements of the Markov model that each row of the matrix of possible transitions should sum to one. CAPD, death and transplantation were taken as absorbing states in the model. Data from the UK Renal Registry [4] and the effectiveness review were used to estimate the transition probabilities. Risk of death was based on annual rates of mortality over the five-year time horizon of the model for younger patients (aged less than 50) without any comorbidities. These mortality rates were taken from Hellerstedt and colleagues [9] and were used for the base analysis of the Markov model. It was assumed that the mortality rates for satellite HD were equivalent to those for hospital HD.

Mortality rates for patients with diabetes (one of the main comorbidities) were estimated from cumulative survival curves in Hellerstedt and colleagues [9]. Data from the review on effectiveness suggested that the risk of death for patients over 65 years of age, compared with patients aged 40 to 45, lay within the interval 1.8 and 2.4. These two values were used to compute mortality rates for diabetic and non-diabetic patients over 65. Based on data from the Renal Registry [4] and the requirement that the added probabilities of the row in the matrix must equal one, transition probabilities were computed for these subgroups in the same manner described as above.

Sensitivity analysis was performed on mortality rates. An average mortality rate was computed for home and hospital HD for every year. Two studies were used to calculate this average: Hellerstedt and colleagues [9] and Mailloux and colleagues [10]. A model was designed to estimate the mortality rates for the second, third and fourth years based on the computed weighted average for the first and fifth years. The equations used to estimate mortality rates were:

for hospital HD: $y = -0.0950x + 0.9650$

for home HD: $y = -0.06x + 1.0167$.

Utilities

Utilities (e.g. values ranging from zero for death to one for full health) were obtained from the literature and were used to weight the time in each state within the model. The summation of time spent in each health state was used to estimate life expectancy. This value was then weighted by the utility value to obtain an estimate of quality adjusted life years (QALYs). Utilities were derived from the study by de Wit and colleagues [11], who reported values of 0.66 (sd 0.29) and 0.81 (sd 0.24) for the comparison of hospital and satellite HD. These estimates were based on valuations obtained using the EQ5D and the UK general population tariff. In the model it was assumed that home HD had the same utility as satellite HD. It was also assumed that all patients were in the same underlying health state prior to treatment or entry to the model.

Utility data were also available from the 1987 study by Churchill and colleagues.[12] This study used a time trade-off approach to derive a utility score for home and hospital HD. The time trade-off scores for home and hospital HD were 0.49 and 0.43 respectively. As these data indicate that home HD was associated with a 13.95% higher utility, this rate was applied to the data from de Wit and colleagues[11] for satellite HD (0.82) to give a value of home HD of 0.92 which was used in sensitivity analysis.

Further sensitivity analyses

Sensitivity analysis was performed for the staffing levels of home and satellite HD, the inclusion of travel costs and the allowances for home HD carers. For variations in home HD staffing, the impact on cost and cost per QALY of the provision of a carer who would assist with home HD sessions was considered. In this analysis an "A" grade carer was assigned for the length of the dialysis session and to assist with placing the patient onto and off dialysis. Different options were also considered for the level of staffing in satellite units. The study by Drey and colleagues[8] reported that satellite units can vary widely in size and have different clinical and nursing staffing levels. In the sensitivity analysis two extreme options were considered: First, a satellite unit with a similar level of staffing to a hospital unit; and second, a satellite unit with minimal nursing and clinical cover. In the first option the cost of staff per patient per annum was assumed to be the same as a hospital unit and in the second it was assumed to be the same as home HD.

Results

The results of the baseline analysis, where the duration and frequency of HD are the same for all three settings, are presented in Table 2. The first section of the table provides information on the cost and QALY results for the three HD modalities. Costs for home HD, satellite HD and hospital HD increase fairly rapidly over time, as the costs of dialysis are incurred in every cycle. The central rows of Table 2 provide information on the net costs and QALYs of home HD compared with the other modalities.

Home HD dominates hospital HD over the time horizon considered (it is both more effective and less costly). The initial costs of home HD were lower than the costs of satellite HD, but the cumulative discounted costs of home HD after one year exceed the costs of satellite HD. The gain in utility from home HD compared with satellite HD was not substantial as the base analysis assumed the same utility weight for both modes of dialysis. Therefore, the gain in utility is caused by the increase in survival of home HD compared with satellite HD. The incremental cost per QALY for home HD compared with satellite HD was estimated to be £1960 and £3740 for the five and ten year follow-up period respectively.

Table 2 Incremental HD cost-effectiveness results: Home compared with satellite and hospital.

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 10
Total costs						
SatH	£16,051	£26,279	£34096	£40,290	£45,490	£61,356
HH	£15,870	£26,573	£34,651	£40,747	£45,980	£62,925
HspH	£16,774	£27,534	£35,756	£42,272	£47,743	£64,433
QALYs						
SatH	1.02	1.50	1.88	2.20	2.48	3.43
HH	1.08	1.63	2.07	2.42	2.73	3.85
HspH	0.83	1.22	1.53	1.79	2.02	2.79
Extra cost for HH versus						
SatH	-£181	£294	£555	£457	£490	£1569
HspH	-£904	-£961	-£1105	-£1525	-£1763	-£1508
QALYs gained by HH versus						
SatH	0.06	0.13	0.19	0.22	0.25	0.42
HspH	0.25	0.41	0.54	0.63	0.71	1.06
Incremental cost per QALY for HH versus						
SatH	HH dominant	£2260	£2920	£2080	£1960	£3740
HspH	HH dominant	HH dominant	HH dominant	HH dominant	HH dominant	HH dominant

SatH = Satellite HD; HH = Home HD; HspH = Hospital HD

<u>Deterministic sensitivity analysis</u>

Data from the effectiveness review suggest that requirements for erythroproetin (EPO), a drug used to reduce anaemia, for short daily HD and nocturnal home HD may be reduced by 50% compared with hospital HD. Short daily HD and nocturnal home HD also having the potential to reduce adverse events by 45% compared with the standard regime of four hour-long sessions three times per week. In this new scenario, home HD did not dominate hospital HD and the incremental cost per QALY relative to hospital HD were £8,408 and £8,694 and £32,936 and £29,269 relative to satellite HD for five and ten year follow-up period respectively.

Results from the model for patients over 65 years of age, reveal an estimated incremental cost per QALY relative to hospital HD of £3,733 at five years (ten year results were not estimated). For patients with diabetes aged less than 50 years, home HD dominated both satellite and hospital HD. Similar analysis was performed for patients with diabetes aged over 65 years, in this scenario home HD dominated the other modalities after three years.

Table 3 summarises the results of further sensitivity analyses performed to assess how robust the model was and to account any limitations in data availability.

Table 3 Sensitivity analysis for home vs. hospital or satellite HD

	vs. hospital HD	vs. satellite HD
Utility for home HD 0.92	Home dominant	Incremental cost per QALY £869 at five and £1,756 at ten years.
An assistant for home HD	Home dominant	Incremental cost per QALY £16,668 at five and £15,605 at ten years.
Clinical cover for satellite HD (£7,539 per patient per year)	Home dominant	Home dominant
Minimal clinical cover for satellite (£2,766 per patient per year)	Home dominant	Incremental cost per QALY £30,285 at five and £31,717 at ten years.
Weighted average mortality rates	Home dominant	Incremental cost per QALY £7,545 at five and £9,131 at ten years.

The impact of variations in mortality rates for home HD was also assessed (Table 4). The incremental cost per QALY falls as the annual mortality of home HD increases because patients incur additional costs (and QALYs) due to their longer term survival.

Table 4 - Incremental cost per QALY for home HD compared with hospital HD for different home HD mortality rates

	Annual mortality rate for home HD					
	1%	2%	3%	4%	5%	10%
Incremental cost per QALY	£6,434	£5,561	£4,575	£3,400	£2,712	HH dominant

Home HD requires considerable time commitment by both the patient and any carer. Data from the EURODICE study on time on dialysis, waiting and travelling, was combined with estimates for setting up/clearing away after home HD obtained from clinical colleagues and used to estimate the weekly time commitment of patients and carers on the different dialysis modalities (Table 5).

Table 5 - Estimated time devoted to the process of HD by patient and carer*

Modality (weekly duration and frequency)	**Estimated time per week**	
	Patient	**Carer**
Home HD (three sessions of 4.5 hours)	18.00	18.00
Nocturnal HD (six sessions of 7 hours)	51.00	9.00 **
SDHD (six sessions of 2 hours)	21.00	21.00
Satellite HD (three sessions of 4.5 hours)	20.29	0.00
Hospital HD (three sessions of 4.5 hours)	20.29	0.00

* Excluding other time that a carer may spend caring for the needs of the person with ESRF
**Excluding the 51 hours when the patient receives HD

Discussion

The principle aim of this paper was to report some of the challenges experienced in conducting an economic evaluation as part of a rapid review, in this case applied to dialysis therapy for ESRD. The data presented in the previous section summarises some of the results made available to decision-makers. The principle findings were that home HD dominates hospital HD and is more costly and more effective than satellite HD with the incremental cost per QALY of home compared with satellite HD being relatively modest. In the next section some of the specific challenges faced in producing these data are described as well as some of the limitations of the methods used.

Challenges in the rapid evaluation of home HD

1. Generalisability of utilities

Data on utilities were derived from studies conducted outside the UK. Although sensitivity analysis was performed on these values, it is unclear whether such data should be used, particularly as their control of case-mix variation was limited. However, these data were identified as part of a comprehensive systematic review and the direction of effect was consistent regardless of the country or time when the study was performed.

2. Generalisability of cost data

The data on cost were derived principally from one dialysis unit in Scotland. It is widely recognised that procedures and guidelines for the modalities considered could vary across centres. Sensitivity analysis was performed to investigate the impact of different ways of organising care, but concerns remain as to whether the level of resource utilisation and unit costs will be generalisable from our review.

The generalisability of economic data has received much attention in recent years.[13,14] The key issues relate to the challenges of generalising from data collected alongside clinical trials to usual practice, difficulty in generalising data over time, and generalising from one setting to another. The latter is termed the transferability and relates to the dialysis and similar rapid reviews.[15]

The cost data used within this study were collected as part of larger European study (EURODICE). The main advantage of using these data lay in Aberdeen being the co-ordinating centre for the study, hence the rapid review team were able to gain access not only to the main report[16] but also to the actual spreadsheets. The costing methodology was very detailed and provided ample information. Home HD was not included in EURODICE but consumable costs and dialysis machines are the same for home as hospital HD. The EURODICE study was also the most recent dialysis costing exercise.

A potential concern with deriving cost data from this one dialysis unit in Scotland, is that it may not be transferable to England and Wales, and NICE have suggested that data need to relevant to the local setting.[17] Unfortunately, they provide limited guidance on the most appropriate approaches to be adopted for this.

Potential approaches to transferring such data are summarised by Drummond and McGuire (2001).[15] These include modelling from the clinical data alone, where clinical data is assumed to be generalisable and supplemented with local resource data and adapting. The dialysis example provides an interesting example in terms of the transferability of cost data. Given that the major cost drivers are fairly straightforward to identify and attached unit costs to, there is considerable scope to attempt to transfer the cost data using different approaches.

3. Quality of data underpinning the transition probabilities

The third methodological concern relates to the transition probabilities used in the model. The data available for the model all relate to patients commencing their RRT in the 1980's. More recently, there have been considerable developments in dialysis technology. There has also been a change in the population of patients receiving RRT, with new patients increasingly likely to be older and with co-morbidities such as diabetes and heart failure.[4] In addition to questions about the generalisability to current UK practice there are also questions regarding the internal validity of such studies. Data from studies were only considered if the study had attempted to control for selection biases. However, only one study was based on a randomised controlled trial[18] and the remaining were observational studies, attempting to use statistical methods such as Cox proportional hazard models to adjust for case mix variations.

A final limitation of the evidence used to estimate transition probabilities was that no data were available to model transitions between modalities, yet in practice these transitions are a real possibility. Sensitivity analysis was performed to assess the impact of relaxing the assumption that patients could not transfer between modalities. As an illustration, the results for a ten percent annual transition to both home and hospital HD from satellite HD are compared with the base analysis are presented below. In this new scenario the costs of satellite HD were lower than the base case analysis and the incremental cost per QALY for Home HD compared with satellite HD was £15,797 and £12,827, respectively, for the five and 10-year follow-up period. This contrasts with incremental costs per QALY of £1960 and £3740 for the same follow-up durations. The explanation for this deterioration in cost-effectiveness is that the increase in survival and reduction in cost following transitions to home HD are more than compensated for by the reductions in the cost consequences following a reduction in survival caused by transitions to from satellite to hospital HD. Even this simple example illustrates the importance of gaining information on transition probabilities between modalities.

4. Use of CAPD and transplantation as absorbing states

Transplantation and CAPD were included in the model as absorbing states which meant that once an individual makes a transition into one of these states, none of their further costs or benefits were included in the model. These assumptions were made partly because transplantation is considered more efficient than HD, which implies that the relevant question might be which form of HD to adopt before transplantation or after transplantation fails? Similarly the relevant question for CAPD might be which form of HD to adopt when CAPD fails or is not appropriate? However, the issue remains that two viable alternatives, that may interact with the costs and outcomes of the other modalities, were excluded from the model.

5. Use of a deterministic model

The results of the deterministic model have some use, although a probabilistic analysis of the outcomes would have been appropriate to fully address the uncertainty in parameter values. The short time scale available did not initially allow this to be performed until after the review was completed. The results of this analysis are summarised below and are compared with the earlier deterministic model.

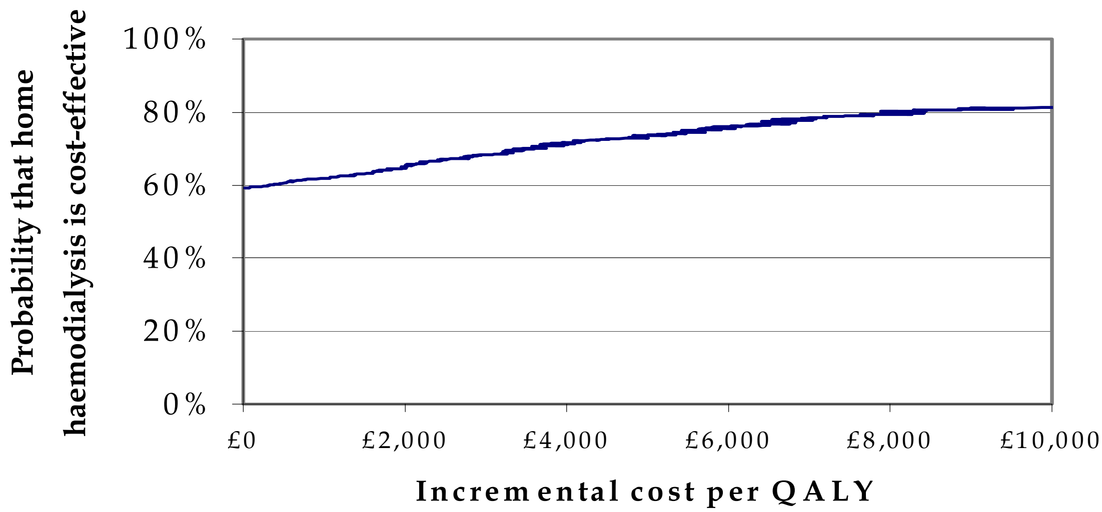
Monte Carlo Analysis

A probabilistic sensitivity analysis was carried out to identify the potential range of expected values in the model and their likely distribution. Distributions were assigned to the transition probabilities from the different modalities to death and to the utilities associated with different states.

Data from the Hellestedt and colleagues[9] were used to calculate the distributions associated with the transition probabilities from home, hospital and satellite to death. Data from de Wit and colleagues [11] were used to calculate distributions of the utility scores of satellite, home and hospital HD.

The results of the Monte Carlo Analysis for the model comparing equal the duration and frequency of HD for the three modalities show that in 58.1% of the iterations home HD was less costly and more effective (dominate) over satellite HD, in 24% of these interactions home HD was more costly and more effective than satellite HD and in 17.9% of the interactions home HD was both less costly and less effective than satellite HD. Figure 3 shows a cost effectiveness acceptability curve (CEAC) for the comparison of home compared with satellite HD.

Figure 3 Cost effectiveness acceptability curve for the comparison of home HD with hospital HD



As Figure 3 highlights, there is a 80% chance that the incremental cost per QALY of home HD compared with satellite HD is less than or equal to £8000 and a 65% chance that the incremental cost per QALY would be less than the £1,960 reported in the deterministic analysis (Table 2). More importantly though, there is a fair chance that home HD is in fact dominant.

For the comparison of home HD and hospital HD the results indicate that hospital HD dominates 94.7% of the iterations (in the remaining 5.3% iterations home HD was both more costly and more effective). This is similar to the deterministic analysis which indicated that home HD would always be dominant.

In this example the results of the probabilistic and deterministic models are similar. Hospital HD is the most costly and least effective of the three treatment modalities, home HD may dominate satellite HD although the incremental cost per QALY and incremental cost were relatively modest.

Both models also show that home HD may not always be cost saving. This is in contrast to the conclusions drawn in other studies but would be expected given the short time horizon these studies considered (typically no more than 12 months) and the assumptions of equal effectiveness (on the basis of less evidence than was used here) that some studies made.[19-23]

Although the results are briefly presented here this probabilistic analysis should ideally be repeated for each of the different scenarios considered e.g. use of a paid carer, different levels of clinical cover for satellite HD, different sources of utility scores, mortality rates, etc as it would be important to consider the magnitude of any uncertainty surrounding estimates of cost-effectiveness for these scenarios.

Value of information

The dialysis rapid review did not allow time to go beyond the estimation of incremental cost per QALY during the project duration. To examine whether further analysis of existing data or additional primary data collection would be worthwhile, a Bayesian approach to the value of information could be used to explore the efficiency of additional information gathering,[24] which can then be used to identify future research options. Such an approach is likely to become increasingly important, particularly rapid reviews, when timely decisions are required, yet the timescales for data collection are short. This could assist in deciding which areas of future research have the greatest value.

Conclusions

This study has indicated that the present low utilisation of home HD needs to be addressed. The results of the analyses are broadly consistent between the deterministic and the probabilistic models. Nevertheless, the probabilistic model is informative in that it indicated that there is a fair chance that Home HD might dominate hospital HD. The number of scenarios that require consideration (only some of which have been presented) could potentially make both the deterministic and probabilistic models unwieldy.

Of greater concern are the assumptions made within the evaluation concerning the generalisability of both cost and outcome data. It is difficult to see how any concerns created by these assumptions could be resolved without more time being available for research. Further, assumptions were also made regarding the structure of the model (e.g. CAPD and transplantation defined as absorbing states). Again further work would have been required to identify the required information to consider the costs and consequences of these modalities.

The problems faced in this evaluation are not unique, indeed they are faced in any study that has to be conducted on a tight timescale with limited resources. Given the limited resources available for research, this implies that choices have to be made concerning whether information is sufficient for decision-makers. These choices will of course be dependent in part on the decision to be made, but discussion and perhaps further research is needed to make these choices in a more informed manner.

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