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Systematic review of the effectiveness and cost-effectiveness, and economic evaluation, of home versus hospital or satellite unit haemodialysis for people with end-stage renal failure

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Systematic review of the effectiveness and cost-effectiveness, and economic evaluation, of home versus hospital or satellite unit haemodialysis for people with end-stage renal failure

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List of abbreviations

ANOVA	analysis of variance
ANZDATA	Australian and New Zealand Combined Dialysis and Transplant Registry
APD	automated peritoneal dialysis
AURAL	Association pour l'Utilisation du Rein Artificiel
BSI	Brief Symptom Inventory
CABG	coronary artery bypass graft
CAPD	continuous ambulatory peritoneal dialysis
CCTR	Cochrane Controlled Trials Register
CDSR	Cochrane Database of Systematic Reviews
CI	confidence interval
COPD	chronic obstructive pulmonary disease
DARE	Database of Abstracts of Reviews of Effectiveness
DH	Department of Health
EDTA–ERA	European Dialysis and Transplant Association–European Renal Association
eKt/V	equilibrated Kt/V
EPO	erythropoietin
EQ-5D	EuroQoL-5 dimensions
ESRD	end-stage renal disease
ESRF	end-stage renal failure
EURODICE	European Dialysis and Cost-Effectiveness (study)
FES	Family Environment Scale
GUHT	Grampian University Hospitals NHS Trust
HMIC	Health Management Information Consortium
HomH	home haemodialysis
HspH	hospital haemodialysis
HSR	Health Services Research
KDQOL	Kidney Disease Quality Of Life
Kt/V	efficiency (fractional urea clearance) of one haemodialysis session (K, rate of urea clearance of the dialyser [ml/minute]; t, time of session [minutes]; V, urea distribution volume after haemodialysis [ml])
MATE	Marital Attitudes Evaluation (Scale)
mEq/l	milliequivalents per litre
MeSH	Medical Subject Headings
NHS EED	NHS Economic Evaluation Database
NICE	National Institute for Clinical Excellence
NKDKTS	National Kidney Dialysis and Kidney Transplantation Study
NLM	National Library of Medicine
NRR	National Research Register
NS	not stated
PAIS	Psychosocial Adjustment to Illness Scale
PCR	protein catabolic rate
QALY	quality-adjusted life-year
QoL	quality of life
RCT	randomised controlled trial

continued

continued

ReFeR-DH	Department of Health (UK) Research Findings Register
RRT	renal replacement therapy
SatH	satellite unit haemodialysis
SCI	Science Citation Index
SD	standard deviation
SEM	standard error of the mean
SF-36	Short Form with 36 items
SIP	Sickness Impact Profile
TTO	Time Trade-Off
URR	urea reduction ratio

All abbreviations that have been used in this report are listed here unless the abbreviation is well known (e.g. NHS), or it has been used only once, or it is a non-standard abbreviation used only in figures/tables/appendices, in which case the abbreviation is defined in the figure legend or at the end of the table.

Executive summary

Background

End-stage renal failure is the irreversible loss of kidney function. When loss of kidney function reaches the point at which the kidneys fail to support life, then renal replacement therapy (RRT) is required. Several types of RRT are available. Renal transplantation is generally seen as the most cost-effective approach for patients who are suitable, with the other modalities of RRT being haemodialysis and peritoneal dialysis. Because transplantation is limited by the supply of donor kidneys, many people need lifelong dialysis. Home haemodialysis offers the opportunity to tailor the haemodialysis regimen more closely to individual requirements. Hospital haemodialysis is provided in a specialist unit in a large district general hospital or teaching hospital, while satellite haemodialysis units tend to be based in smaller district general hospitals.

Objectives

This review aims to assess the effectiveness and cost-effectiveness of home haemodialysis, compared with haemodialysis carried out in a hospital or satellite unit, for people with end-stage renal failure.

Methods

The primary outcomes considered were quality of life, hospitalisation rate, employment/school status, technique failure and access failure; other outcomes were measures of anaemia, use of erythropoietin, biochemical indices of renal disease, dialysis adequacy, blood pressure, adverse events and mortality. Electronic searches were conducted to identify published and unpublished studies. Two reviewers independently extracted data and assessed study quality. A Markov model comparing home with hospital and satellite haemodialysis was constructed. The model was used to estimate costs and quality-adjusted life-years (QALYs) for a 5-year period for patients starting RRT on home, satellite or hospital haemodialysis.

Results

Number and quality of studies

A total of 27 studies met the inclusion criteria on effectiveness: four systematic reviews, one randomised crossover trial and 22 comparative observational studies. The methodological quality of the systematic reviews was assessed using a 10-item checklist designed for this purpose. Out of an overall score from 1 (extensive flaws) to 7 (minimal flaws), one review scored 5 (minor flaws), one review scored 4, and two reviews scored 3 (major flaws). The quality of the primary studies was assessed using a checklist designed to assess the quality of both randomised and non-randomised studies, and contained 27 items. The overall mean score for the quality of all primary studies was 12 (out of a possible 27).

Direction of evidence

Despite major concerns about patient selection effects, the general direction of evidence from the included studies suggests that home haemodialysis is more effective than hospital haemodialysis, and also modestly more effective than satellite haemodialysis.

Summary of benefits

People dialysed at home generally experienced a better quality of life. There was a suggestion, however, that their partners tended to be less satisfied, both with the home setting for haemodialysis and with the increased dependency placed on them. Compared with hospital haemodialysis, patients on home haemodialysis were hospitalised less, tended to live longer, were more likely to be in full-time work and experienced fewer adverse events during haemodialysis. The one study giving details of technique survival (the time that a person remains on a particular form of RRT) suggested that patients dialysed in satellite units achieved a longer median technique survival time than those on home haemodialysis. For some outcomes, a number of studies reported statistically significant differences in favour of home haemodialysis; for other outcomes, differences were more modest but generally still favoured home haemodialysis.

People undergoing home haemodialysis, however, are a highly selected group; they tend to be younger and have fewer co-morbidities than those being dialysed in hospital or satellite units. Because of these differences and the opportunities for longer and more frequent haemodialysis sessions in the home than would normally be available in hospital or satellite units, it is difficult to provide an accurate estimate of the relative effectiveness of home haemodialysis.

Costs

The evidence is overwhelmingly in favour of lower total costs for home haemodialysis compared with hospital haemodialysis. Despite the initial high costs of home haemodialysis, due to set-up and training costs, the payback period for these higher costs (relative to hospital haemodialysis) is approximately 14 months. Satellite units may vary considerably in cost, depending on the staffing intensity and the ability to maximise use of the haemodialysis machines. For low-risk adults (the base case analysis), home haemodialysis is less costly per session than satellite haemodialysis, which in turn is less costly than hospital haemodialysis. The principal reason for this is the lower staffing requirements of home and satellite haemodialysis.

Cost/QALY

The review identified six studies with strong designs, although potentially still subject to patient selection bias. The outcome measure used in most studies was survival. One study with QALYs as an outcome measure found that costs were lower and QALYs higher for home haemodialysis compared with hospital haemodialysis. Overall, the studies supported home over hospital haemodialysis. Home haemodialysis may also have advantages over satellite haemodialysis, though some researchers noted benefits of satellite haemodialysis that are hard to quantify, such as patient and family preferences for having treatment outside of the home.

The results of the economic model generally reflected those from the literature, for younger, fitter patients without serious co-morbidities who received haemodialysis for 4–5 hours 3 times per week. The main difference between the results of the model and the literature was that, over a 5-year period, the model indicated that home haemodialysis did not dominate, that is, home haemodialysis was more effective but more costly than satellite haemodialysis, although the additional cost per QALY was modest, at approximately £2200.

Sensitivity analyses

Sensitivity analysis was conducted on the cost of home haemodialysis (cost of the machine and length of the training period), the staffing requirements for satellite haemodialysis (to reflect the different ways in which such units could be organised), the level of benefits each modality of haemodialysis might provide, travel costs and the cost of allowances. The two factors that most influenced the estimates of cost per QALY were travel costs and the cost of providing allowances for the carers of patients on home haemodialysis. For patients facing the lowest travel costs (i.e. living closest to the haemodialysis unit) and receiving the highest level of allowance (i.e. the most disabled), the incremental cost per QALY of home haemodialysis, compared with hospital haemodialysis, was approximately £12,000. When compared with satellite haemodialysis, the incremental cost per QALY of home haemodialysis was £45,000–50,000.

Limitations of the calculations

In general, the data used in the model were limited and came from non-randomised studies. It is important to note that a new generation of home haemodialysis machines is under development but could not be analysed in this review. These new machines may lower the rate of complications in the home or diminish the need for carer involvement, thereby reducing the need for family participation (which is often seen as a factor lessening the attractiveness of home haemodialysis compared with satellite haemodialysis).

Conclusions

Home haemodialysis has tended to be used on a highly selected group of relatively young patients with low co-morbidity. This review shows that it is generally more effective than hospital haemodialysis on a range of outcomes, and modestly more effective than satellite haemodialysis. It is unclear to what extent these findings are influenced by selection bias. The evidence is in favour of lower total annual costs for home haemodialysis compared with hospital haemodialysis, with treatment costs of satellite haemodialysis lower than hospital haemodialysis but higher than home haemodialysis.

Generalisability of the findings

Most of the included studies were observational studies, which are particularly vulnerable to unknown confounding factors that could bias the

results. Overall, the number of people on home or satellite haemodialysis was much less than those on hospital haemodialysis. Within studies, socio-demographic characteristics and co-morbidities were generally not evenly balanced between the participant groups, although some studies attempted to adjust for this by employing Cox proportional hazards regression models. Finally, in many of the studies, the haemodialysis intervention was poorly described in terms of the equipment used, and the duration and frequency of haemodialysis. For these reasons, any suggestion of generalisability must be at best tentative.

Implications

Expanding home and satellite haemodialysis services may provide a method of coping with increasing numbers of people requiring RRT, with less additional resources required than would otherwise be needed to expand hospital haemodialysis services. While the expansion of home haemodialysis may improve the well-being and financial security of patients, it may add considerably to the stress on carers and families. The net effect on a family's income is uncertain because it depends upon what, if any, paid employment would be given up by the carer.

The expansion of home haemodialysis programmes may be difficult to achieve without recruiting and training additional nurses. Under-supported programmes may not realise the same level of benefits as those programmes identified from the literature.

Recommendations for research

Further prospective comparative studies are needed on the effectiveness and cost-effectiveness of home versus satellite unit haemodialysis. Further qualitative research is also needed on the acceptability to patients and their carers/families of home haemodialysis as a form of treatment.

Chapter 1

Aim and background

Aim of the review

This review aims to assess whether home haemodialysis is more effective and cost-effective than haemodialysis provided in a hospital or a satellite unit for people with end-stage renal failure (ESRF), except those for whom peritoneal dialysis is currently adequate. When data allow, the patient population is split into four patient groups: adults by risk class (low, moderate and high risk)[1] and children. In addition, when data allow, the effect of different frequencies of home haemodialysis is assessed in relation to the frequency provided in hospitals.

Description of underlying health problem

ESRF is the irreversible loss of kidney function. When the loss of kidney function reaches the point at which the kidneys may fail to support life, then renal replacement therapy (RRT) is required. The two forms of RRT available are renal transplantation and dialysis, as described below. It is likely that those patients needing RRT will move between different modalities of treatment during their lives.

Of the different modalities of RRT available, transplantation is widely viewed to be the treatment of choice,[2] but the number of donor kidneys is limited and therefore a long wait for a transplant is often inevitable. Furthermore, transplantation may not be an option for all patients, particularly those with significant co-morbidities. Therefore, many patients need lifelong dialysis. The principal types of dialysis are peritoneal dialysis and haemodialysis.

In peritoneal dialysis, fluid (dialysate) is instilled into the peritoneal cavity via a catheter and remains there for several hours, and 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 is instilled to continue the process. The two main forms of this technique are continuous ambulatory peritoneal dialysis (CAPD) and automated peritoneal dialysis. In CAPD, a patient's fluid is exchanged every 4–5 hours during the day and about 8 hours overnight. In automated peritoneal dialysis, the fluid exchanges are performed automatically overnight by machine, with a resultant increase in cost. The effectiveness and cost-effectiveness of these different types of peritoneal dialyses compared with each other and with haemodialysis are not considered in this review.[2,3]

In haemodialysis, waste products are removed from the blood by allowing them to pass across a thin semi-permeable membrane into dialysis fluid (dialysate), which is then discarded along with the waste products. The dialysate is formulated to attract the excess salts and water across the membrane without ever coming into direct contact with the blood. Blood is taken from the patient and passed through a dialyser containing the semi-permeable membrane across which the fluid is passed so that dialysis can take place. This process is controlled by a monitor, often called a dialysis machine. The process of haemodialysis can be delivered in many different ways (*Figure 1*). Haemodialysis can vary in terms of the setting in which it is carried out (e.g. home, satellite unit or hospital), the type of equipment used (e.g. different haemodialysis machines), the duration of sessions (e.g. 4, 6 or 8 hours), the frequency of sessions (e.g. 3, 5, 6 or 7 times per week), the type of membranes used (e.g. those made out of cellulose, modified cellulose or synthetic materials, or the flux of the membrane) and the dialysate (e.g. acetate or bicarbonate).

The different ways of delivering haemodialysis may vary in just one or several of the categories depicted in *Figure 1,* but in most circumstances the same combination of haemodialysis components that could be offered in hospital could also be provided in a home or satellite setting. The one exception is that, for a variety of reasons, chronic hospital haemodialysis is rarely conducted more than 3 times per week. Appendix 1 provides a brief summary of the major developments in haemodialysis therapy.

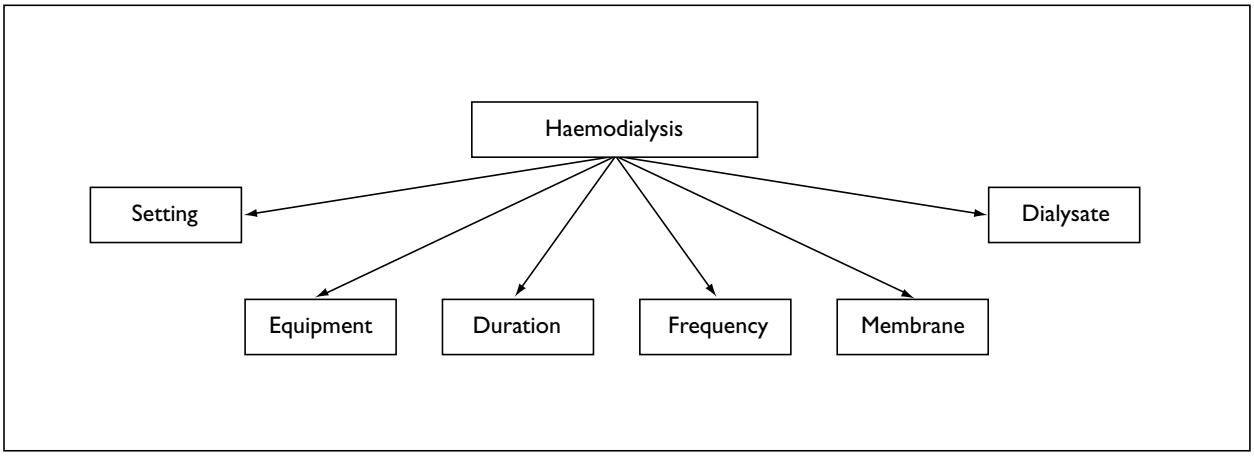

FIGURE 1 *Various components involved in the delivery of haemodialysis*

Incidence and prevalence of ESRF

Adults

The main cause of ESRF among adults is glomerulonephritis (including glomerulonephritis not proven), with pyelonephritis being the second most frequent cause.[4] The number of adults starting on RRT has progressively increased in recent years. In 1993, the rate was 73, 95 and 79 adults per million of the population for England, Wales[4] and Scotland,[5] respectively. In 1998, 4566 people in England,[4] 374 people in Wales[4] and 537 people in Scotland[5] started RRT, giving acceptance rates per million population of 92 (95% confidence interval [CI], 90 to 95) for England,[4] 128 (95% CI, 115 to 141) for Wales[4] and 105 for Scotland.[5] Given the greater proportion of people from the Asian subcontinent (who are at greater risk of renal failure) in England, it might have been expected that the rate for England would have been greater.[4]

Data over time are not available on the number of patients in each diagnosis group starting RRT for all of England and Wales, but data from Scotland suggest that this number is increasing for all groups. The number of patients starting RRT in Scotland during the periods 1990–1994 and 1995–1999 included those with diabetes mellitus (257 and 441 patients, respectively), multisystem diseases (416 and 600 patients), interstitial nephropathies (402 and 537 patients), glomerulonephritis (336 and 382 patients) and diagnosis unknown/other (326 and 479 patients).[5]

The proportion of older patients (aged > 75 years) in the incident RRT population is increasing, while the proportion of patients in the younger age group (aged < 50 years) is falling, although the absolute number is increasing. The number of patients in Scotland in the younger age group starting RRT during the periods 1990–1994 and 1995–1999 included those with diabetes mellitus (103 and 125 patients, respectively), multisystem diseases (85 and 97 patients), interstitial nephropathies (195 and 226 patients), glomerulonephritis (150 and 140 patients) and diagnosis unknown (79 and 85 patients). The number of patients in the older age group starting RRT during the periods 1990–1994 and 1995–1999 included those with diabetes mellitus (5 and 35 patients, respectively), multisystem diseases (41 and 101 patients), interstitial nephropathies (16 and 58 patients), glomerulonephritis (10 and 41 patients) and diagnosis unknown (57 and 129 patients).[5] The number of patients aged under 50 years with a primary renal diagnosis of glomerulonephritis would appear to have reached a plateau, suggesting that the rate of provision of RRT for this group is now meeting the incidence. The rate of provision of RRT, however, continues to increase for all diagnostic groups in patients aged over 75 years.[5]

The number of adults receiving RRT in 1998 was 25,892 in England (523 people per million population; 95% CI, 517 to 530), 1716 in Wales (585 people per million population; 95% CI, 558 to 613) and 2892 (including children) in Scotland.[4,5] Because of the increasing incidence, which has exceeded the death rate, the prevalence rates have increased over time, with an increase in prevalence of 6680 patients in England from 1993 to 1998, 296 patients in Wales from 1995 to 1998, and 702 patients (including children) in Scotland from 1993 to 1998.[4,5]

In the UK, 61% of all people receiving RRT are males. The median age of all adults receiving treatment in 1999 was 54 years, and 28.7% of adults receiving RRT were over 65 years. Those who received haemodialysis had a median age of 62 years (compared to a median age of 59 years for peritoneal dialysis patients and 49 years for transplant patients). Although UK data are limited for those aged over 65 years, it appears that the elderly are much more likely to have a primary diagnosis of type 2 diabetes mellitus.[4] As the uptake rate of RRT has increased over time, the median age of patients and the number of co-morbidities that they suffer have increased.

Children

The most common cause of ESRF in children is renal dysplasia (28%), followed by obstructive uropathy (20%) and glomerulopathies (17%).[6] For children (under 18 years of age), it was estimated in 1999 that 101 new patients per year in the UK would require RRT (based on the average of the previous 3 years of data).[6] This estimate gives an acceptance rate of 1.7 per million population based on the whole population, or 7.4 per million of the population aged under 18 years. Children from the Asian subcontinent accounted for 10.3% of these new cases, whereas the expected rate based on the Asian proportion of the total population would be 4.7%.

Data on changes in incidence over time were not available. With regard to prevalence, the number of patients in England and Wales under 15 years of age being treated for ESRF was 429 in 1992 compared with 528 in the year 2000.[4] Between 1996 and 1999, a yearly average of 434 children under 14 years of age received RRT. This value equates to a prevalence of 12.2 per million of the whole population, or 53.4 per million of those aged less than 18 years.[6]

Current service provision

Adults

The most frequent treatment for ESRF (in terms of the proportion treated) is transplantation, but dialysis (in its various forms) still accounts for approximately 50% of treatment (*Table 1*).

Over the last 5 years, the proportion of patients receiving transplants and peritoneal dialysis has declined, even though the absolute numbers receiving these modalities have increased. The largest change has been the growth in the number of people who receive haemodialysis in satellite units, while the number of people on home haemodialysis has fallen, indicating that they are a highly selected group of patients.

TABLE 1 *Proportion of adult patients with ESRF receiving RRT, by modality of treatment, in England, Wales (1998)* † and Scotland (1999)‡*

Modality of treatment	England (%)	Wales (%)	Scotland (%)
Transplantation	48	55	47
Peritoneal dialysis	20	18	15
Hospital haemodialysis	19	15	33
Satellite haemodialysis	11	11	3
Home haemodialysis	2	1	2

* *Based on data reported in the UK Renal Registry*[4]
† *Total number of patients was 25,892 in England and 1716 in Wales*
‡ *Based on data reported in the UK Renal Registry*[4] *and the Scottish Renal Registry*[5]

Approximately 3% of patients receiving haemodialysis receive a transplant after 1 year, and 7% receive one after 2 years.[4] The rates of transplantation do, of course, change for different risk groups. For example, of adults under 65 years of age with ESRF, 40% of those with type 1 diabetes receive a transplant, 22% of those with type 2 diabetes receive a transplant, and 61% of those without diabetes receive a transplant. Similar figures for those over age 65 years are 9%, 5% and 24%, respectively.[4]

Figures for the number of people who might be eligible for home haemodialysis are difficult to estimate. For centres that cover remote areas, all patients who are stable on haemodialysis might be considered. Factors that may influence the number of people eligible for home haemodialysis are age, whether the cause of ESRF was diabetes or multisystem failure as opposed to other causes, and the likelihood of receiving a transplant. Data from the Scottish Renal Registry[5] suggest that all those patients aged 75 years or over would have a median survival on RRT of 2 years or less, while those aged between 64 and 75 years with diabetes or multisystem failure as a cause of ESRF would also be expected to survive for 2 years or less. In contrast, those aged less than 65 years would be expected to have a median survival of greater than 2 years, regardless of the cause. As the data presented in this section suggest, it is these younger patients who would be most likely to receive a transplant.

In England and Wales, the incidence of RRT per million of the population is 13.2 for those aged 45–54 years, 9.9 for those aged 55–64 years and 8.4 for those aged 65–74 years. Of those aged over 65 years, 26% have diabetes, renal vascular disease or hypertension as a cause of ESRF.

If younger adults and children are much more likely to receive renal transplants than those older than 40 years, and if those patients over 75 years, and those between 65 and 74 years with diabetes or multisystem failure are not offered home haemodialysis because of short expected survival, then a crude estimate of the number of people per year who are currently offered RRT in England and Wales (total population, 52.5 million) and who might be eligible for home haemodialysis is 1500. Many of these people, however, might be unsuitable for home haemodialysis because of the severity of their condition or the lack of someone willing and able to act as a carer.

Children

The Paediatric Renal Registry reported in 2000 that the vast majority of children with ESRF receive transplants, with a sizeable proportion of them receiving pre-emptive transplantation before dialysis is needed.[4] The same report also estimated that it would be some time before the number of children receiving dialysis in the UK exceeds 200. Of the 528 children receiving treatment in the units contributing to the Paediatric Renal Registry, 56 (11%) received haemodialysis, 79 (15%) received peritoneal dialysis, and 393 (74%) underwent renal transplantation (data collected between September 1999 and May 2000). No data were reported on the numbers of children receiving haemodialysis in a home, satellite or hospital setting.

Current service cost

Approximately 2% of the healthcare budget is consumed by people with ESRF,[7] and this is likely to continue given current trends in the uptake rates of RRT and use of therapies. Using the data reported in *Table 1* on the proportion of patients receiving each type of RRT and the data on prevalence of RRT reported above (*Description of underlying health problem*), and assuming an annual cost of home haemodialysis of £19,871 per patient (see chapter 4), it is possible to estimate a total cost for the current provision of home haemodialysis. In England, assuming 2% of the 25,900 people receiving RRT received home haemodialysis, the cost of home haemodialysis is £10,293,000 per year. In Wales, the cost of using home haemodialysis to manage 1% of the 1716 patients receiving RRT is estimated to be £341,000.

Description of the interventions

Home haemodialysis

Of the 34 haemodialysis units in the UK, 24 provide home haemodialysis. In only six of the units, however, is the proportion of haemodialysis patients receiving home haemodialysis above 10%, and only 2% of adult patients receive home haemodialysis.[4]

In the 1970s, home haemodialysis was more frequently used among the population receiving RRT, although those receiving this treatment were still a highly selected group.[5] Patients were typically younger and fitter than the average patient today, and thus more likely to be stable and have the ability to carry out self-care. The extent to which older people with ESRF or people with one or more co-morbidities are able to cope with the requirements of home haemodialysis is unclear. The presence of a carer (e.g. spouse or parent) is normally necessary during home haemodialysis in case the patient experiences problems.

Home haemodialysis is initiated after a period of 2–4 months of training the patient and their carer in a hospital haemodialysis unit. The equipment and consumables necessary for haemodialysis require substantial space in a patient's home, which may have to undergo considerable modification to accommodate the process and to ensure appropriate water and power supplies. Currently, home dialysis uses the same type of equipment and consumables as hospital haemodialysis and has minimal requirement for NHS staff. Patients without any problems may only require regular clinic appointments and 2–3 visits by nursing staff per year. The home-based patients also require visits by technicians for regular servicing of their dialysis and water purification equipment. If clinical problems develop, however, the number of nurse visits and likelihood of hospitalisation increase. Furthermore, technical problems with the equipment may also disrupt the dialysis treatments.

Despite the possible problems, home haemodialysis offers a number of potential advantages over hospital haemodialysis. Patients do not have to travel to hospital or wait for treatment once there. Home haemodialysis also offers the opportunity to tailor the dialysis regimen more closely to individual requirements by changing the

timing, length and/or frequency of dialysis sessions. The standard hospital haemodialysis regimen is 3–5 hours, 3 times per week. Because the individual has sole use of the home dialysis machine, it may be possible to adopt a regimen of short, frequent haemodialysis sessions (1.5–2 hours, 5–7 times per week) or slow nocturnal haemodialysis (while sleeping for 6–10 hours, 3–7 times per week). More frequent and/or longer haemodialysis is believed to improve an individual's physical well-being, albeit at the cost of the extra consumables and increased work for the patient and carer.

More frequent and/or longer but slower haemodialysis sessions could be offered in a hospital or satellite unit, but the logistics and constraints that these units face mean that increased frequency can rarely be considered. The burden of additional trips to the hospital or satellite unit may also be unappealing to patients.

Hospital haemodialysis

Hospital haemodialysis is provided in a specialist unit in a large district general hospital or teaching hospital receiving tertiary referrals. There will be a programme of regular haemodialysis for patients with ESRF, usually three treatments of 3–5 hours per week, provided on an outpatient basis. These units may also include facilities to provide haemodialysis to hospitalised patients with acute renal failure and to provide a service to intensive care units and high dependency units for patients too unwell to transfer to the dialysis unit. The number of dialysis stations in hospital units for the dialysis of patients with ESRF in England ranges from 7 to 55 stations, with a median of 19, and in Wales ranges from 10 to 23 stations, with a median of 16.[4]

The units for treatment of those with ESRF are generally open six days per week; some are closed overnight. Many units are closed on Sundays. A fully trained renal physician is on call at all times to deal with any emergencies, such as access failure or acute deterioration in clinical well-being. The average number of consultant nephrologists per unit is 3.7 in England and 2.4 in Wales. There is also a large team of nurses to provide care. The median number of nurses per unit is 22 (range, 9.5–142.8) in England and 14 (range, 11–20.8) in Wales.[4]

Satellite unit haemodialysis

Patients with ESRF receiving dialysis in satellite units will have commenced haemodialysis in a hospital unit. Once their condition has stabilised, they transfer to a satellite unit nearer their home. Such units tend to be in smaller district general hospitals and contain a varying number of dialysis machines serving a group of patients with ESRF. A survey conducted in 1999 found that 57% of satellite units were based in acute hospitals, 31% on other hospital sites and 12% on non-hospital sites. Nineteen units were privately run.[8]

In 1998, the median number of patients cared for in a satellite unit was 35 (range, 6–160) in England and 49 (range, 36–60) in Wales. The median number of dialysis stations per unit was 8 (range, 3–41) in England and 13 (range, 9–13) in Wales. Some satellite units, especially in England, are thus of a substantial size, and at the end of 1998, a further seven main hospital units in England and one in Wales were planning to develop a satellite centre.[4]

Nursing staff are specialised, but medical cover is limited. The mean patient-to-nurse ratio in 1999 was 5.6:1.[8] In 1999, only 12% (9 of 74) satellite units had permanent on-site medical cover; however, in five of these units, cover was provided up to and including consultant level.[8] Off-site cover was most frequently provided by the main hospital unit. The opening times vary, but satellite units tend to be open only during the day. If problems with access or illness occur, then the patients are transferred to the hospital unit to be reviewed by a renal physician.

Anticipated costs

For an individual patient deemed eligible for home haemodialysis, this option is likely to be less costly to the NHS than hospital haemodialysis. It may be only slightly more costly than satellite haemodialysis, although this will depend upon the way care is delivered in the satellite unit and the inclusion of travel costs. Given the current level of demand for RRT, the increased adoption of home haemodialysis is unlikely to translate into any cost-savings. If, as expected, the number of patients accepted onto RRT continues to increase, then home haemodialysis offers an option for restricting increases in the RRT budget. If the cost of home haemodialysis per patient per year is £19,871, then increasing the number of patients receiving home haemodialysis from 2% to 3% for England and from 1% to 2% for Wales would increase NHS costs by £5,147,000 in England and £340,986 in Wales. These values represent an additional 260 patients treated by home haemodialysis in England and an additional 17 in Wales.

Chapter 2

Effectiveness

Methods for reviewing effectiveness

Search strategy

Electronic searches were conducted to identify published and unpublished studies on the clinical effectiveness and cost-effectiveness of haemodialysis carried out at home, compared with haemodialysis carried out in a hospital or satellite unit, for people with ESRF. The search terms were built upon those of a previous HTA review of methods of dialysis,[2] and involved the use of Medical Subject Headings (MeSH) as well as textword searching. The following databases were searched. The full details of each strategy are listed in appendix 2.

1. MEDLINE, 1966 to 5 October 2001; EMBASE, 1980 to week 46 of 2001; HealthSTAR, 1975 to 2000; CINAHL, 1982 to October 2001 (Ovid): Separate search strategies were developed for each database and then combined to produce a final strategy that was run concurrently on the four databases. Duplicates were removed from the resulting set using Ovid's de-duplicating feature. Running separate searches for each database would have resulted in 3669 hits, but the combined search, after de-duplication, resulted in 2949 hits.
2. PREMEDLINE (Ovid), 13 December 2001.
3. BIOSIS (Edina), 1985 to October 2001.
4. Science Citation Index (SCI; Web of Science), 1981 to October 2001.
5. The Cochrane Library (Issue 3, 2001): Within the Cochrane Library, the Cochrane Database of Systematic Reviews (CDSR), Cochrane Controlled Trials Register (CCTR), Database of Abstracts of Reviews of Effectiveness (DARE), NHS Economic Evaluation Database (NHS EED) and HTA database were searched.
6. National Research Register (NRR), Issue 3, 2001.
7. Health Management Information Consortium (HMIC), 1979 to 2001.
8. British Library Inside (December 2001).
9. National Library of Medicine (NLM) Gateway (http://www.gateway.nlm.nih.gov/gw/Cmd; accessed on 4 December 2001) was used to search Health Services Research (HSR) Meetings, HSRProj and Locatorplus.
10. Current Controlled Trials (http://www.controlled-trials.com/; accessed on 4 December 2001).
11. Clinical Trials (http://www.clinicaltrials.gov/ct/gui/c/r; accessed on 4 December 2001).
12. Department of Health (UK) Research Findings Register (ReFeR-DH; http://www.info.doh.gov.uk/doh/refr_web.nsf/Home?OpenForm; accessed on 4 December 2001).
13. World Wide Web was searched using the Northern Light search engine (accessed on 6 December 2001).
14. References of selected studies were checked.
15. SCI cited reference search (1981 to January 2002) was carried out for all studies selected for inclusion in the review.

Inclusion and exclusion criteria

All titles and abstracts identified by the above search strategies were assessed to identify potentially relevant items. For all potentially relevant items, full-text papers were then obtained and formally assessed independently by two researchers to check whether they met the inclusion criteria, using a study eligibility form developed for this purpose (appendix 3). Any disagreements that could not be resolved through discussion were referred to an arbiter. The following inclusion criteria were applied.

Types of study

Randomised controlled trials (RCTs), controlled clinical trials, comparative observational studies or systematic reviews were included. Reviews that did not describe how the studies included in the review were identified and synthesised (i.e. did not contain a methods section) were excluded. Studies in which no attempt was made to match or describe the sociodemographic characteristics and/or co-morbidity of the participant groups were excluded. With regard to observational studies, although initially it was our intention to include only prospective comparative observational studies, due to the limited data, this condition was subsequently relaxed to

also allow the inclusion of retrospective comparative observational studies. Studies reported in non-English languages were noted (appendix 4) but not included in the review.

Types of participants

Participants included people suffering from ESRF, except those for whom peritoneal dialysis was currently adequate. When data allowed, the patient population was split into four groups: adults by risk class (low, medium and high risk) and children.[1]

Types of intervention

For inclusion, the intervention comprised haemodialysis carried out at home compared with haemodialysis carried out in a hospital or satellite unit.

Types of outcomes

Primary outcomes were quality of life (QoL), hospitalisation rate, employment/school status, technique failure and access failure. Other outcomes were measures of anaemia, erythropoietin (EPO) use, biochemical indices of renal disease, dialysis adequacy, blood pressure, complications (including intradialytic complications) and mortality.

Data extraction strategy

A data abstraction form was developed (appendix 5) to record details of study designs, characteristics of participants, interventions and outcomes. The form was based on one used in a systematic review of methods of dialysis therapy.[2] Two reviewers extracted data independently. Any differences that could not be resolved through discussion were referred to an arbiter.

Quality assessment strategy

Two reviewers independently assessed the quality of the included studies. Any differences that could not be resolved through discussion were referred to an arbiter. The methodological quality of the systematic reviews was assessed by a previously validated 10-item checklist (appendix 6) developed by Oxman.[7,9] The checklist contained nine criteria, scored as 'yes', 'partially' or 'no', depending on the extent to which they had been met. There was also one summary criterion for overall scientific quality, scored on a scale of 1 to 7, with 1 indicating 'extensive flaws' and 7 indicating 'minimal flaws'.

The primary studies were assessed using a checklist (appendix 7) developed by Downs and Black.[10] The checklist was designed to assess the quality of both randomised and non-randomised studies, and contained 27 questions in total, covering the following subscales:

- reporting (ten questions)
- external validity (three questions)
- internal validity – bias (seven questions)
- internal validity – confounding (six questions)
- power (one question).

The checklist allowed an overall score for study quality to be reported, as well as scores for each of the subscales. Question 27 of the checklist (power) was simplified to just check whether the study had provided an indication of statistical power. A list of principal confounders and possible adverse events was developed (appendix 8) to provide information supplementary to questions 5 and 8 of the checklist. The maximum achievable scores within each subscale were: 11 for reporting, 3 for external validity, 7 for internal validity – bias, and 6 for internal validity – confounding, providing an overall maximum achievable score of 27.

Results

Quantity and quality of research available

Number of studies identified

The total numbers of potentially relevant studies identified by the systematic search are shown in *Table 2*. Elimination of duplicate records reduced the number of studies selected from 409 to 339. Forty-nine studies were non-English language and were noted but not included (appendix 4). Thus, 290 studies were selected for further assessment, and full-text articles were obtained if possible. An additional 28 articles were identified by scanning the reference lists of these papers. An SCI cited search was carried out for those articles that met the inclusion criteria, and a further 38 potentially relevant articles were identified. In total, therefore, 356 studies were selected for assessment. Full-text articles were assessed and excluded if they failed to meet the specified inclusion criteria in terms of study design, participants, interventions or outcomes.

Number and type of studies included

In total, 27 published studies met the inclusion criteria on effectiveness (*Table 3*). There were four systematic reviews,[11–14] one randomised crossover trial[15] and 22 comparative observational studies.[16–37] A list of the included studies with their associated references is given in appendix 9.

TABLE 2 *Databases searched, hits screened and full-text papers ordered*

Database searched	Number of hits screened	Number of studies selected
Multifile search (MEDLINE, HealthSTAR, EMBASE, CINAHL)	2949	212
PREMEDLINE	59	5
BIOSIS	218	34
SCI	479	72
The Cochrane Library		
CDSR	0	0
DARE	3	0
CCTR	57	0
HTA	14	2
NHS EED	55	18
NRR	17	2
HMIC	213	17
British Library Inside	241	22
NLM Gateway		
HSRProj	0	0
HSR Meetings	9	2
Locatorplus	23	6
Current Controlled Trials	0	0
Clinical Trials	1	1
ReFeR-DH	2	2
World Wide Web	3691*	14

* *Potentially relevant hits were screened*

TABLE 3 *Sources of references to included effectiveness studies*

Database	No. of studies
Ovid multifile search	23
SCI	2
BIOSIS	1
Reference lists	1
Total	27

Number and type of studies excluded

Forty-nine studies were non-English language and were noted but not included (appendix 4). The remaining 329 articles for which full-text papers were obtained were excluded because they failed to meet one or more of the specified inclusion criteria in terms of study design, participants, interventions or outcomes. It was not possible to obtain the two items selected from the search of the NRR because the authors could not be contacted.

Study quality, characteristics and evidence rating

Table 4 contains the results of the assessment of the four systematic reviews. In three reviews,[11,13,14] the search methods used to find evidence were stated. In all four reviews, the search for evidence was not completely comprehensive, in terms of the search methods employed. One review[13] reported the selection criteria for including studies (in terms of study design, participants, interventions and outcomes), while in the other three reviews this information was reported for some, but not all, of the selection criteria. Bias in the selection of articles was avoided in one review,[13] to the extent that explicit selection criteria were given and independent screening of full-text papers was done by at least two reviewers.

The criteria used for assessing the validity of the included studies were reported in one review.[13] Appropriate assessment of the validity of the studies included in the reviews (in terms of selection criteria applied or analysis of included studies) was done in one review.[13] Also, one review[13] reported the methods used to combine the findings of the included studies in order to reach a conclusion, while in another review[12] this information was only partially provided. In one review,[14] the findings of the included studies were combined appropriately (in relation to the homogeneity of participants, interventions and outcomes, comparability of settings, and treatment of unit-of-analysis errors), relative to the primary question the review addressed.

In three reviews,[12–14] the conclusions were supported by the data and/or the analysis reported; in the fourth review,[11] the conclusions were not entirely supported by the data and/or the analysis. Based on the extent to which the nine preceding items on the checklist had been met, out of an overall score from 1 (extensive flaws) to 7 (minimal flaws), one review[13] scored 5, one review[14] scored 4, and two reviews[11,12] scored 3 (appendix 10).

Table 5 contains the overall and subscale scores from the quality assessment of the 23 included primary studies. Appendix 10 contains the detailed scores for each of the primary studies.

The overall mean quality score for all primary studies was 12 (out of a possible 27). The mean

TABLE 4 *Quality assessment of included systematic reviews*

Oxman Quality Assessment Checklist for Systematic Reviews[9]	**Number of reviews meeting criteria**		
	Yes	**Partially**	**No**
1. Were the search methods used to find evidence (primary studies) on the primary question(s) stated?	3	0	1
2. Was the search for evidence reasonably comprehensive?	0	4	0
3. Were the criteria used for deciding which studies to include in the review reported?	1	3	0
4. Was bias in the selection of articles avoided?	1	0	3
5. Were the criteria used for assessing the validity of the studies that were reviewed reported?	1	0	3
6. Was the validity of all of the studies referred to in the text assessed using appropriate criteria (either in selecting studies for inclusion or in analysing the studies that are cited)?	1	0	3
7. Were the methods used to combine the findings of the relevant studies (to reach a conclusion) reported?	1	1	2
8. Were the findings of the relevant studies combined appropriately relative to the primary question the review addresses?	1	2	1
9. Were the conclusions made by the author(s) supported by the data and/or the analysis reported in the review?	3	1	0
10. Overall, how would you rate the scientific quality of this review? ***Overall score (item 10):*** 1 Extensive flaws; 2 (2 reviews); 3 Major flaws; 4 (1 review); 5 Minor flaws (1 review); 6; 7 Minimal flaws			

scores within each of the subscales were: reporting, 6 (out of a possible 11); external validity, 1 (out of a possible 3); internal validity – bias, 4 (out of a possible 7); and internal validity – confounding, 2 (out of a possible 6). One study provided an indication of statistical power.

The reporting subscale consisted of ten questions. In 22 studies (96%), the hypothesis or aim or objective was clearly described, and the main outcomes were clearly described in the introduction or methods section. Nine studies (39%) clearly described the characteristics of the participants, four studies (17%) clearly described the interventions, four studies (17%) clearly described the distribution of principal confounders, nine studies (39%) partially described the distribution of principal confounders, and 14 studies (61%) clearly described the main findings. Seventeen studies (74%) provided estimates of the random variability in the data for the main outcomes, two studies (9%) reported important adverse events that might be a consequence of the intervention, and 13 studies (57%) described the characteristics of participants lost to follow-up (or had no losses to follow-up or losses so small as not to affect the findings). Ten studies (43%) reported actual probabilities (e.g. 0.045 rather than < 0.05).

The external validity subscale consisted of three questions and attempted to address the representativeness of the findings of the study and whether they might be generalised to the population from which the participants were recruited. In five studies (22%), the people who were asked to participate in the study were representative of the entire population from which they were recruited. In four studies (17%), the people who were prepared to participate were representative of the entire population from which they were recruited. In 15 studies (65%), the staff, places and facilities where the participants were treated were representative of the treatment that the majority of people would have received.

The internal validity/bias subscale consisted of seven questions. In all 23 studies (100%), either the participants were not blinded to the intervention or the study did not indicate whether blinding of participants took place. However, it would be virtually impossible to blind participants to their modality of haemodialysis. In all 23 studies

TABLE 5 *Quality assessment of included primary studies*

Study	Reporting (maximum score, 11)	External validity (maximum score, 3)	Internal validity – bias (maximum score, 7)	Internal validity – confounding (maximum score, 6)	Overall score (maximum score, 27)	Indication score, power provided
Arkouche *et al.*, 1999[16]	6	2	5	2	15	No
Bremer *et al.*, 1989[17]	8	3	5	1	17	No
Capelli *et al.*, 1985[18]	7	1	5	4	17	No
Churchill, 1988[34]	4	0	4	1	9	No
Courts & Boyette, 1998[19]	8	0	5	2	15	No
Covic, 1998[20]	3	0	2	0	5	No
Freeman & Richards, 1979[35]	5	1	3	0	9	No
Hart & Evans, 1987[21]	7	1	4	1	13	No
Hellerstedt *et al.*, 1984[22]	5	2	2	4	13	No
Livesley, 1981[23]	2	1	3	1	7	No
Mailloux *et al.*, 1996[24]	7	3	5	4	19	No
McGee, 1981[25]	5	0	5	1	11	No
McGregor *et al.*, 2001[15]	10	0	5	3	18	Yes
Page & Weisberg, 1991[36]	6	1	4	2	13	No
Piltz-Kirkby & Fox, 1982[37]	6	0	5	0	11	No
Price *et al.*, 1978[26]	3	1	3	2	9	No
Reichwald-Klugger *et al.*, 1984[27]	7	0	5	0	12	No
Rubin *et al.*, 1989[28]	6	1	3	3	13	No
Schreiber & Huber, 1985[29]	0	0	2	2	4	No
Soskolne & De Nour, 1987[30]	7	1	5	0	13	No
Westlie *et al.*, 1984[31]	8	1	4	2	15	No
Williams *et al.*, 1983[32]	3	2	4	3	12	No
Woods *et al.*, 1996[33]	7	3	5	2	17	No
Overall mean score	6	1	4	2	12	

(100%), the staff measuring the main outcomes of the intervention were not blinded or the study did not indicate whether blinding took place. No study was deemed to have reported retrospective unplanned subgroup analyses. In 13 studies (57%), the analyses adjusted for different lengths of follow-up of participants or follow-up was the same for all study participants. Eighteen studies (78%) used appropriate statistical tests to assess the main outcomes. In 18 studies (78%), compliance with the intervention was deemed to be reliable; and in 21 studies (91%), the main outcome measures used were deemed to be valid and reliable.

The internal validity/confounding (selection bias) subscale consisted of six questions. Information was given in 12 studies (52%) to indicate that the participants in different intervention groups were recruited from the same population, and information was given in eight studies (35%) to indicate that they were recruited over the same period of time. One study (4%) randomised the participants to intervention groups, but the authors did not indicate whether the randomised intervention assignment was concealed from patients and healthcare staff until recruitment was complete. In ten studies (43%), there was adequate adjustment for confounding in the analyses from which the main findings were drawn or confounding was taken into account in the analyses. In nine studies (39%), losses of participants to follow-up were taken into account or the proportion lost to follow-up was too small to affect the main findings of the study.

In summary, the quality of the studies was variable in terms of reporting, with generally low external validity, better internal validity in terms of preventing bias, but low internal validity in terms of preventing confounding of participant groups. Within the reporting subscale, the vast majority of studies clearly described the hypothesis/aim/objective and main outcomes, but most did not clearly describe the intervention or the

characteristics of patients lost to follow-up. Although the studies had generally low external validity in terms of participant representativeness, in the majority the participants were treated by staff in places and facilities that were representative of the treatment that most people in the source population would have received. The scores for most studies on the internal validity (bias) subscale tended to be slightly better, although the overall mean score was still low. Given the nature of the interventions considered and the fact that the included studies contained only one randomised trial, it was not surprising that blinding of participants or of staff measuring the outcomes either did not occur or could not be determined from the studies – certainly blinding of participants would not have been possible. Most of the studies possessed low internal validity in terms of preventing confounding of participants, which was partly a consequence of the lack of RCTs. In addition, the majority of studies neither indicated whether the participants in the different intervention groups had been recruited over the same period of time, nor reported losses to follow-up.

Characteristics of included studies

Appendix 11 provides details of the characteristics of the included studies (study design, participants, interventions and outcomes). In terms of study design, four studies were systematic reviews, one study was a randomised (crossover) trial, and 22 studies were comparative observational studies.

Of the 23 primary studies (i.e. not systematic reviews), one compared home haemodialysis with both hospital and 'self-assisted' hospital haemodialysis (self-assisted hospital haemodialysis for the purposes of this review is defined as akin to satellite unit haemodialysis),[17] 19 compared home with hospital haemodialysis, and three compared home with satellite unit haemodialysis.[16,28,35] Many patients are dialysed in hospital renal units or large dialysis centres that may, or may not, be attached to hospitals. For the purposes of this monograph, we will refer to them as hospital dialysis patients. In 13 studies (57%), the comparison groups were not restricted to just home and hospital or satellite unit haemodialysis, but also included other modalities (e.g. CAPD and renal transplantation). Fourteen studies took place in the USA, two each in Canada, Germany and the UK, and one each in France, Israel and New Zealand. Ten studies provided information on the time period in which they were carried out; of these studies, the earliest start date given was November 1964, while the latest end date given was December 1997. Three studies provided information on the length of follow-up of participants, which ranged from 1 year[24,33] to 6 years.[32]

In the included studies, the number of people on home or hospital/satellite unit haemodialysis ranged from nine to 3172; 11 studies had less than 100 participants. The total number of people on home haemodialysis was 1760, while the total number on hospital haemodialysis was 8380, and the total number being dialysed in satellite units was 1258. The number of people on home haemodialysis was much less than those undergoing hospital haemodialysis, reflecting the standard selection procedure. Four studies reporting QoL included as participants the spouses/partners/significant others of those undergoing haemodialysis.[25,29,30,36] In one study,[25] the participants consisted of only the spouses of home and hospital haemodialysis patients.

In total, 21 studies gave details of participants' ages. Three studies, however, gave only the mean age of the participant group as a whole,[16,23,26] and a fourth merely stated that the age distribution was similar between the groups.[20] Across studies, the mean ages of people on home haemodialysis ranged from 12.1 years[27] to 74.5 years,[31] compared with 14.1 years[27] to 75.2 years[31] for hospital haemodialysis, and 46 years[35] to 54.5 years[17] for satellite unit haemodialysis. One study[27] focused on children/adolescents (mean age of home dialysis group, 12.1 years; mean age of hospital dialysis group, 14.1 years), and one study[31] focused on people aged 70 years or older (mean age of home dialysis group, 74.5 years; mean age of hospital dialysis group, 75.2 years).

When data allowed, the patient population was split into four groups: adults by co-morbidity risk groups (low, medium and high risk) and children. Adults were classed as: low risk if they were less than 70 years of age and had no co-morbid illness; medium risk if they were aged 70–80 years, or any age with one co-morbid illness, or less than 70 years with diabetes; or high risk if they were greater than 80 years of age, or any age with two co-morbidities, or any age with visceral cancer.[1] Generally, studies provided only the mean age and range of ages for each participant group as a whole and stated the percentage of each group with specific co-morbid conditions, without identifying at-risk categories within each participant group separately throughout the study. However, six studies did provide outcome information in relation to specific risk groups.[15,18,22,27,31,33]

Four studies[18,19,27,30] gave details of the number of men and women in each of the participant groups; one of these was a small study in which the home and hospital participant groups were totally comprised of men.[19] Five studies provided only the percentages of men and women for each of the participant groups.[17,21,28,33,37] Another study merely stated that the gender distribution was similar between the groups.[20] Four studies gave only numbers of men and women for the overall participant group.[16,23,26,36] Another study provided only the percentages of men and women for the overall participant group.[32] In total, there were at least 482 men and 287 women undergoing home haemodialysis, at least 2035 men and 1873 women undergoing hospital dialysis, and at least 509 men and 486 women undergoing dialysis in a satellite unit.

In all, 11 studies reported on the ethnicity of the participants. Based on the information provided, the studies contained participants whose ethnicity was described as white (at least 3102 patients), black (at least 1118), Native American (two), Oriental (two), Jewish (58), Polynesian (one) and non-white/other (1389). In the majority of the studies, the ethnicity of the home dialysis and hospital dialysis participant groups was predominantly white, with the exception of the small study by Courts and Boyette.[19] In the study by Rubin and colleagues comparing home with satellite unit haemodialysis,[28] the ethnicity of the satellite unit participant group was predominantly black. In the study by Soskolne and De Nour,[30] the ethnicity of all participants was Jewish.

Six studies with survival as an outcome employed the Cox proportional hazards regression model (Arkouche and colleagues,[16] Capelli and colleagues,[18] Mailloux and colleagues,[24] Rubin and colleagues,[28] Williams and colleagues,[32] and Woods and colleagues[33]). Of these six studies, two compared home with satellite unit haemodialysis,[16,28] while four compared home with hospital haemodialysis.[18,24,32,33] The Cox model is a regression technique that can be used to statistically adjust for differences in baseline characteristics between groups that are being compared. As with other survival techniques such as the Kaplan–Meier procedure, it allows for censoring of survival times due to withdrawal or transfer to another therapy. The Cox model provides a relative hazard ratio for a given factor compared with a reference value. For example, if hospital haemodialysis had a hazard ratio of 1.00 (reference value) and home haemodialysis had a hazard ratio of 1.20, then this would mean that the death rate was 20% higher for home haemodialysis compared with hospital dialysis. Conversely, a hazard ratio of 0.80 for home haemodialysis would mean a 20% lower risk of death compared with hospital dialysis.

Arkouche and colleagues[16] compared home (n = 231) with satellite unit (n = 240) haemodialysis. They used the Cox model to determine the hazard ratio for the following co-variates: modality of dialysis (satellite unit as reference), age (≤ 34 years as reference, versus 35–44, 45–54, 55–64 and ≥ 65 years), sex (female as reference), causes of end-stage renal disease (ESRD; chronic glomerulonephritis as reference, versus other, unknown, vascular and diabetes), and period of the start of haemodialysis (1986–90 as reference, versus 1974–80, 1981–85 and 1991–97). No co-variates involving the process of treatment appear to have been included in the model, although frequency and duration of sessions (4–6 hours, 3 times per week), type of dialyser, dialysate flow rate, blood flow rate and dialysis composition appear to have been the same for both modalities.

Rubin and colleagues[28] also compared home (n = 150) with satellite unit (n = 954) haemodialysis. They included the following co-variates in their model: modality of dialysis (home as reference), age at start of dialysis (by 20-year difference, e.g. 60 versus 40 years), race (black as reference), sex (male as reference), marital status (married as reference), and joint effects of causes of ESRD (hypertension as reference versus chronic glomerulonephritis, hypertension as reference versus chronic interstitial nephritis, and type 2 diabetes mellitus as reference versus chronic interstitial nephritis). No co-variates involving the process of treatment were included in the model, although frequency and duration of sessions (4 hours, 3 times per week) appear to have been the same for both modalities.

Capelli and colleagues[18] compared home (n = 64) with hospital (n = 276) haemodialysis. They included the following co-variates in their model: modality of dialysis, age, race, sex, diabetic status and the date started on haemodialysis treatment. However, the Cox model was not clearly explained. No co-variates involving the process of treatment were included in the model, although frequency and duration of sessions (4–5 hours, 3 times per week) appear to have been the same for both modalities.

Mailloux and colleagues[24] compared home (n = 74) with hospital (n = 687) haemodialysis.

Initially, a number of variables that were believed to affect survival were entered into the Cox model, and non-significant factors were identified and removed using a backward elimination process. The following co-variates were included in the model: modality of dialysis (reference modality unclear), age (≥ 61 years as reference, versus ≤ 40 years and 41–60 years), race (black/other as reference, versus white), causes of ESRD (hypertension/tubulointerstitial diseases/chronic glomerulonephritis/adult polycystic kidney disease as reference, versus diabetes mellitus, renal vascular disease and other), and risk factors (hypertension, pre-existing cardiac disease and low serum albumin, with the absence of these co-morbidities as reference). No co-variates involving the process of treatment appear to have been included in the model, and frequency and duration of dialysis sessions were not reported for either modality.

Williams and colleagues[32] compared home (n = 261) with hospital (n = 1560) haemodialysis. They included the following co-variates in their model: modality of dialysis (hospital as reference), age, and the interaction between age and the treatment group. No co-variates involving the process of treatment appear to have been included in the model, and frequency and duration of dialysis sessions were not reported for either modality.

Woods and colleagues[33] compared home (n = 70) with hospital haemodialysis (n = 3102). They included the following co-variates in their model: modality of dialysis (hospital as reference), age (for each additional 10 years), whether on active insulin therapy (reference was patients without this factor), co-morbidities (arrhythmia, chronic obstructive pulmonary disease [COPD], congestive heart failure, myocardial infarction, peripheral vascular disease, obesity, stroke – for each of these, the reference was patients without this factor), and also whether an active smoker, less than 12 years of education, unable to eat independently, unable to transfer independently or unable to walk independently – for each of these, the reference was patients without this factor. No co-variates involving the process of treatment appear to have been included in the model, and frequency and duration of dialysis sessions were not reported for either modality.

Tabulation of results

The results of the studies are given in appendix 12. All p-values are those reported by the authors.

Discussion of results

Sixteen studies reported on QoL.[12–14,17,19,21,23,25,27,29–31,33,34,36,37] The QoL instruments used included the Haemodialysis Stressor Scale, Clinical Anxiety Scale, Psychosocial Adjustment to Illness Scale (PAIS), Sickness Impact Profile (SIP), Karnofsky Scale, Short Form with 36 items (SF-36), Middlesex Hospital Questionnaire, Nottingham Health Profile, Beck Depression Inventory, Kidney Disease Quality of Life (KDQOL), Time Trade-Off (TTO), Family Environment Scale (FES), Marital Attitudes Evaluation (MATE) Scale, Campbell's Index of Well-Being, General Affect Scale and Index of Overall Life Satisfaction.

Two studies provided information on hospitalisation rates.[12,17] Six studies provided information on employment status,[14,17,19,21,30,37] and one reported school status.[27] One study gave details of technique survival (the time that a person remains on a particular form of RRT).[28] Three studies reported measures of anaemia, with one reporting haemoglobin levels,[20] while two reported haematocrit.[15,31] Three studies provided information on EPO use.[12,15,16] Four studies reported biochemical indices of renal disease,[15,31,33,35] including calcium, albumin, phosphate, potassium and alkaline phosphatase. Three studies reported dialysis adequacy in terms of Kt/V (fractional urea clearance).[15,20,33] Two studies provided details of blood pressure measurements,[15,31] including pre- and postdialysis blood pressure measured standing and supine. Two studies gave details of adverse events,[15,31] including hypotension, vomiting, cramps, arrhythmia and headaches. Nine studies provided information on mortality/survival,[11,16,18,22,24,26,28,32,33] including median survival times and survival rates at 1, 5, 10 and 20 years.

Sociodemographic characteristics and co-morbidities were not evenly balanced between the participant groups, thereby potentially confounding the results. Six studies with survival as an outcome attempted to adjust for this imbalance by using the Cox proportional hazards regression model.[16,18,24,28,32,33] The risk factors that the six studies included in their Cox models appeared to be appropriate, for example, age at the start of treatment, presence of diabetes, causes of ESRD and co-morbidities, although not all studies included these factors to the same extent. However, none of the studies appeared to have incorporated co-variates associated with the process of treatment in their Cox models, for example, the duration and frequency of dialysis. If such co-variates are not considered and

differences between groups exist but are not taken into account, then it is possible that the study results will reflect the combination of modality, case mix and also treatment characteristics, rather than modality and case mix alone. A prospective RCT would be required to truly determine the effectiveness of home haemodialysis compared with hospital or satellite unit dialysis, independent of other factors.

Assessment of effectiveness

Critical review and synthesis of information

Twenty-two of the 27 included studies were observational studies. In observational studies, the intervention is not randomly allocated, wherefore the results can be affected by biases inherent in the allocation of the participants, with the risk of uneven distribution of known and unknown confounders. Because home haemodialysis is generally undertaken by patients who are highly selected, a deliberate allocation bias exists with regard to this group. An additional source of heterogeneity is that the indications for home haemodialysis may have altered over the period during which the included studies were published. A meta-analysis was not undertaken, in order to avoid generating a spuriously precise overall estimate of effect around results that might be potentially biased.

Although a number of studies gave details of the distribution of co-morbidities between the participant groups,[17–19,21,22,24,28,31,33,36] in no study were all co-morbidities approximately balanced between groups. Generally, the percentage of home haemodialysis participants with specific co-morbidities was lower than the percentage of people in the hospital/satellite unit group with those co-morbidities, introducing further potential for confounding. *Table 6* summarises the baseline characteristics of the primary studies, including those participants with diabetes. In two studies,[15,20] including the only RCT, people with co-morbidities were excluded, thus reducing the studies' external validity.

In many studies, the intervention was poorly described in terms of the equipment used and the duration and frequency of dialysis. Five studies provided information on the type of equipment used.[15,16,18,28,35]

Duration and frequency of dialysis

Nine studies provided information on the frequency and/or duration of dialysis sessions (*Table 7*), six comparing home with hospital haemodialysis[12,15,18,20,24,27] and three comparing home with satellite unit haemodialysis.[16,28,35] In five studies, the duration and/or frequency of dialysis was greater for home dialysis than for hospital/satellite dialysis;[12,15,20,24,27] and in four studies, the duration was the same for both comparison groups.[16,18,28,35] In one study, the duration of dialysis was given for the home dialysis group only.[24] In four studies, the frequency of dialysis was not stated;[20,24,27,35] and in four studies, frequency was the same for both groups, at 3 times per week.[15,16,18,28]

Of the five studies in which the duration and/or frequency of dialysis was greater for home haemodialysis compared with hospital dialysis, Covic[20] reported higher mean haemoglobin values for the home dialysis group. Mailloux and colleagues[24] reported better survival rates for the home dialysis group. McGregor and colleagues,[15] in a randomised crossover trial, reported higher calcium levels, lower phosphate levels and better blood pressure control for the home dialysis group. Reichwald-Klugger and colleagues,[27] in a QoL study, reported that the social contacts of the children in the home dialysis group were disrupted less, but the social contacts of their parents were disrupted more, compared with the hospital group. A systematic review by Mohr and colleagues[12] reported improved QoL outcomes for the daily/nocturnal dialysis groups, as well as a reduction in hospital inpatient days, when compared with standard dialysis.

Of the four studies in which the duration and/or frequency of haemodialysis was the same for both participant groups, one study compared home with hospital dialysis[18] and three compared home with satellite unit dialysis.[16,28,35] Capelli and colleagues[18] reported better survival rates for the home dialysis group compared with the hospital group. Arkouche and colleagues[16] reported that survival was comparable between the home and satellite unit dialysis groups. Rubin and colleagues[28] reported a lower mortality rate for the home dialysis group, although the satellite unit group had a longer median technique survival time. Freeman and Richards[35] reported higher alkaline phosphatase values for the home dialysis group compared with the satellite unit group.

In summary, the duration and frequency of dialysis sessions were either greater for those patients undergoing home haemodialysis compared with hospital/satellite unit dialysis, or the same for each treatment modality. People receiving home haemodialysis are a highly selected group, and in general the outcomes

TABLE 6 *Summary of the baseline characteristics in the primary studies*

Study	Comparators (haemodialysis modality)	Number of participants	Age (years)*	Men (%)	Participants (%) with diabetes mellitus
Arkouche *et al.*, 1999[16]	Home	231	NS	NS	NS
	Satellite	240	NS	NS	NS
Bremer *et al.*, 1989[17]	Home	47	53	51	4
	Satellite†	41	55	54	5
	Hospital	105	57	51	16
Capelli *et al.*, 1985[18]	Home	64	44	69	5
	Hospital	276	52	62	15
Churchill, 1988[34]	Home	36	NS	NS	8
	Hospital	38	NS	NS	10
Courts & Boyette, 1998[19]	Home	5	48	100	20
	Hospital	5	48	100	NS
Covic, 1998[20]	Home	33	NS	NS	NS
	Hospital	84	NS	NS	‡
Freeman & Richards, 1979[35]	Home	29	NS	NS	NS
	Satellite	23	NS	NS	NS
Hart & Evans, 1987[21]	Home	287	47	64	8
	Hospital	347	52	50	10
Hellerstedt *et al.*, 1984[22]	Home	188	62	NS	21
	Hospital	1799	53	NS	30
Livesley, 1981[23]	Home	51	NS	NS	NS
	Hospital	34	NS	NS	NS
Mailloux *et al.*, 1996[24]	Home	74	44 (median)	69	4
	Hospital	687	59 (median)	NS	22
McGee, 1981[25]	Home	28	NS	NS	NS
	Hospital	22	NS	NS	NS
McGregor *et al.*, 2001[15§]	Home	9	48	44	‡
	Hospital				
Page & Weisberg, 1991[36]	Home	NS	NS	NS	NS
	Hospital	NS	NS	NS	NS
Piltz-Kirkby & Fox, 1982[37]	Home	24	NS	NS	NS
	Hospital	25	NS	NS	NS
Price *et al.*, 1978[26]	Home	93	NS	NS	NS
	Hospital	166	NS	NS	NS
Reichwald-Klugger *et al.*, 1984[27]	Home	10	12	70	NS
	Hospital	10	14	50	NS
Rubin *et al.*, 1989[28]	Home	150	38	53	4
	Satellite	954	52	51	65
Schreiber & Huber, 1985[29]	Home	132	NS	NS	NS
	Hospital	137	NS	NS	NS
Soskolne & De Nour, 1987[30]	Home	29	53	86	NS
	Hospital	29	54	86	NS
Westlie *et al.*, 1984[31]	Home	26	75	NS	12
	Hospital	53	75	NS	11
Williams *et al.*, 1983[32]	Home	261	51	NS	NS
	Hospital	1560	NS	NS	NS
Woods *et al.*, 1996[33]	Home	70	49	60	14
	Hospital	3102	59	51	30

* *Age is given as the mean, unless otherwise stated*
† *For the purposes of this review, self-care hospital dialysis was defined as being akin to satellite unit dialysis*
‡ *Patients with diabetes mellitus were excluded from the study*
§ *Randomised crossover trial*

TABLE 7 *Studies reporting duration and frequency of haemodialysis*

Study	Duration and frequency		
	Home haemodialysis	**Hospital haemodialysis**	**Satellite haemodialysis**
Arkouche *et al.*, 1999[16]	4–6 hours, 3 times per week		4–6 hours, 3 times per week
Capelli *et al.*, 1985[18]	4–5 hours, 3 times per week	4–5 hours, 3 times per week	
Covic, 1998[20]	8 hours	4 hours	
Freeman & Richards, 1979[35]	6 hours		6 hours
Mailloux *et al.*, 1996[24]	Minimum of 15 hours per week	NS	
McGregor *et al.*, 2001[15]	6-8 hours, 3 times per week	3.5–4.5 hours, 3 times per week	
Mohr *et al.*, 2001[12]	1.5–2 hours (short daily) or 6–10 hours (nocturnal), 5–7 times per week	Average of 3.5 hours, 3 times per week	
Reichwald-Klugger *et al.*, 1984[27]	Average of 7 hours	Average of 4.3 hours	
Rubin *et al.*, 1989[28]	Average of 4 hours, 3 times per week	Average of 4 hours, 3 times per week	

examined by the studies tended to favour the home dialysis group. Rubin and colleagues,[28] however, reported a longer median technique survival for the group undergoing dialysis in a free-standing facility (satellite unit). Also, Reichwald-Klugger and colleagues[27] reported that the social contacts of parents of the home dialysis group were disrupted more than those of parents of the hospital group. It should be noted that, in some of the above studies,[12,15,20,35] the primary comparison was of different duration/frequencies of haemodialysis or of different types of dialysis systems, rather than specifically of home haemodialysis versus hospital or satellite unit haemodialysis. However, the home setting was the most appropriate one for longer, more frequent or overnight dialysis to take place.

Outcomes

The primary outcomes for this review were QoL, hospitalisation rate, employment/school status, technique failure and access failure. Other outcomes included measures of anaemia, EPO use, biochemical indices of renal disease, dialysis adequacy, blood pressure, adverse events and mortality. Although access failure was not referred to in any of the included studies, all the other outcomes were reported to a greater or lesser extent. Information on adverse events is given at the end of this chapter.

Quality of life

Sixteen studies, using a variety of instruments, reported the QoL of people undergoing haemodialysis. Appendix 12 details the results of the studies, while *Table 8* gives a brief summary of the instruments used or area investigated. The information provided fell into three broad categories: general QoL measures, QoL measures relating to haemodialysis, and psychosocial QoL measures.

General QoL measures

Seven primary studies[17,21,31,33,34,36,37] and two systematic reviews[12,14] reported general QoL measures comparing home with hospital haemodialysis; one study[17] also included satellite unit dialysis within the comparison. Of the primary studies, three (Bremer and colleagues,[17] Westlie and colleagues,[31] and Woods and colleagues[33]) had overall quality assessment scores of 14 or above, three had scores of 10–13 (Hart and Evans,[21] Page and Weisberg,[36] and Piltz-Kirkby and Fox[37]), and one had a score of less than 10 (Churchill[34]).

The primary studies with a quality assessment score of 14 or above generally reported better outcomes for people undergoing home haemodialysis. Bremer and colleagues[17] found that, in general, patients on home haemodialysis ($n = 47$) reported better outcomes for both objective and subjective QoL when compared with patients on 'self-care' hospital dialysis (defined for the purposes of this review as akin to dialysis in a satellite unit; $n = 41$) and compared with those on 'staff-assisted' hospital dialysis ($n = 105$). The authors used questionnaires containing demographic, medical and QoL measures derived from various other instruments.

TABLE 8 *Studies reporting QoL measures*

Study	Instrument used/area focused on
Bremer *et al.*, 1989[17]	Objective/subjective QoL measures
Cameron *et al.*, 2000[13]	Emotional distress/psychological well-being
Churchill, 1988[34]	TTO
Courts & Boyette, 1998[19]	Haemodialysis Stressor Scale, Clinical Anxiety Scale, Generalised Contentment Scale, PAIS
Hart & Evans, 1987[21]	SIP, Karnofsky Scale, Index of Well-Being, Index of Psychological Affect, Overall Life Satisfaction Scale
Livesley, 1981[23]	Middlesex Hospital Questionnaire
McGee, 1981[25]	Pless and Satterwhite instrument
Mohr *et al.*, 2001[12]	SIP, SF-36, Nottingham Health Profile, Beck Depression Inventory, KDQOL, Dialysis-Related Symptoms
Page & Weisberg, 1991[36]	FES, MATE Scale
Parsons & Harris, 1997[14]	Campbell's Index of Well-Being, General Affect Scale, Overall Life Satisfaction Scale, Karnofsky Scale
Piltz-Kirkby & Fox, 1982[37]	Home environmental support
Reichwald-Klugger *et al.*, 1984[27]	Fear and stress factors
Schreiber & Huber, 1985[29]	Psychological well-being
Soskolne & De Nour, 1987[30]	PAIS, BSI
Westlie *et al.*, 1984[31]	Karnofsky Scale
Woods *et al.*, 1996[33]	Functional ability

Objective QoL measures included hours of care per week, hours of sleep per night, number of activities given up, level of pain, days since intercourse, days since orgasm and whether more tired. Subjective QoL measures included positive affect, negative affect, affect balance, general affect, well-being, overall life, hard/easy, tied down/free and helpless/independent. Home dialysis patients also generally scored higher than satellite unit (self-care hospital) dialysis patients or staff-assisted hospital dialysis patients on a range of satisfaction measures (standard of living, friends, sex life, health, religion, marriage and children).

Westlie and colleagues[31] compared various aspects of the life satisfaction and physical performance (modified Karnofsky Scale) of patients aged 70 years or over undergoing home haemodialysis ($n = 26$) and hospital dialysis ($n = 53$). When at home and off dialysis, a higher percentage of home dialysis patients than hospital dialysis patients were satisfied with the social contact with their family (100% versus 92.3%, respectively) and friends (85.4% versus 83%). Home dialysis patients had less of a desire for transplantation (30.8% versus 50.9%) and were less likely to have considered stopping all treatment (3.9% versus 5.7%). Home dialysis patients were more likely to be outdoors when off dialysis (92.3% versus 83%), participate in church activities (76.9% versus 39.6%), engage in active hobbies (73.1% versus 56.6%) and cook their own meals (57.7% versus 41.5%). On a scale of 1 to 6 (0 = definitely not, 6 = very much), home dialysis patients on average scored higher on enjoyment of life (5.38 versus 5.09). On a scale of 1 to 5 (1 = much worse, 5 = much better), home dialysis patients rated their perceived health (compared to others their age) higher than did hospital dialysis patients (3.73 versus 3.09). When physical performance was measured according to a modified Karnofsky Scale, 46.1% of home dialysis patients had no complaints and experienced almost normal activity, compared with 30.2% of hospital patients.

Woods and colleagues[33] compared 70 home haemodialysis patients (who were in training for home haemodialysis, either at home or in a dialysis unit, 30 days after onset of ESRD) with 3102 patients who were being dialysed in hospital 30 days after onset of ESRD. A higher percentage of those in training for home dialysis were unable to eat independently compared with those being dialysed in hospital (2.9% versus 2.3%, respectively), while a higher percentage

of hospital dialysis patients were unable to transfer independently (8.6% versus 9.2%) and walk independently (4.3% versus 9.3%).

The findings of the primary studies with a quality assessment score of 10–13 also generally favoured the home haemodialysis group. Hart and Evans[21] compared home (n = 287) with hospital (n = 347) haemodialysis. They reported that the home haemodialysis group achieved better scores than the hospital group in all categories of the SIP instrument (sleep and rest, emotional behaviour, body care and movement, home management, mobility, social interaction, ambulation, alertness behaviour, communication, work, recreation and pastimes, and eating). With regard to objective indicators of QoL, more of the home dialysis group were able to work (54.8% versus 44.8%), and they had better mean scores on the Index of Well-Being (11.23 versus 10.56), Index of Psychological Affect (5.47 versus 5.09) and Index of Overall Life Satisfaction (5.25 versus 4.99). When functional ability was measured according to the Karnofsky Scale, 59.1% of the home dialysis group had no complaints and experienced almost normal physical activity, compared with 44.7% of the hospital group.

Page and Weisberg,[36] in a comparison of home with hospital haemodialysis involving a total of 42 patients (and also 37 partners), employed the FES and MATE scales. The FES contains 100 items, with the respondent describing their family based on three basic dimensions of relationship, personal growth and systems maintenance. The MATE Scale contains 45 items and evaluates several dimensions of close relationships. The results of the FES showed that the families of home dialysis patients were seen as being more encouraging of direct expression of feelings, although less active in recreational pursuits, compared with families of hospital dialysis patients. The MATE results showed that the hospital group patients and their partners demonstrated, on all subscales, higher levels of marital relationship dissatisfaction than the home group.

Piltz-Kirkby and Fox,[37] in a study comparing home (n = 24) with hospital (n = 25) haemodialysis, measured QoL in terms of home environmental support with a questionnaire addressing three aspects of support systems, described as information-giving, material aid and services, and emotional support. The questionnaire combined two scales, the first of which measured the importance that the respondent placed on a given statement about health, care or support, and the second of which measured the respondent's satisfaction with that statement. The authors reported that the home dialysis group had a higher level of emotional support than the hospital group. Both 'importance' and 'satisfaction' measures were significantly higher in the home group on the following aspects: family interest and concern for the patient undergoing dialysis, availability of services from the family when needed, trust and confidence of the patient in their dialysis assistant, dialysis assistant's interest and concern for the patient, and availability of people with whom to discuss medical and technical concerns.

The primary study with a quality assessment score of less than 10 also favoured home haemodialysis. Churchill[34] reported that the home haemodialysis group (n = 36), when compared with the hospital group (n = 38), scored higher on the TTO scale (0.49 versus 0.43, respectively). The TTO score is the ratio between the years of full health considered equivalent to a lifetime of ESRD and the expected lifetime with ESRD. The TTO scale ranges from 0 to 1, with 0 equivalent to death and 1 equivalent to full health.

Two systematic reviews also reported general QoL measures. Mohr and colleagues[12] compared nocturnal or short daily haemodialysis with conventional hospital haemodialysis 3 times per week, reporting on the effect on patients' QoL of daily dialysis compared with conventional dialysis or participant baseline data. (The review did not explicitly state whether nocturnal or short daily dialysis was carried out at home.) Statistically significant findings were summarised from four studies in which a variety of instruments were used (SF-36, Nottingham Health Profile, SIP, Beck Depression Inventory, KDQOL ESRF-targeted areas and Dialysis-Related Symptoms). The authors concluded that the evidence on improved QoL with daily dialysis was convincing, despite the limitations in study designs, the use of diverse instruments and small sample sizes.

A systematic review by Parsons and Harris[14] reported that, based on the study by Evans and colleagues[38] (see appendix 9, *List of included studies*), people on home haemodialysis scored higher than those on hospital dialysis on the (case mix-adjusted) Campbell Index of Well-Being (11.2 versus 10.6, respectively), General Affect Scale (5.5 versus 5.1), Overall Life Satisfaction Scale (5.3 versus 5.0) and (case mix-adjusted) Karnofsky Scale (73.7 versus 71.5). The Campbell Index of Well-Being ranges from 2.1 to 14.7, with

a higher score indicating greater well-being. The General Affect Scale ranges from 1 to 7, with a higher score indicating better general affect, and the Index of Overall Life Satisfaction also ranges from 1 to 7, with a higher score indicating greater satisfaction. The Karnofsky Scale ranges from 0 (dead) to 100 (full ability to carry out normal activity).

QoL measures relating to haemodialysis

Three primary studies[19,25,27] comparing home with hospital haemodialysis reported QoL measures specifically relating to haemodialysis. Of the three studies, one (Courts and Boyette[19]) had an overall quality assessment score of 14 or above, and the other two (McGee[25] and Reichwald-Klugger and colleagues[27]) had scores of 10–13.

The small study by Courts and Boyette[19] reported that the home haemodialysis group ($n = 5$) achieved better mean scores than the hospital group ($n = 5$) on the Haemodialysis Stressor Scale (20.4 versus 63.8, respectively). This scale was developed to assess the type and extent of stress factors perceived by people on haemodialysis. It consists of a 4-point scale and items relating to dialysis equipment, treatment discomfort and boredom, with a higher score indicating a higher level of stress.

McGee,[25] through structured interviews with the spouses of 28 people being dialysed at home and 22 being dialysed in hospital, investigated areas such as satisfaction with the location of dialysis, resentment of dialysis, marital happiness, dependence on spouse, and family functioning (measured by the Pless and Satterwhite instrument). The author reported that a lower proportion of spouses of home dialysis patients were satisfied with the location of dialysis than the spouses of hospital dialysis patients (74.1% versus 95.2%), and more spouses of home dialysis patients felt that their partners were dependent on them (100% versus 77.3%). Proportionally fewer happily married spouses of home dialysis patients resented dialysis than those who were unhappily married (25% versus 87.5%), while more happily married spouses of hospital dialysis patients resented dialysis than those who were unhappily married (38% versus 25%).

In the Reichwald-Klugger study[27] of psychosocial adaptation to haemodialysis, children being dialysed at home ($n = 10$) and their parents were compared with children being dialysed in hospital ($n = 10$) and their parents. The authors developed interview guides, based on a catalogue of variables they composed covering various aspects of the daily life of children on haemodialysis. They summarised the burdens of the children in terms of the fears of, and stress caused by, 24 complications possibly occurring during dialysis. The complication feared most by children who were dialysed at home was coagulation in the dialyser or tubing system, although the complications that caused them the most stress were infection at the shunt site and trauma to the shunt. The complication feared most by children who were dialysed in hospital was disappearance of the shunt/fistula murmur, and the complications that caused them most stress were infection at the shunt site and trauma to the shunt. The two stress factors caused by dialysis that were mentioned most frequently by both home and hospital dialysis patients were attachment to the artificial kidney and puncture of the fistula. With regard to long-term changes in social contacts, home dialysis disrupted the social contacts of three out of eight children and all their parents, while hospital dialysis disrupted the social contacts of eight out of ten children but only two of ten sets of parents.

Psychosocial measures of QoL

Four primary studies[19,23,29,30] and one systematic review[13] comparing home with hospital haemodialysis reported psychosocial measures of QoL. Of the primary studies, one (Courts and Boyette[19]) had an overall quality assessment score of 14 or above, one (Soskolne and De Nour[30]) had a score of 10–13, and two (Livesley[23] and Schreiber and Huber[29]) had scores of less than 10.

The small study by Courts and Boyette[19] of five men on home haemodialysis and five men on hospital dialysis reported that the home dialysis patients all achieved better mean scores (lower scores are considered better) on the Clinical Anxiety Scale (10.4 versus 30.6), Generalised Contentment Scale (20.4 versus 41.2) and PAIS Self Report (46.6 versus 68.2).

Soskolne and De Nour[30] interviewed 29 home haemodialysis patients and 29 hospital haemodialysis patients and their spouses on issues concerning psychosocial adjustment to dialysis. In addition to the interviews, the Brief Symptom Inventory (BSI) and PAIS questionnaires were also distributed to patients and their spouses. The BSI is a 53-item questionnaire providing information about psychological distress along nine dimensions (somatisation, obsessive–compulsive, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation and psychotism). Each item is scored

from 0 to 4, with higher numbers indicating more distress. On the BSI profile, home haemodialysis patients reported less psychological distress than hospital dialysis patients on all dimensions, with the differences reaching statistical significance in four dimensions (somatisation, depression, anxiety and phobic anxiety). The PAIS is a 45-item questionnaire providing information along seven domains of adjustment (healthcare orientation, vocational environment, domestic environment, sexual relations, extended family, social environment and psychological distress). Each item is scored from 0 to 3, with higher numbers indicating more problems. The PAIS overall mean scores were: 32.6 for home dialysis patients versus 34.9 for hospital dialysis patients, and 26.9 for home dialysis spouses versus 34.9 for hospital dialysis spouses. The authors indicated that section two (vocational environment) was omitted from the study due to the limited number of pairs (patients and spouses) and spouses.

Schreiber and Huber,[29] in a study published in 1985, undertook a mailed survey of home and hospital dialysis patients' significant others to obtain their ratings on the changes in the dialysis patients' well-being after beginning dialysis treatment. They reported mixed results. Compared with the hospital group (n = 137), more of those dialysing at home (n = 132) were more nervous (66% versus 64%), more tense (74% versus 68%) and more irritable (61% versus 53%), but more self-confident (40% versus 29%) and less anxious (53% versus 66%).

A study by Livesley[23] found that the home haemodialysis group (n = 51) did not do as well as the hospital group (n = 34) on the depression subscale of the Middlesex Hospital Questionnaire (4.3 versus 2.7, respectively), although the author noted that the groups' scores on the other subscales were not significantly different.

Cameron and colleagues,[13] in a systematic review of emotional distress and psychological well-being across RRTs, reported that hospital haemodialysis was associated with greater emotional distress than home haemodialysis.

In summary, people who undergo home haemodialysis are a highly selected group. The evidence suggests that they have a better QoL compared with those undergoing hospital dialysis, in terms of general QoL measures (e.g. functional ability), aspects specifically related to haemodialysis (e.g. disruption to social contacts) and also psychosocial aspects (e.g. self-confidence). However, for all studies, the direction of effect is not always the same, for example, patients undergoing home haemodialysis have also been reported as being more anxious and depressed than those being dialysed in hospital. Furthermore, spouses of people being dialysed at home have reported experiencing a lower QoL and less satisfaction with the dialysis process than spouses of people being dialysed in hospital.

Hospitalisation rate

Two studies provided information on hospitalisation rates (appendix 12).[12,17] Bremer and colleagues,[17] in a primary study with an overall quality assessment score of over 14, reported a mean hospitalisation rate of 13.4 days per patient per year for home haemodialysis, compared with 11.5 days per patient per year for satellite unit (self-care hospital) dialysis and 15.1 days per patient per year for hospital (staff-assisted) dialysis. Mohr and colleagues,[12] in a review comparing short daily or nocturnal haemodialysis with hospital haemodialysis 3 times per week, found an average 43% reduction (weighted CI, 23% to 63%) in hospital days associated with daily or nocturnal haemodialysis.

Employment/school status

Five primary studies and one systematic review provided information on employment status (appendix 12).[14,17,19,21,30,37] Of the primary studies, two (Bremer and colleagues,[17] and Courts and Boyette[19]) had overall quality assessment scores of 14 or above, and three (Hart and Evans,[21] Piltz-Kirkby and Fox,[37] and Soskolne and De Nour[30]) had scores of 10–13. One primary study (Reichwald-Klugger and colleagues,[27] with a quality assessment score of 10–13) reported on school status. Bremer and colleagues[17] reported that 42% of 47 patients on home haemodialysis were employed full-time and 4% part-time, while 6% of 41 self-care hospital patients were employed full-time and none part-time, and 9% of 105 staff-assisted hospital patients were employed full-time and 23% employed part-time. Courts and Boyette[19] noted that one of five home haemodialysis patients worked full-time, compared with two of five hospital dialysis patients. In a study by Evans and colleagues[38] (see appendix 9, *List of included studies*, under Hart and Evans, 1987), 40% of the 287 patients in the home haemodialysis group were employed, compared with 24% of the 347 patients in the hospital haemodialysis group. Soskolne and De Nour[30] reported that 65% of 29 home haemodialysis patients were working, compared with 52% of 29 hospital dialysis patients. Piltz-Kirkby and Fox[37] noted that 38% of 24 people

undergoing home haemodialysis were employed, compared with 12% of 25 people being dialysed in hospital.

A systematic review by Parsons and Harris[14] provided comparative information derived from four sources on the employment status of people being dialysed at home, in satellite units or in hospital.[17,38–40] Morris and Jones[40] reported that 35% of people undergoing haemodialysis at home were employed, compared with 30% of those being dialysed in hospital. Data from the Australian and New Zealand Combined Dialysis and Transplant Registry (ANZDATA)[39] indicated that 48% of people undergoing home haemodialysis were employed full-time, compared with 26% of those undergoing dialysis in a satellite unit and 22% of those being dialysed in hospital. In addition, 19% of people undergoing home haemodialysis were employed part-time, compared with 20% of those being dialysed in a satellite unit and 18% of people undergoing dialysis in hospital.

In a small study of children aged from 7 years, 7 months to 19 years, 8 months, Reichwald-Klugger and colleagues[27] reported that the ten home haemodialysis patients missed an average of 22% of school activities, compared with 37% of school activities missed by the ten hospital dialysis patients. Class repetitions occurred in three out of eight children undergoing home dialysis and in five out of ten children undergoing hospital dialysis. Educational guidance after initiation of dialysis was found to be more difficult in seven out of ten children undergoing home dialysis, compared with four out of ten children undergoing hospital dialysis. Apathy and sadness contributed to a difficult education in three out of ten children undergoing home dialysis and two out of ten children undergoing hospital dialysis. Two out of ten children undergoing home dialysis had an additional tutor at home, compared with five out of ten children undergoing hospital dialysis. The results, therefore, were variable with no definite benefit to either group.

Technique failure

Technique survival is the time that a person remains on a particular form of RRT before changing to another form of RRT. One study by Rubin and colleagues published in 1989[28] (with a quality assessment score of 10–13) reported that participants undergoing dialysis in a free-standing facility (satellite unit) had a longer median technique survival time than those undergoing home dialysis (9.7 years compared with 7.5 years, respectively; appendix 12). Patients were censored at the time of transfer from the programme or if renal function returned. If patients received a transplant, they were considered censored at the time of transplantation. Patients who received a transplant and subsequently returned to dialysis were not re-entered into the analysis. Any transfer from one dialysis therapy to another that lasted longer than 4 months was considered a dialysis technique failure.

Measures of anaemia

Three studies reported measures of anaemia: two (McGregor and colleagues,[15] and Westlie and colleagues[31]) had overall quality assessment scores of 14 or above, and one (Covic[20]) had a quality assessment score of less than 10 (appendix 12). McGregor and colleagues in their 2001 study[15] and Westlie and colleagues in their 1984 study[31] reported haematocrit, while the study by Covic[20] (the abstract for which was published in 1998) reported haemoglobin level. McGregor and colleagues,[15] in their randomised crossover trial involving nine patients, reported a mean haematocrit of 33% for patients on long (6–8 hours) home dialysis, compared with 31% for patients on short (3.5–4.5 hours) hospital haemodialysis. Westlie and colleagues[31] also found a higher mean haematocrit for home dialysis patients, at 28.4%, compared with 26.4% for the hospital group. Covic[20] reported that the mean haemoglobin for patients on 8-hour home haemodialysis was 11.3 g/l, compared with 8.3 g/l for patients on 4-hour standard hospital haemodialysis ($p < 0.05$).

Use of EPO

In a randomised crossover study by McGregor and colleagues,[15] five out of the nine patients were receiving EPO at a dose of 6000 units per week, which was constant throughout the study period (appendix 12). A systematic review by Mohr and colleagues,[12] comparing nocturnal or short daily dialysis with conventional hospital haemodialysis, reported EPO dose based on weighted results from five clinical studies involving 116 patients in total. Nocturnal/daily dialysis achieved a weighted average percentage reduction of 41% in EPO dose (weighted CI, 32% to 50%).

Biochemical indices of renal disease

Four studies reported biochemical indices of renal disease (appendix 12).[15,31,33,35] Three studies (McGregor and colleagues,[15] Westlie and colleagues,[31] and Woods and colleagues[33]) had overall quality assessment scores of 14 or above, and one (Freeman and Richards[35]) had a quality assessment score of less than 10. McGregor and colleagues[15] reported lower mean phosphate values for long home

dialysis compared with short hospital dialysis (2.2 versus 2.4 mmol/l, respectively). Westlie and colleagues[31] reported higher potassium levels for the home group compared with the hospital group (5.04 versus 4.84 milliequivalents per litre [mEq/l], respectively). Freeman and colleagues[35] reported alkaline phosphatase values of 212 IU/l for the home dialysis group compared with 121 IU/l for the satellite unit dialysis group.

McGregor and colleagues[15] reported higher mean levels of albumin for long home haemodialysis compared with short hospital dialysis (38.4 versus 37.1 g/l, respectively). Westlie and colleagues[31] also reported that albumin levels were higher for the home dialysis group compared with the hospital dialysis group (3.52 versus 3.48 g/dl, respectively). Woods and colleagues[33] reported that serum albumin at the beginning of treatment for ESRD was lower for the home haemodialysis group compared with the hospital dialysis group (3.5 versus 3.6 g/dl, respectively). McGregor and colleagues[15] reported higher mean levels of calcium for long home haemodialysis compared with short hospital dialysis (2.64 versus 2.55 mmol/l, respectively), and Westlie and colleagues[31] reported that calcium levels were higher for the home dialysis group compared with the hospital dialysis group (9.53 versus 9.45 mg/dl, respectively).

Dialysis adequacy

Three studies gave details of Kt/V as a measure of dialysis adequacy (appendix 12).[15,20,33] Two studies (McGregor and colleagues,[15] and Woods and colleagues[33]) had an overall quality assessment score of 14 or above, while one (Covic[20]) had a score of less than 10. Woods and colleagues[33] noted a Kt/V (prescribed) of 1.02 for the home haemodialysis group compared with 1.00 for the hospital dialysis group; no information was provided on frequency or duration of dialysis. McGregor and colleagues[15] reported an equilibrated Kt/V of 1.19 for long home dialysis (6–8 hours, 3 times per week) compared with 1.17 for short hospital haemodialysis (3.5–4.5 hours, 3 times per week). Covic[20] reported Kt/V for 8-hour home haemodialysis compared with 4-hour standard hospital dialysis (1.72 versus 1.23, respectively; $p < 0.05$).

Blood pressure

In both the studies reporting blood pressure,[15,31] the home dialysis group achieved better control (appendix 12). McGregor and colleagues,[15] in a randomised crossover trial involving nine patients and published in 2001, reported a mean predialysis blood pressure of 155/89 mmHg for long home haemodialysis compared with 169/93 mmHg for short hospital dialysis (systolic, $p < 0.05$; diastolic, not significant); mean postdialysis blood pressure was 131/78 mmHg for home patients compared with 148/82 mmHg for those dialysed in hospital (systolic, $p < 0.05$; diastolic, not significant). Westlie and colleagues[31] reported on mean pre- and postdialysis standing and supine blood pressure measurements. Predialysis standing blood pressure for home haemodialysis was 136/65 mmHg compared with 140/76 mmHg for hospital haemodialysis (systolic, not significant; diastolic, $p < 0.001$), while postdialysis standing blood pressure was 111/56 mmHg for home haemodialysis and 124/69 mmHg for hospital haemodialysis (systolic, $p < 0.01$; diastolic, $p < 0.01$). Predialysis supine blood pressure for home haemodialysis was 142/65 mmHg compared with 146/75 mmHg for hospital haemodialysis (systolic, not significant; diastolic, $p < 0.001$), while postdialysis supine blood pressure was 122/58 mmHg for home haemodialysis and 138/73 mmHg for hospital haemodialysis (systolic, $p < 0.001$; diastolic, $p < 0.01$). No information was provided on the duration or frequency of dialysis.

Adverse events

Two studies reported on adverse events,[15,31] details of which are given at the end of this chapter (*Adverse effects of intervention*) and in appendix 12.

Mortality/survival

Eight primary studies and one systematic review provided information on mortality/survival for people undergoing home haemodialysis compared with hospital or satellite unit dialysis (appendix 12).[11,16,18,22,24,26,28,32,33] Of the primary studies, four (Arkouche and colleagues,[16] Capelli and colleagues,[18] Mailloux and colleagues,[24] and Woods and colleagues[33]) had an overall quality assessment score of 14 or above, three (Hellerstedt and colleagues,[22] Rubin and colleagues,[28] and Williams and colleagues[32]) had quality assessment scores of 10–13, and one (Price and colleagues[26]) had a score of less than 10. Six studies employed the Cox proportional hazards regression model,[16,18,24,28,32,33] two comparing home with satellite unit haemodialysis[16,28] and four comparing home with hospital haemodialysis.[18,24,32,33] Often used in survival analysis, the Cox model is a regression technique that can be used to statistically adjust for differences in baseline characteristics between groups being compared.

Arkouche and colleagues[16] compared 231 home haemodialysis patients with 240 satellite unit haemodialysis patients. Employing the Cox model, they reported that home haemodialysis (hazard ratio, 1.535; 95% CI, 0.718 to 3.282) did not differ significantly from satellite unit dialysis in terms of survival ($p = 0.2694$). Co-variates that were statistically significant were diabetes (hazard ratio, 7.009; 95% CI, 2.801 to 17.542; $p < 0.0001$) and renal vascular diseases (hazard ratio, 2.558; 95% CI, 1.187 to 5.513; $p = 0.0165$) as causes of ESRD. Age at the start of haemodialysis was also significant: 35–44 years (hazard ratio, 2.884; 95% CI, 1.121 to 7.418; $p = 0.0280$), 45–54 years (hazard ratio, 2.744; 95% CI, 1.037 to 7.259; $p = 0.0420$), 55–64 years (hazard ratio, 5.462; 95% CI, 2.029 to 14.707; $p = 0.0008$) and ≥ 65 years (hazard ratio, 7.715; 95% CI, 2.435 to 24.437; $p = 0.0005$). The results were significantly influenced by age at the start of haemodialysis and whether diabetes or renal vascular disease were causes of ESRD, but they were not influenced by the modality of treatment. The authors reported that survival was similar between home and satellite unit dialysis patients, but did not provide separate outcome data for each modality.

Rubin and colleagues[28] also compared home with satellite unit haemodialysis. They reported that 14% of 90 people starting home therapy within 180 days of initiation of dialysis died, compared with 18% of 60 people starting home therapy more than 180 days after of initiation of dialysis, and 23% of 954 people undergoing dialysis in a satellite unit (free-standing facility). Employing the Cox model, satellite unit dialysis (hazard ratio, 1.39; $p = 0.003$) differed significantly from home dialysis. Other statistically significant co-variates were: age by 20-year difference (hazard ratio, 1.17; $p = 0.001$), joint effects of the causes of ESRD in terms of chronic glomerulonephritis (hazard ratio, 0.76; $p = 0.004$), chronic interstitial nephritis (hazard ratio, 0.59; $p = 0.0003$) and type 2 diabetes mellitus (hazard ratio, 0.62; $p = 0.009$). Age at the start of dialysis treatment was an important factor in survival. Patients with chronic interstitial nephritis survived longer than those with hypertension or type 2 diabetes mellitus, and patients with chronic glomerulonephritis survived longer than patients with hypertension. The authors reported a 39% increase in the risk of death for a patient undergoing satellite unit haemodialysis as compared with home haemodialysis.

Capelli and colleagues[18] reported that the median survival time for 64 patients on home haemodialysis was 48.3 months compared with 30.1 months for 276 hospital patients; after 1.5 years of dialysis, the median lifetime remaining was 37.0 months for home patients and 32.1 months for hospital patients. The smoothed (over time) median survival time for home dialysis patients was 47.21 months compared with the adjusted (for age and diabetic status) median survival time of 34.5 months for hospital patients. The smoothed survival rates for home haemodialysis patients were 92.7% at 1 year and 36.2% at 5 years, compared with the adjusted survival rates for hospital patients of 79.9% at 1 year and 32.5% at 5 years.

Capelli and colleagues[18] employed the Cox proportional hazards regression model. Because the proportional hazards assumption was found to be invalid for home haemodialysis, a separate analysis involving time-dependent co-variates was conducted instead. This analysis was not clearly explained, but it was reported that the home haemodialysis patients had improved adjusted median survival times compared with hospital haemodialysis patients ($p < 0.05$). The factors found to significantly affect patient survival were modality of dialysis, age at the start of treatment and diabetic status. The authors reported that home dialysis patients had a dramatically lower risk of death compared with hospital dialysis patients in the first 18 months of treatment; after 18 months, the risk of death and median lifetime survival for home dialysis patients were comparable to those for hospital dialysis patients.

Mailloux and colleagues[24] reported that 28% of patients undergoing home haemodialysis had died compared with 53% of 687 patients undergoing dialysis in hospital. They reported a median survival of 147 months for 74 patients on home haemodialysis compared with 47 months for 687 patients on hospital haemodialysis. The survival rates were 99% at 1 year, 87% at 5 years and 35% at 20 years for the home dialysis patients, compared with 87% at 1 year, 38% at 5 years and 5% at 20 years for hospital patients. When they compared the home dialysis patients with an attempted matched group (based on age, diagnosis and length of time on dialysis) of 74 hospital dialysis patients, the median survival length for the matched hospital group was 110 months, with survival rates of 66% at 5 years and 18% at 20 years.

Mailloux and colleagues[24] employed the Cox model and reported that statistically significant co-variates were diabetes mellitus (hazard ratio,

2.12; $p = 0.0001$), renal vascular disease (hazard ratio, 1.9; $p = 0.0001$), other diagnoses as causes of ESRD (hazard ratio, 1.9; $p = 0.0001$), and patients at start of treatment aged ≤ 40 years (hazard ratio, 0.31; $p = 0.0001$) or aged 41–60 years (hazard ratio, 0.64; $p = 0.0002$). Other statistically significant co-variates were white ethnicity (hazard ratio, 1.38; $p = 0.0365$) and the following risk factors: hypertension (hazard ratio, 1.465; $p = 0.0017$), pre-existing cardiac disease (hazard ratio, 1.461; $p = 0.0031$) and low serum albumin (hazard ratio, 1.64; $p = 0.0001$). The authors reported that ever having been on home haemodialysis halved the risk of death (hazard ratio, 0.489), compared with hospital dialysis, and that certain diagnoses, age ≥ 61 years, having one or more of three risk factors, or switch in dialysis modality were associated with significantly shorter survival.

Williams and colleagues[32] compared 261 home haemodialysis patients with 1560 hospital patients. They employed the Cox model and reported that home haemodialysis (hazard ratio, 0.63; $p = 0.01$) differed significantly from hospital dialysis. Age was also significant (hazard ratio for an age increase of 1 year, 1.01; $p < 0.001$), although the interaction of treatment effect with age was not significant. The authors reported that the risk of death for a patient on home haemodialysis was less than the risk of death for a patient on hospital dialysis of the same age, for all ages between 20 and 60 years.

Woods and colleagues[33] reported that, by the end of the follow-up period of 1500 days in their study, 16 (23%) of 70 home haemodialysis patients had died, compared with 1644 (53%) of 3102 hospital dialysis patients. Home haemodialysis patients were defined as those who, 30 days after onset of ESRD, were in training for home haemodialysis either at home or in a dialysis unit. Using the Cox model, the authors reported that patients receiving home haemodialysis had significantly improved survival compared with those receiving hospital dialysis (hazard ratio, 0.58; 95% CI, 0.35 to 0.95; $p = 0.03$). Other statistically significant co-variates were age (hazard ratio, 1.40; $p < 0.001$); whether on active insulin therapy (hazard ratio, 1.30; $p < 0.001$); co-morbidities including arrhythmia (hazard ratio, 1.10; $p = 0.1$), COPD (hazard ratio, 1.18; $p = 0.03$), congestive heart failure (hazard ratio, 1.20; $p = 0.001$), myocardial infarction (hazard ratio, 1.42; $p < 0.001$), peripheral vascular disease (hazard ratio, 1.14; $p = 0.03$), stroke (hazard ratio, 1.27; $p < 0.01$) and obesity (hazard ratio, 0.81; $p < 0.01$); whether an active smoker (hazard ratio, 1.21; $p < 0.01$); and serum albumin, per 0.2-g/dl increase (hazard ratio, 0.92; $p < 0.001$). Woods and colleagues[33] reported that the risk of mortality for home haemodialysis patients was 42% lower than for patients being dialysed in hospital.

Hellerstedt and colleagues[22] provided survival rates of patients with and without diabetes who were on home and hospital haemodialysis. Of those without diabetes, the survival rates for 148 home haemodialysis patients were 94% at 1 year and 64% at 5 years, compared with the survival rates of 87% at 1 year and 55% at 5 years for 1259 hospital dialysis patients. Of those with diabetes, the survival rates for 40 home haemodialysis patients were 90% at 1 year and 56% at 5 years, compared with the survival rates of 83% at 1 year and 41% at 5 years for 540 hospital dialysis patients.

In contrast to the generally superior survival rates for people undergoing home haemodialysis given above, Price and colleagues,[26] in a study published in 1978, reported a 50% survival time of 5 years, 8 months for the home group of 93 people, which was less than the 7 years, 1 month for the hospital group of 166 people. In this study, the records of all patients who underwent dialysis between November 1964 and November 1976 were reviewed. However, it should be noted that, although hospital haemodialysis began in 1964, home haemodialysis did not begin until 1969. During this 5-year period, therefore, some patients who otherwise might have been dialysed at home would actually have been treated in hospital.

A systematic review by Jacobs and Selwood[11] on trends in the development of RRTs in France during the period from 1982 to 1992 reported that, for patients aged 15–34 years at the start of RRT, those undergoing home haemodialysis had survival rates of 93.4% at 5 years and 90.3% at 10 years, compared with 96% at 5 years and 86% at 10 years for those undergoing hospital dialysis. For patients aged 55–64 years at the start of RRT, those undergoing home haemodialysis had survival rates of 78% at 5 years and 56% at 10 years, compared with 59% at 5 years and 32% at 10 years for those undergoing hospital dialysis.

In summary, the risk of mortality for patients undergoing home haemodialysis was generally lower than for patients undergoing hospital or satellite unit haemodialysis. Hellerstedt and colleagues[22] reported better survival rates for

home haemodialysis patients, both with and without diabetes, compared with patients being dialysed in hospital. In contrast, Price and colleagues[26] reported a better survival rate for hospital patients, although for the first 5 years of the study period, home haemodialysis was not available as a treatment option. A review by Jacobs and Selwood[11] also reported better survival rates for patients being dialysed at home compared with those being dialysed in hospital, apart from the 15–34 year age group at 5 years, when the hospital patients demonstrated better survival rates. Of the four studies using the Cox model and comparing home with hospital haemodialysis, Williams and colleagues[32] as well as Woods and colleagues[33] reported a statistically significant difference in favour of home dialysis in terms of lower mortality risk, Mailloux and colleagues[24] reported that ever having been on home haemodialysis halved the mortality risk, and Capelli and colleagues[18] reported that home dialysis patients had a dramatically lower mortality risk in the first 18 months of treatment, after which the mortality risk became comparable with that of the hospital patients. Of the two studies using the Cox model and comparing home with satellite unit haemodialysis, Rubin and colleagues[28] reported a statistically significant difference in favour of home dialysis in terms of lower mortality risk, while Arkouche and colleagues[16] reported that survival was comparable for both groups.

Other co-variates that were found to significantly affect mortality risk in the studies employing the Cox model were age at the start of treatment,[16,18,24,28,32] ethnicity,[24] diabetes,[16,18,24,28,33] renal vascular disease,[16,24] chronic glomerulonephritis,[28] chronic interstitial nephritis,[28] arrhythmia,[33] congestive heart failure,[33] myocardial infarction,[33] peripheral vascular disease,[33] stroke,[33] obesity,[33] hypertension,[24] pre-existing cardiac disease,[24] low serum albumin[24,33] and whether an active smoker.[33]

Summary and conclusions of evidence for and against the interventions

The number of people being dialysed at home and in satellite units was much less than the number being dialysed in hospital. Socio-demographic characteristics and co-morbidities were not evenly balanced between the participant groups: people undergoing home haemodialysis were generally younger and more likely to be men and to have less co-morbidities, such as diabetes, than those being dialysed in hospital. However, a number of studies with survival as an outcome attempted to take account of this by using the Cox proportional hazards regression model to adjust for sociodemographic and co-morbidity differences in study participants. For example, Woods and colleagues[33] reported a 63% reduction in the risk of death (unadjusted) for the home dialysis group when compared with the hospital group. Applying the Cox model, with adjustment for patient characteristics and for the effect of co-morbid conditions, the risk of death for the home haemodialysis group changed to 42% lower than the risk for those being dialysed in hospital.

The haemodialysis intervention was generally poorly described, more so in terms of the equipment used, less so in terms of the duration and frequency of dialysis. In five studies,[12,15,20,24,27] the duration and/or frequency of dialysis was greater for home dialysis than for the other modalities, and in four studies,[16,18,28,35] it was the same; other studies did not report the duration or frequency of dialysis. Outcomes in these nine studies, including QoL, blood pressure control, measures of anaemia, survival and biochemical indices of renal disease, generally favoured home haemodialysis over the other modalities, whether or not the duration and/or frequency of dialysis was greater or the same for home dialysis. Rubin and colleagues,[28] however, reported a higher median technique survival rate for people dialysed in satellite units compared with home dialysis, and in the Reichwald-Klugger study,[27] the QoL outcomes for children and their parents showed mixed benefits for the home and hospital groups.

The review's primary outcomes were QoL, hospitalisation rate, employment/school status, technique failure and access failure. Other outcomes included measures of anaemia, EPO use, biochemical indices of renal disease, dialysis adequacy, blood pressure, adverse events and mortality. Although access failure was not referred to in any of the included studies, all the other outcomes were reported by one or more studies.

The evidence from the included studies for the stated outcomes, for all age groups, suggests that home dialysis is more effective than hospital dialysis, and also more effective than satellite unit dialysis, but modestly so. With regard to technique survival, the limited evidence suggested that patients being dialysed in satellite units

achieved a longer median technique survival time than those on home dialysis. People on home dialysis tended to experience a better QoL, in terms of functional ability and well-being. However, there was some evidence to suggest that their partners tended to be less satisfied with home dialysis and also with the increased dependency placed on them by those being dialysed at home. When compared with hospital dialysis, people on home dialysis also tended to have fewer hospitalisations, live longer, be capable of full-time work and experience fewer intradialytic adverse events, such as headaches and cramps. A number of the reported outcomes, such as blood pressure control, were statistically significant in favour of home dialysis. Many others, such as QoL outcomes, were more modestly in favour of home dialysis but nevertheless potentially worthwhile.

Of the two studies comparing home with satellite unit haemodialysis and using the Cox model, Arkouche and colleagues[16] reported that survival was comparable for both comparison groups, while Rubin and colleagues[28] reported a statistically significant lower mortality risk for home haemodialysis patients. Of the four studies comparing home with hospital haemodialysis and using the Cox model, Williams and colleagues[32] and Woods and colleagues[33] reported a statistically significant lower mortality risk for home haemodialysis patients, Mailloux and colleagues[24] reported that ever having been on home haemodialysis halved the mortality risk, and Capelli and colleagues[18] reported that home haemodialysis patients had a dramatically lower mortality risk in the first 18 months of treatment, after which the mortality risk became comparable with that of the hospital patients.

No studies employing the Cox model appeared to have included co-variates involving the process of treatment, for example, dose prescribed and achieved, compliance and local patterns of practice. It is possible that, if factors associated with the process of treatment are not considered, then the study results will reflect the combination of modality, case mix and treatment characteristics, rather than just the combination of modality and case mix alone. However, three studies[16,18,28] did report that the frequency and duration of dialysis sessions were the same for both comparison groups. Therefore, in these three studies, the results should not have been influenced by differences between the participant groups in this aspect of the treatment process.

Those risk factors that the six studies did include in their Cox models would appear to have been appropriate, for example, age at start of treatment, presence of diabetes, causes of ESRD and co-morbidities, although not all studies included these factors to the same degree. The results suggest that patients undergoing home haemodialysis have a lower mortality risk than patients undergoing dialysis in hospital, and more cautiously so in satellite units, but these results may be biased by unknown confounding factors. A prospective RCT would be required in order to truly determine the effectiveness of home haemodialysis compared with hospital or satellite unit dialysis, independent of other factors.

Patients on home haemodialysis are deliberately a highly selected group. They are generally younger and have less co-morbidity than those who are dialysed in hospital. Also, home dialysis provides an opportunity to dialyse more frequently and for longer periods than would be possible in hospital or in satellite units. It is therefore difficult to disentangle the true benefits of home haemodialysis from the effects of such socio-demographic and co-morbidity factors and the opportunity provided by home dialysis for greater duration and/or frequency of dialysis sessions.

Clinical effect size

A number of studies reported statistically significant outcomes, mostly in favour of home haemodialysis, in areas such as measures of anaemia, dialysis adequacy, blood pressure, adverse events and QoL. On measures of anaemia, a study by Covic[20] of 8-hour home dialysis versus 4-hour standard dialysis reported that mean haemoglobin (g/L) for the home group was higher ($p < 0.05$). No information was provided on whether EPO was used. The same study[20] also reported that, with regard to dialysis adequacy, mean Kt/V for the home group was higher ($p < 0.05$).

A randomised crossover trial by McGregor and colleagues,[15] published in 2001, comparing long home dialysis (6–8 hours, 3 times per week) with short hospital dialysis (3.5–4.5 hours, 3 times per week) reported that the pre- and postdialysis systolic blood pressures were significantly higher in patients on hospital dialysis compared with home dialysis. Westlie and colleagues,[31] in a study comparing home with hospital dialysis, also found that postdialysis blood pressure (systolic and diastolic), both standing and supine, was significantly higher for the hospital group.

In relation to adverse events, McGregor and colleagues[15] reported that, after 8 weeks of long home dialysis, participants in the study reported fewer uraemia-related symptoms ($p < 0.05$) and less physical suffering ($p < 0.005$). Westlie and colleagues[31] stated that the home dialysis group had a significantly lower mean number of complications per dialysis than the hospital group ($p < 0.001$).

As far as QoL is concerned, McGregor and colleagues[15] reported that the participants felt that long home dialysis interfered more with their social activities than hospital dialysis ($p < 0.05$). Livesley,[23] in a study of home versus hospital haemodialysis, reported that the home dialysis group had a higher score ($p < 0.05$) on the depression subscale of the Middlesex Hospital Questionnaire, favouring the hospital group (a higher score indicates a worse outcome). However, Soskolne and De Nour,[30] in a study comparing home versus hospital haemodialysis, reported that, on the BSI, the home group scored significantly better than the hospital group on somatisation ($p < 0.05$), depression ($p < 0.005$), anxiety ($p < 0.05$) and phobic anxiety ($p < 0.005$), with higher scores indicating more distress.

In a systematic review by Mohr and colleagues,[12] short daily (1.5–2 hours) or nocturnal (6–10 hours) haemodialysis, 5–7 times per week, was compared with conventional hospital dialysis (average of 3.5 hours), 3 times per week. With regard to QoL, they reported that patients undergoing daily dialysis showed significantly better mental health ($p < 0.05$), more vitality ($p < 0.02$) and more energy (SF-36 form).

In quite a few of the outcomes that were reported, the differences between the modalities were modest and not statistically significant, although the general direction of effect tended to favour home haemodialysis over hospital or satellite unit dialysis.

Important subgroup differences

When data allowed, the patient population was split into four groups: adults by risk class (low, medium and high risk) and children.[1] Adults were classed as: low risk if they were less than 70 years of age and had no co-morbid illness; medium risk if they were aged 70–80 years, or any age with one co-morbid illness, or less than 70 years with diabetes; or high risk if they were greater than 80 years of age, or any age with two co-morbidities, or any age with visceral cancer.

Generally, studies provided only the mean age and range for each participant group and the percentage of each group with specific co-morbid conditions, without identifying at-risk categories within each participant group separately throughout the study. Therefore, although most studies contained a number of low-, medium- and high-risk participants, in general only aggregate results were reported and it was not possible to relate outcomes to specific subgroups. However, six studies did provide outcome information in relation to specific risk groups.[15,18,22,27,31,33]

In the study by Reichwald-Klugger and colleagues[27] investigating psychosocial adaptation to haemodialysis, the 20 participants were all children/adolescents. The mean age of the home haemodialysis group was 12 years, 1 month, while the mean age of the hospital group was 14 years, 1 month. The home haemodialysis group missed fewer school activities than the hospital group and had less disruption to long-term social contacts, although the parents of the home group had more disruption to long-term social contacts than the parents of the hospital dialysis group.

All nine participants in the randomised crossover trial carried out by McGregor and colleagues[15] were low risk in that their mean age was 48 years (range, 23–63 years), they were not on anti-hypertensive drugs, and people with diabetes mellitus, overt cardiac disease, prior nephrectomy or any recent illness were excluded. This study of long home dialysis compared with short hospital dialysis found that hospital patients' pre- and postdialysis systolic blood pressure was significantly higher than that of home dialysis patients, and diastolic blood pressure for the hospital group also tended to be higher.

In the study by Capelli and colleagues,[18] the participants in both groups were mostly low risk in that they were less than 70 years of age. However, some participants had diabetes (4.7% of home group, 14.9% of hospital group) and were medium risk. Although results for the diabetic participants within the home and hospital groups were not given separately, employing the Cox proportional hazards regression model, the investigators found that participants with diabetes had a 1.2 times greater risk of death at 6 months after onset of dialysis compared to those without diabetes, increasing to 1.7 and 2.3 times greater risk at 1 and 2 years, respectively.

The study by Woods and colleagues[33] contained a mixture of low-, medium- and possibly high-risk

participants. Information on the distribution of co-morbidities for the home dialysis group compared with the hospital dialysis group was provided for diabetes (14% versus 30%, respectively), insulin therapy (14.3% versus 22.3%), arrhythmia (14.3% versus 10.1%), COPD (14.3% versus 11.2%), congestive heart failure (24.3% versus 38.6%), myocardial infarction (4.3% versus 13.5%), obesity (11.4% versus 22.5%), peripheral vascular disease (12.9% versus 17.8%) and stroke (2.9% versus 10.1%). Using the Cox model, relative risk ratios for all participants with specific co-morbidities were reported compared to all participants without such co-morbidities. The mortality rate for participants with arrhythmia was 10% higher than for those with no arrhythmia, for participants with active insulin therapy 30% higher than for those with no active insulin therapy, for participants with COPD 18% higher than for those with no COPD, for those with congestive heart failure 20% higher than for those without congestive heart failure, for those who had suffered a myocardial infarction 43% higher than for those with no myocardial infarction, and for those with peripheral vascular disease 14% higher than for those with no peripheral vascular disease.

The study by Hellerstedt and colleagues[22] contained a mixture of low- and medium-risk participants. The home haemodialysis group consisted of 148 people without diabetes (mean age, 64 years) and 40 with diabetes (mean age, 56 years), while the hospital group consisted of 1259 people without diabetes (mean age, 54 years) and 540 with diabetes (mean age, 50 years). For participants with diabetes, the cumulative survival rates for the home group at 1 and 5 years were 90% and 56%, respectively, compared with 83% and 41% for the hospital group. For participants without diabetes, the cumulative survival rates for the home group at 1 and 5 years were 94% and 64%, respectively, compared with 87% and 55% for the hospital group. For those participants with diabetes, although the mean age of the hospital group was lower than that of the home group, the home group had the better survival rates at 1 and 5 years. No information was provided on duration or length of dialysis sessions.

The participants in the study by Westlie and colleagues[31] were all aged 70 years or over and a mixture of medium and high risk. The mean age of the home group was 74.5 years (range, 70–82 years), while the mean age of the hospital group was 75.2 years (range, 70–84 years). Co-morbidities were approximately balanced between the groups. The home group achieved lower systolic and diastolic blood pressure, both pre- and postdialysis, standing and supine, as well as less frequent intradialytic complications, and generally reported a better QoL.

Adverse effects of intervention

Two studies comparing home with hospital haemodialysis provided information on adverse events;[15,31] both had overall quality assessment scores of 14 or above. None of the studies comparing home with satellite unit haemodialysis provided information on adverse events. From the limited evidence available, it would appear that those on home haemodialysis suffered fewer adverse events than the hospital dialysis group. McGregor and colleagues[15] reported 16 episodes of hypotension in 216 treatments for the home group, five of which required saline to restore blood pressure, compared with 31 episodes in 216 treatments for the hospital group, eight of which required saline to restore blood pressure. A study by Westlie and colleagues[31] also found that the home dialysis group suffered fewer episodes of adverse events. During the participants' previous 14 dialyses (a total of 367 dialyses for the home group and 714 dialyses for the hospital group), the home dialysis group suffered fewer episodes of hypotension than the hospital group (34 versus 113, respectively), vomiting (3 versus 27), cramps (6 versus 45), arrhythmia (4 versus 105) and headaches (0 versus 22).

Conclusion of review on effectiveness

People undergoing home haemodialysis are a highly selected group. They are more likely to be younger, to be men and to have fewer co-morbidities than those being dialysed in hospital or in satellite units. Some studies with survival as an outcome attempted to adjust for these differences by, for example, using the Cox proportional hazards regression model. It was nevertheless difficult to disentangle these sociodemographic and case-mix differences, and also the opportunities provided for longer and more frequent dialysis sessions in the home than would normally be available in hospital or satellite units, in order to provide a true estimate of the relative effectiveness of home haemodialysis.

Overall, the evidence from the included studies suggests that, for the stated outcomes, home haemodialysis is more effective than hospital dialysis and also more effective than satellite unit dialysis, but modestly so. Some outcomes were statistically significant in favour of home dialysis; other differences were more modest, although

the general direction of effect still tended to favour home dialysis. Compared with hospital haemodialysis, people undergoing home dialysis tended to experience a better QoL and were more likely to be in full-time employment, live longer, have fewer hospitalisations, have better blood pressure control and experience fewer intradialytic adverse events.

Compared with satellite unit haemodialysis, the limited evidence available suggested that people undergoing home dialysis experienced a moderately better QoL, were more likely to be in full-time employment, experienced comparable or better survival rates, but had more hospitalisations and a moderately shorter technique survival time.

Chapter 3

Systematic review of economic evidence

Methods for reviewing economic evidence

Search strategies

Studies that reported both costs and outcomes of home versus hospital or satellite haemodialysis were identified from a systematic review of the literature described in chapter 2. The only additional search performed was on the Harvard Database of cost–utility analyses.

Inclusion and exclusion criteria

To be included, studies had to compare home with satellite or hospital haemodialysis in terms of costs and effectiveness. Studies reported in languages other than English were identified from their abstracts but were not included in the review. One reviewer assessed all abstracts for relevance. Full papers were obtained for all studies that appeared potentially relevant and were then formally assessed for relevance.

Data extraction strategy

The following data were extracted for each included study:

1. study characteristics:
   - research question
   - study design
   - comparison
   - setting (UK versus non-UK)
   - treatment groups
   - numbers receiving or randomised to each intervention
   - dates to which data on effectiveness and costs related
   - other characteristics and follow-up
   - duration of follow-up for both effectiveness and costs
2. results:
   - summary of costs, effectiveness and/or utility (point estimate and, if reported, range or standard deviation [SD])
   - sensitivity analyses (if any)
3. conclusions, as reported by the authors of the study.

Quality assessment strategy

A single economist assessed included studies against the 35-point *BMJ* checklist for reviewers of economic analyses.[41] The questions were set out on a standard form generated before the review. These criteria can be split into three broad headings: those that relate to design issues (criteria 1–7), those that relate to data collection issues (criteria 8–19), and those that relate to analysis and interpretation of results (criteria 20–35).

Data synthesis

No attempt was made to synthesise quantitatively the studies that were identified. Data from all included studies published after 1990 were summarised and critiqued by a single economist in order to identify common results, variations and weakness between studies. The data were then interpreted alongside the results of the systematic review of effectiveness so that conclusions could be drawn on the relative efficiency of home versus hospital or satellite haemodialysis.

Results

A total of 18 studies that considered both costs and outcomes were identified from the review of the literature as eligible for inclusion. *Table 9* classifies the 18 studies according to the type of economic analysis and three study characteristics: study type (strong study designs versus uncontrolled observational study), source of data (UK versus non-UK) and focus of comparison (home versus hospital dialysis, home versus satellite dialysis versus hospital dialysis, or frequency of dialysis).

Six studies identified had a strong study design,[12,16,42–45] while 12 studies were based on data from unmatched comparisons or modelling of such data.[46–57] The studies with strong designs included four comparative observational studies[16,42,44,45] and two systematic reviews.[12,43] Many of the studies reported costs and outcomes separately and/or reported costs per life-year saved, but appropriately did not calculate incremental cost-effectiveness or cost–utility ratios, because virtually all the evidence indicates that home haemodialysis costs less than hospital haemodialysis. Three studies[43,44,48] took a cost-minimisation approach

TABLE 9 *Summary of characteristics of included published economic evaluation studies*

Type of economic analysis	Type of study		Source of data†		Focus of comparison†		
	Strong study designs*	**Uncontrolled observational**	**UK**	**Non-UK**	**Home versus hospital dialysis**	**Home versus satellite versus hospital dialysis‡**	**Frequency of dialysis**
Cost–benefit analysis		Buxton & West, 1975[46]	Buxton & West, 1975[46]		Buxton & West, 1975[46]		
Cost–utility analysis	de Wit, 1998[42]			de Wit, 1998[42]		de Wit, 1998[42]	
Cost-effectiveness analysis or separate reporting of costs and outcomes	Arkouche *et al.*, 1999[16] Ting *et al.*, 1999[45] Mohr *et al.*, 2001[12]	Stange & Sumner, 1978[57] Ludbrook, 1981[53] Garner & Dardis, 1987[49] Croxson & Ashton, 1990[47] Kooistra *et al.*, 1998[51] Mackenzie & Mactier, 1998[54] Kooistra & Vos, 1999[50] Lim *et al.*, 1999[52] Pierratos, 2000[55] Traeger *et al.*, 2001[56]	Ludbrook, 1981[53] Mackenzie & Mactier, 1998[54]	Stange & Sumner, 1978[57] Garner & Dardis, 1987[49] Croxson & Ashton, 1990[47] Kooistra *et al.*, 1998[51] Arkouche *et al.*, 1999[16] Kooistra & Vos, 1999[50] Lim *et al.*, 1999[52] Ting *et al.*, 1999[45] Pierratos, 2000[55] Mohr *et al.*, 2001[12] Traeger *et al.*, 2001[56]	Stange & Sumner, 1978[57] Ludbrook, 1981[53] Garner & Dardis, 1987[49] Croxson & Ashton, 1990[47] Mackenzie & Mactier, 1998[54] Lim *et al.*, 1999[52]	Arkouche *et al.*, 1999[16]	Kooistra *et al.*, 1998[51] Kooistra & Vos, 1999[50] Ting *et al.*, 1999[45] Pierratos, 2000[55] Mohr *et al.*, 2001[12] Traeger *et al.*, 2001[56]
Cost-minimisation analysis or systematic review of cost studies	Goeree *et al.*, 1995[44] Peeters *et al.*, 2000[43]	Delano *et al.*, 1981[48]	Peeters *et al.*, 2000[43]	Delano *et al.*, 1981[48] Goeree *et al.*, 1995[44] Peeters *et al.*, 2000[43]	Peeters *et al.*, 2000[43]	Delano *et al.*,1981[48] Goeree *et al.*,1995[44] Peeters *et al.*, 2000[43]	Peeters *et al.*, 2000[43]
Total studies	6	12	4	15	8	5	7

* *The 'Strong study designs' column includes RCTs, controlled clinical trials, prospective comparative observational studies or systematic reviews of these study designs*

† *The classification for this characteristic is non-mutually exclusive because studies may be listed in more than one category*

‡ *Satellite and self-care hospital units are interpreted to be the same type of unit in this report*

(given the lack of evidence that outcomes with home haemodialysis are worse than with hospital haemodialysis), one study took a cost–benefit approach,[46] one study took a cost–utility approach (using quality-adjusted life-years [QALYs] as outcomes),[42] and the remainder all used cost-effectiveness analysis (using life-years as outcomes) but reported costs and outcomes separately when dominance occurred. Only four of the included studies used data from the UK.[43,46,53,54]

(Additional studies identified in the literature search had cost data relevant to the UK, but they were excluded from this section because they did not look at both costs and outcomes.) Eight studies[43,46,47,49,52–54,57] had a focus on home versus hospital haemodialysis, five[16,42–44,48] provided data relevant to satellite (self-care hospital) units, and seven of the studies[12,43,45,50,51,55,56] provided comparisons pertinent to the assessment of frequency of dialysis.

The subsequent sections of this review provide a summary and critique of the included studies by focus of comparison, though the focus is on studies since 1990 because these more recent studies may be more relevant. Appendix 13 provides a summary of information from each of the included studies published after 1990, and appendix 14 assesses these studies against the *BMJ* guidelines for good economic evaluation.[41] In addition to the published literature, one of the three industry submissions provided an economic evaluation.[58] This Baxter Healthcare industry submission is discussed separately later in this chapter (page 36).

Economic evaluations of home versus hospital haemodialysis

An early economic evaluation of home versus hospital haemodialysis by Buxton and West[46] took a cost–benefit perspective for both treatments by calculating the implicit social value (i.e. the value of treatment implied by a decision to undertake treatment) of maintaining a patient on haemodialysis. This perspective is a reminder that, when comparing home versus hospital haemodialysis, an implicit judgement has been made that provision of haemodialysis is worth the social cost. Buxton and West estimated implicit social values of maintaining a patient using haemodialysis per year under a range of assumptions, always showing that the implicit social value (cost) was lower for home dialysis. Other early studies also showed that home haemodialysis resulted in lower costs per life-year saved than hospital haemodialysis,[47,57] particularly when accounting for social costs such as output gains from market and non-market activity.[49] Ludbrook[53] used a cost-effectiveness modelling approach to show that the cost per life-year gained was lower for home than hospital dialysis, but she also demonstrated that patient selection may affect the estimated results. Despite the continuing possibility of bias from patient selection, the evidence that home haemodialysis costs less and achieves health outcomes that are most likely to be at least as good as hospital haemodialysis has led to a situation in which most other studies either simply identify cost and effects separately or use a cost-minimisation approach.

A study by Mackenzie and Mactier[54] provided an assessment of home and hospital haemodialysis costs in a UK hospital-based renal unit. Outcomes were followed for home patients for 6 years, but costs were based on a single year of follow-up, so discounting was not relevant. This study showed that survival, adjusted for a number of patient characteristics, was still better for home patients than hospital patients, though the study did not adjust for length of dialysis. The estimation of annual costs of haemodialysis treatment found home haemodialysis to cost less than hospital haemodialysis (£13,577 versus £15,470, respectively, in 1994/95 pounds sterling), though the analysis did not include costs of treatments related to complications, patient transport or hospital overheads. Despite these omissions, the payback period required to recoup the higher initial costs of home haemodialysis was estimated at 14.2 months. The authors concluded that the evidence of survival benefits and increased costs of hospital treatment made home dialysis a desirable option for suitable patients, though no sensitivity analyses were provided.

Peeters and colleagues[43] undertook a systematic review of economic evaluations (excluding cost-of-illness studies) of haemodialysis in Western Europe. The review, which provides an excellent description of a thorough costing process, focuses on the adequacy of the costing methodology used. Service costs as well as costs of treating morbidity associated with treatment were assessed. The authors considered 3 sessions per week for hospital dialysis and daily sessions for home haemodialysis, if costs were provided per session. Most studies pertained to 1 year of data, so discounting was not relevant. The assessment of costs was provided using an index relative to the costs of CAPD as well as in the currencies presented in the studies. Less than half of the studies included the costs of morbidity associated with treatment, and only four studies met their standards for reporting and completeness. Despite these concerns and the fact that they calculated the cost of home haemodialysis using daily sessions, all studies showed that average annual treatment costs of home dialysis were less than those of hospital dialysis (including treatment for complications or morbidity related to treatment) due largely to lower staff use.

One exception to the dominance of home versus hospital haemodialysis occurred in a study based in Malaysia.[52] Although survival outcomes were based on up to 16 years of follow-up, cost estimates were based on treatments during a single year and were therefore not discounted. In this study, which used average rather than incremental cost-effectiveness ratios, home dialysis was found to cost more per year and resulted in fewer life-years saved than hospital haemodialysis. The authors attributed the higher cost of home dialysis to the fact that the machine was used only for one patient; this potentially

inefficient use may be particularly problematic in countries with highly constrained healthcare resources. It may also reflect this country's lower cost of labour (one of the principal savings provided by home haemodialysis, according to other studies). The reason for the estimated lower survival (based on registry data) of home patients was not clear, but it is also possible that the quality of home haemodialysis may be compromised in resource-constrained developing countries. The study therefore provides a caution that the results from most of the literature on the dominance of home over hospital haemodialysis in developed countries should not be automatically applied to all settings.

Economic evaluations of home versus satellite versus hospital dialysis

As noted above in the Peeters systematic review of costing studies,[43] haemodialysis in satellite units provides a compromise between home and hospital dialysis, avoiding some of the extra costs entailed in both settings. An early study was based on the assumption that any gains in survival for home haemodialysis patients were due to a selection benefit. This study showed that, while home dialysis initially cost more than satellite haemodialysis, the payback period (during which the higher home start-up and training costs were surpassed by satellite costs) was roughly 14 months.[48]

Goeree and colleagues[44] cited five cohort studies showing no difference in patient survival (adjusted for age and presence of diabetes mellitus) on haemodialysis versus CAPD and concluded that a cost-minimisation approach was suitable, although they did not cite results from studies of differences in survival for home versus hospital haemodialysis. Costs were measured over a 1-year period and therefore were not discounted. Their analysis, which broke down costs by overhead, support department, personnel, supplies, medication and patient treatment costs, showed that total average annual costs in 1993 Canadian dollars per patient were: Can$88,585 for hospital haemodialysis, Can$55,593 for self-care (satellite) haemodialysis, Can$44,790 for CAPD and Can$32,570 for home haemodialysis. Because the authors used some patient data, they were able to control for age, sex, renal disease, heart disease, diabetes and nutritional status; they found that only nutritional status was negatively associated with patient costs. Yet they expressed concern that their estimated cost differences may still reflect some underlying selection due to additional patient, provider or healthcare system characteristics.

The most comprehensive analysis of out-centre haemodialysis (defined to include both home haemodialysis and self-care/satellite haemodialysis) versus hospital haemodialysis was by Arkouche and colleagues.[16] While most of the focus of this study was on survival benefits of out-centre versus hospital haemodialysis (as discussed earlier in chapter 2), a brief assessment of the annual treatment costs of the three forms of haemodialysis in France was provided based on results from another study using data from 1 year of treatment.[11] The estimated expenditures in US dollars per patient were US$80,000 for hospital haemodialysis, US$50,000 for self-care/satellite haemodialysis, US$42,000 for CAPD and US$42,000 for home haemodialysis. These estimates are fairly similar to the Canadian estimates provided above,[44] except that the French estimate of the cost of home haemodialysis relative to other venues was slightly higher. While survival did not differ between the home and self-care/satellite patient groups, the authors were very enthusiastic about the possible advantages of self-care haemodialysis (including the fact that the patients had sole use of a machine and could schedule sessions at their convenience), despite the slightly higher cost.[16]

The only economic evaluation identified in our review that assessed QoL as well as survival and costs was a study performed in The Netherlands by de Wit.[42] This study used a 5-year Markov modelling approach and provided separate analysis of costs by age and first versus subsequent years of treatment. The study indicates that the perspective was societal, but excluded time and work-loss costs. Treatment-associated hospitalisation costs varied substantially by age. Because the author had data for only five patients receiving home haemodialysis, these patients were pooled with the satellite centre patients for measuring outcomes. Given the similarity in survival benefits found by Arkouche and colleagues,[16] such pooling is probably reasonable. QoL was measured using the EuroQoL-5 dimensions (EQ-5D), the standard gamble and the TTO methods for eliciting health state preferences. Because of some inconsistencies in the rankings of patient valuations, the author used general population measures for the base case analysis. Relative to hospital haemodialysis and ignoring the rankings for peritoneal dialysis, the models showed that home haemodialysis had the lowest annual treatment costs and highest QoL, followed by satellite dialysis. More specifically, hospital haemodialysis was the most expensive treatment and resulted in the lowest QoL as valued by the general population. The implications of the incorporation of different lengths of survival

were unclear, and average rather than incremental cost-effectiveness ratios were presented (possibly due to the dominance of home/satellite haemodialysis over hospital haemodialysis). Because of the inconsistencies in the ranking of QoL using different instruments plus the fact that for some of the treatments the QoL differences were not substantial (e.g. across the different forms of peritoneal dialysis), de Wit suggested that the QoL comparisons may not be a pivotal factor in policy decisions pertaining to ESRF treatments.

Economic evaluations of frequency of dialysis

It is important to remember that, because the focus of our analysis is on home versus hospital or satellite haemodialysis, our systematic review did not necessarily identify all studies conducting an economic evaluation of the frequency of dialysis. Pierratos[55] provided a review of the literature of outcomes and costs of the frequency of dialysis, though the methods used for identifying articles were not specified, and it has not been classed as a systematic review. As mentioned earlier, Peeters and colleagues[43] found home haemodialysis to consistently cost less per year of treatment than hospital dialysis or satellite dialysis, even though, when studies provided costs per session, they assumed that daily haemodialysis was provided in the home.

Because daily haemodialysis may not only increase frequency but also increase the total weekly dialysis dose, Kooistra and colleagues[50,51] conducted their comparison, of 3 versus 6 sessions per week for home haemodialysis patients, under conditions in which they held the weekly dose constant. Their study followed 13 patients for up to 24 years (mean, 9.7 years). The authors found beneficial effects on a number of clinical measures and also showed a significant improvement in QoL based on measures in the Nottingham Health Profile and the SF-36, though the patient samples were extremely small. They provided a very rough estimate of costs separately from their more detailed assessment of health outcomes, but they were not able to estimate reductions in costs of hospitalisations due to the small sample of patients. The authors reported, however, that the costs of daily home haemodialysis in The Netherlands were roughly comparable to the costs of hospital haemodialysis 3 times per week if a nurse was involved, and that the costs of daily home haemodialysis were roughly comparable to the costs of CAPD if a nurse was not involved. The former comparison, if valid, would favour home haemodialysis over hospital haemodialysis because outcomes would be better, or at least the same, at equivalent or lower cost, though explicit sensitivity analyses were not conducted.

Traeger and colleagues[56] conducted an observational assessment of 15 patients who were converted from standard haemodialysis to short daily haemodialysis, though they assessed differentially the effects of frequency and increases in the weekly dose. The authors found improvements in clinical outcomes that they attributed to increases in frequency rather than weekly dose. Average annual treatment costs of home short daily and self-care hospital daily haemodialysis were approximately equal and were less than hospital haemodialysis, although they were more than dialysis 3 times per week at home. Like Kooistra and colleagues,[50,51] however, Traeger and colleagues considered only treatment costs and did not consider the implications of daily treatment for possible reductions in treatment-associated costs such as hospitalisation for complications.

In a study from the USA, Ting and colleagues[45] used data from 22 patients to assess the full cost implications of short daily haemodialysis versus hospital haemodialysis 3 times per week. Patients were selected prospectively, and each patient served as his or her own control. Productivity and transport costs were excluded. The authors reported improvements in clinical measures and QoL as well as annual reductions in costs for the year after switching treatment compared with the year prior to switching. The reduction in costs of US$4241 per year was not statistically significant, possibly due to the small sample size.

The strongest economic evaluation to date of short daily haemodialysis (at home or in hospital) or nocturnal haemodialysis versus hospital dialysis 3 times per week was provided by Mohr and colleagues.[12] This study was a systematic review of the evidence of the outcomes from these different treatments and modelling of the costs of direct health services from a societal (i.e. all payers for health services) perspective using a clinical decision analysis framework. Costs were based on Medicare payments and estimated patient payments from a single year, so discounting was not necessary. The review found evidence of improvements in clinical outcomes and QoL for patients on short daily haemodialysis. The economic modelling for a base case scenario showed that simulated costs were lower with all three modalities of treatment involving daily treatment versus haemodialysis 3 times per week. Estimated

annual costs in 1998 US dollars were: US$68,400 for conventional hospital haemodialysis, US$60,800 for short daily hospital haemodialysis, US$57,700 for nocturnal home haemodialysis and US$57,400 for short daily home haemodialysis. The cost reductions resulted primarily from reductions in hospital days. Sensitivity analysis regarding expected costs showed that there was considerable uncertainty in the estimates; for example, daily dialysis was actually cost-increasing under their worst-case scenario but resulted in a 50% reduction in costs under their best-case scenario.

Baxter Healthcare industry submission

This section describes and comments on the economic evaluation provided in the Baxter Healthcare industry submission.[58] The first section below provides a summary description of the design of their economic evaluation. Subsequent sections describe and critique their data collection and analysis approach.

Baxter Healthcare submission design issues

While the scope for this HTA review is to compare the costs and outcomes of home versus hospital haemodialysis, Baxter Healthcare[58] conducted a review of the economic literature and concluded that such a comparison was not necessary, because their review of the literature indicated that home haemodialysis offers improved survival and health outcomes, with lower costs than hospital haemodialysis. Rather than use an economic model to explore uncertainty in this conclusion, the implications of the frequency of dialysis for the cost-effectiveness or dominance of home haemodialysis, or the use of a specialist hospital versus a satellite centre (i.e. the three options as addressed in this report), the Baxter Healthcare submission chose to specify an "integrated care pathway" of state-of-the-art optimal care for renal failure patients and used Markov modelling to compare the "integrated care pathway" with treatment currently provided under the NHS.

Data collection issues: review of the literature

The Baxter Healthcare submission[58] provides estimates of home and hospital haemodialysis effectiveness and cost using industry data and estimates from the literature. Several points are relevant. First, the review of the literature did not specify the methodology used to identify the studies, so it is not clear whether a systematic review approach was used. Second, the Baxter Healthcare submission did not critique the study design of the included studies, though it did indicate that some studies attempted to adjust for possible patient selection that might have resulted in biased assessment of survival benefits of home versus hospital haemodialysis. Third, the submission reported only point estimates of costs and outcomes, and did not report or analyse the effects of uncertainty in the estimates. Fourth, as is appropriate for this assessment, the perspective of the Baxter Healthcare analyses was primarily that of the health service (e.g. costs to the NHS), though the submission does discuss the extent of costs beyond NHS costs, especially in a discussion of costs to patients and families (submission pages 34–35).[58]

Analysis issues: Baxter Healthcare's Markov modelling of "integrated care pathway"

The Baxter Healthcare submission's Markov model compared the "integrated care pathway" versus current provision of dialysis services under the NHS over a 20-year period. Following National Institute for Clinical Excellence (NICE) guidelines, outcomes were discounted at 1.5% and costs were discounted at 6%. For the NHS current provision scenario, transition probabilities between various states (e.g. home haemodialysis, peritoneal dialysis, hospital haemodialysis and transplantation) were derived from the UK Renal Registry.[59] The transition probabilities from the UK Renal Registry pertain only to the first 2 years following initiation of treatment, but the submission authors applied them to the full 20-year cycle. For the "integrated care pathway" scenario, three assumptions were introduced (submission page 41).[58]

- All new patients entered dialysis through an improved pre-dialysis service that reduced the use of acute unplanned dialysis to < 10% of all new patients, rather than the current 37%.
- Home haemodialysis was chosen by 15% of all dialysis patients (compared to the current 2%) instead of hospital haemodialysis.
- Half of patients were selected for peritoneal dialysis.

While the "integrated care pathway" scenario is quite appealing, it is not clear that it can be achieved without specific intervention. More to the point, it is not clear why Markov modelling is appropriate for this hypothetical comparison. Markov modelling seems best suited to compare alternative treatments for a particular patient population (e.g. home haemodialysis versus hospital haemodialysis, or 3 versus 6 haemodialysis sessions per week). In the Baxter Healthcare comparison, however, the beneficial alternatives (e.g. reduction in the use of unplanned dialysis, greater use of home dialysis and greater use of peritoneal dialysis) were simply mandated. It is no surprise, therefore, that outcomes (measured by patients alive at 20 years,

total life-years and QALYs) were better and costs were lower under the dominant "integrated care pathway" scenario versus the current NHS scenario. Furthermore, the main text of the Baxter Healthcare submission does not identify the sources of uncertainty incorporated into the Markov model, so the extremely narrow CIs on the estimated costs and outcomes are difficult to interpret.

Summary comments on economic evidence

While patient selection issues are difficult to control for completely, the evidence is consistent with a situation in which the health outcomes from home or satellite haemodialysis are at least as good or better than the health outcomes achieved from hospital haemodialysis. Regarding costs, the evidence suggests that average annual amortised treatment costs are less for home haemodialysis than for hospital dialysis, though the exact cost advantage is difficult to determine due to potential patient selection. Many of the studies presented results on outcomes and costs separately, because outcomes were usually at least as good with home haemodialysis and average annual treatment costs were less. Yet the failure to incorporate survival and model lifetime costs meant that the literature is unclear on the extent to which lifetime costs differ. In particular, it is unclear whether the lifetime costs of someone starting on home haemodialysis are lower than those of a patient starting on hospital haemodialysis (if people receiving home haemodialysis survive longer, then they will also accrue more dialysis costs). Despite the initially higher costs of home haemodialysis due to set-up and training costs, the payback period for these higher costs (based on data from a study published in 1981[48]) appears to be roughly 14 months, which is shorter than the survival of some patients with ESRF who could be treated at home.

The studies included in the review of economic evaluations use similar health outcomes for home and satellite haemodialysis. The review of effectiveness reported in chapter 2 suggests that home haemodialysis may be associated with slightly better outcomes, though once again selection may explain at least part of the association.

Different forms of satellite units may vary considerably in cost, depending on the degree of staffing intensity and the ability to maximise continuous use of the machines. While satellite haemodialysis was generally found to cost more than home haemodialysis, some researchers noted benefits that are hard to quantify, such as patient and family preferences for having treatment outside of the home. The situation is undoubtedly affected, however, by whether someone lives alone and whether a carer needs to go into the home.

The review of frequency provided some indication of the dominance of short daily or nocturnal home haemodialysis over hospital haemodialysis, because outcomes would be better and costs may be lower once expected reductions in hospitalisation rates are considered. It is important to note, however, that this review was not targeted to provide an assessment of the incremental cost-effectiveness of the benefits and costs of home haemodialysis 3 times per week versus daily.

One industry submission[58] contained an economic analysis, but the focus of the modelling in this submission was on the costs of a conceptualised ideal integrated care pathway. While such an approach is theoretically appealing, the focus of this review is on the comparison of home versus satellite or hospital dialysis as currently practised in the UK, with some attention to the implications of daily home haemodialysis (short or nocturnal) versus conventional hospital haemodialysis 3 times per week. Therefore, the next chapter of this review provides an economic model of these comparisons and extends the current literature by incorporating considerations of uncertainty in the estimates of outcomes and costs.

Chapter 4

Modelling cost-effectiveness and utility

The main economic evaluation assesses the cost-effectiveness of home haemodialysis relative to the alternative of hospital haemodialysis or satellite unit haemodialysis. Additional analyses include an assessment of the increased frequency and duration of home haemodialysis relative to the standard frequency of 3 sessions per week provided in hospital.

Basic model

The economic evaluation was conducted using a Markov model, constructed using DATA™ 4.0 software (TreeAge Software Inc., USA). The model was designed to estimate costs and outcomes over the lifetime of a cohort of typical patients for the different management strategies (*Figure 2*). A subgroup analysis was performed for cohorts of adults at high, moderate and low risk.

Patients in the model start in one of the following three states: home haemodialysis (although this state initially includes a stabilisation and training period), hospital haemodialysis or satellite haemodialysis. Patients can be in only one state of health at any one time and can make a transition (a movement between these states) only once per cycle. A cycle is a discrete time period considered in the model as the minimum length of time someone can be in a particular state.

Death, transplantation and CAPD are included in the model only as 'absorbing' states. Once an individual makes a transition into one of these states, none of the costs or benefits incurred in these states are included in the analysis.

As shown in *Figure 2*, patients in the home haemodialysis state can stay in the same state during the cycle or be transferred to hospital haemodialysis, satellite haemodialysis, CAPD, transplantation or death at the end of the cycle. Patients in hospital haemodialysis can stay in the same state or be transferred to home haemodialysis, satellite haemodialysis, CAPD, transplantation or death at the end of the cycle. Patients in satellite haemodialysis can stay in the same state during the cycle or be transferred to hospital haemodialysis, home haemodialysis, CAPD, transplantation or death at the end of the cycle.

To populate the model, data were required on direct health service costs, probabilities of transition to the specified health states, probabilities of specific events used to estimate the cost of the specified states (e.g. non-fatal complications), and QoL estimates.

Costs

The model will include the direct health service costs associated with the treatment options. In order to provide an indication of costs that may be borne by patients and their families, time and travel costs as well as productivity changes are also estimated, although these are reported separately.

All cost data are presented in 2001/02 pounds sterling. A cost per year is calculated for each state of health in the model. The model used to estimate the present value of the costs is:

$$PVC_A = C_1 + \sum_{t=0}^{n} [(P_{1t})(P_{2t})C_2] \div (1 + 0.06)^n$$

where PVC_A is the present value of the cost of dialysis over n years for $t = 0,\ldots n$ years and for A representing one of the treatment alternatives in *Figure 2*, and:

C_1 = total cost of access surgery/set-up
P_{1t} = probability of being alive in year t
P_{2t} = probability of being in any of the three states of dialysis considered
C_2 = costs of dialysis
6% = discount rate for healthcare costs.

The costs are calculated by measuring the resources used for each patient, or per event in the case of complications (*Table 10*). This information has, as outlined below, been obtained from previous studies.

Cost estimates for each method of haemodialysis

Hospital haemodialysis

The costs for each of the items reported in *Table 10* are detailed below. Except in cases otherwise noted, the cost data were obtained from the European Dialysis and Cost-Effectiveness

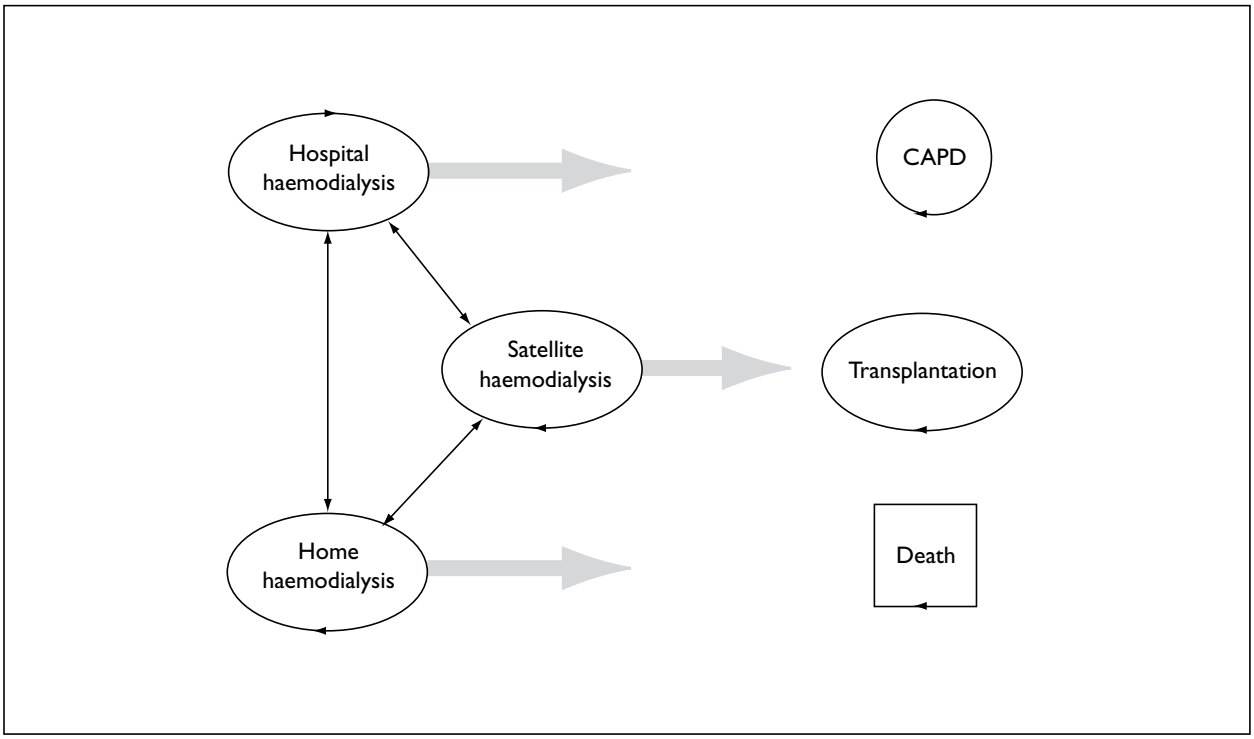

FIGURE 2 *Structure of the Markov model: patients in one of the three haemodialysis states can stay in that same state during a cycle or be transferred at the end of the cycle to a different haemodialysis state or to one of the 'absorbing' states (CAPD, transplantation or death)*

TABLE 10 *Summary of data sources for each area in which resource use may occur*

Costs	Relevant variables	Method of costing	Reported outcome
Access	Access surgery/set-up cost	Calculated as an equivalent annual cost for all reusable items involved in the surgery and a one-time cost for all consumable items. Labour costs were based on the high and low estimates (obtained from the operating theatres) of time and staffing for each surgical procedure	Cost per event
Training	Training costs	Time spent by NHS staff in the training of patients for the procedure	Cost per patient
Dialysis	Consumables	Resource use by the individual: drugs and other consumables	Cost per patient
	Capital costs, including building and equipment	Calculated from yearly cost data obtained from Grampian University Hospitals NHS Trust	Cost per patient
	Consultant and junior time for patient	Based on estimates of staff time per dialysis session	Cost per patient
	Nursing costs	Based on estimates of staff time per dialysis session	Cost per patient
Complications	Costs of intradialytic complications	By number of episodes and identification of the resources used for each type of complication	Cost per event
	Costs of interdialytic complications	By number of episodes and identification of the resources used for each type of complication	Cost per event

(EURODICE) study.[60] The costs in this study were reported in 1998/99 UK pounds sterling and have been adjusted for inflation (using the Hospital and Community Health Services inflation index) to 2001/02 UK pounds sterling.

Access costs
The costs of access surgery came from Kirby and Vale.[61] The costs of creating the arteriovenous fistula were calculated by identifying items of resource use from studies and by consulting the renal administrator at Grampian University Hospitals NHS Trust (GUHT) in Aberdeen. Local prices were then attached to each item, and drug costs were obtained from the *British National Formulary*.[62] The cost of creating access was estimated to be £2151.

Training costs
Hospital haemodialysis patients do not require the training that home haemodialysis patients need. The cost of training per hospital haemodialysis patient is assumed to be £0.

Building costs
For building space, an equivalent annual cost was calculated by taking the cost of the building space used and amortising this cost based on the estimated lifespan of the building, using the appropriate discount rate (6%). The amortisation was done assuming a 50-year lifespan. A cost of hospital building space used per dialysis session was calculated at £7.16. Assuming dialysis 3 times per week per patient, the yearly cost of building space per dialysis patient was £1117.

Equipment/systems costs
Four types of equipment costs were included:

- dialysis machines (including maintenance)
- water treatment systems
- computers
- anticoagulation ultrasound (used occasionally to check the fistula for clotting).

The lifespan of each type of equipment was assumed to be 10 years, and an equivalent annual cost was calculated using the same amortising methods described above. Costs per year were calculated assuming that dialysis occurred 3 times per week. The dialysis machine cost per dialysis session was estimated at £4.61, resulting in a dialysis machine cost per patient-year of £719.66. The water treatment cost per dialysis session was calculated at £1.67, resulting in a yearly water treatment system cost per patient of £260.94. The computer cost per dialysis session was £0.03 in 1998/99; adjusting for inflation, the yearly computer cost per patient was £4.99. The anticoagulation ultrasound cost per session was estimated at £0.27, resulting in a yearly ultrasound cost per patient of £41.55. The total equipment/system cost per patient per year was therefore estimated at £1027 (i.e. £719.66 + £260.94 + £4.99 + £41.55).

Consumables
Data from the EURODICE study[60] were used to estimate the cost of consumable supplies for the dialysis sessions. In the EURODICE study, resource use per patient per session was recorded and costed (*Table 11*). A cost per dialysis session was calculated to be £42.98 in 1998/99. Assuming dialysis 3 times per week, the yearly consumable cost per patient was £6704.88 (£42.98 × 3 × 52). After adjusting for inflation, the yearly cost was estimated to be £7143 in 2001/02.

Medical staff
Data from the EURODICE study[60] were used to estimate the cost of medical staff at £5.26 per session in 1998/99. Assuming dialysis 3 times per week and adjusting for inflation, the yearly medical staff cost per patient in 2001/02 was £874.

Nursing staff
Based on data from the EURODICE study,[60] the cost of nursing staff per dialysis session was £40.10 in 1998/99. Assuming dialysis 3 times per week and adjusting for inflation, the yearly nursing staff cost per patient in 2001/02 was estimated at £6665.

Interdialytic complication cost
Data from Kirby and Vale[61] and Bremer and colleagues[17] were used to estimate the cost of interdialytic complications. From the Bremer study,[17] an estimate of number of days in hospital per year was obtained (13.4 days for home haemodialysis and 15.1 days for hospital haemodialysis). A cost per day in hospital was obtained from Kirby and Vale,[61] adjusted for inflation, and a total cost per year per patient was computed to be £3119.

Intradialytic complication cost
Data from Kirby and Vale[61] and Westlie and colleagues[31] were used for the cost of intradialytic complications. The percentage of complications (including vomiting, cramping and hypotension) per dialysis session was obtained from the Westlie study.[31] Assuming that complication rates remain constant and taking treatment costs from Kirby and Vale,[61] adjusted for inflation, an intradialytic complication cost per patient per year was computed to be £149.

TABLE 11 *Amount and cost of consumables used in a dialysis session*

Item	Units per package	Cost per package	Units per session	Cost per session
EPO	1000	£8.78	2000	£17.56
Antiseptic	1 litre	£5.23	50 ml	£0.26
Hypochlorite	5 litres	£4.38	250 ml	£0.22
Bicarbonate	10 litres	£1.70	10l	£1.70
Dialysate	5 litres	£3.50	5l	£3.50
Heparinised saline	Per dose	£1.95	1	£1.95
Heparin	5 ml	£0.86	7.5 ml	£1.29
Lignocaine	10 x 2 ml	£0.86	1 x 2 ml	£0.09
Dialyser	1	£7.75	1	£7.75
Dialysis needle	50	£32.90	2	£1.32
Hypodermic needle (25 gauge)	50	£1.60	1	£0.03
Hypodermic needle (21 gauge)	50	£1.60	1	£0.03
Hypodermic needle (19 gauge)	50	£1.92	1	£0.04
Hypodermic syringe (2 ml)	100	£3.00	2	£0.06
Hypodermic syringe (10 ml)	100	£5.00	2	£0.10
Hypodermic syringe (20 ml)	1	£0.15	1	£0.15
Bag priming (Cobe)	200	£141.00	1	£0.71
Dialysis line blood set	1	£4.23	1	£4.23
Dialysis priming set	100	£72.85	1	£0.73
Procedure pack C	1	£0.45	1	£0.45
Adhesive poly transpore (1.25 cm)	10 m	£0.20	6 cm	£0.001
Adhesive poly transpore (2.5 cm)	10 m	£0.40	6 cm	£0.002
Cotton wool balls	5	£0.05	5	£0.05
Gauze swab, sterile	5	£0.10	5	£0.10
Wipes, hard surface	200	£2.58	1	£0.01
Swab, pre-inject	100	£0.66	1	£0.01
Gloves, non-sterile pair	100	£2.29	2	£0.05
Apron	100	£2.02	2	£0.04
Plastic bag, clear (100 gauge)	50	£0.79	1	£0.02
Plastic bag, clear (400 gauge)	10	£0.79	0.5	£0.04
Plastic bag, orange (160 gauge)	50	£1.11	2	£0.04
Paper towels	100	£9.84	4	£0.39
Wipes	135	£4.14	1	£0.03
Cin bins (shared)	1	£1.10	0.0336	£0.04
Total cost per session				£42.98

Satellite haemodialysis

The basic economic model assumes that the costs of satellite haemodialysis access, building space, training, consumables, and interdialytic and intradialytic complications are the same as those of hospital haemodialysis. Therefore, only the methods for estimating staff costs are described below.

Medical staff costs

A recent study[8] on the organisation and delivery of healthcare in satellite renal units in England and Wales showed that only 12% of satellite units had permanent daytime cover on the site. The annual cost of medical staff for satellite haemodialysis was calculated by multiplying the cost of medical staff for hospital haemodialysis,

reported above at £874, by the proportion of satellite units with medical cover (12%) reported by Drey and colleagues.[8] This calculation gave an annual cost per patient of £105.

Nursing staff costs
Total nursing staff costs were estimated at £6452. Data from EURODICE[60] and Drey and colleagues[8] were used to estimate the cost of nursing staff. The unpublished study by Drey and colleagues[8] reported that there were 6.07 nurses per centre or 0.76 whole-time-equivalent nurse per dialysis session. Assuming one nurse of grade G and 5.07 nurses of grade E, the cost per session per patient was £41.36 for a dialysis session of 4.5 hours. Therefore, the annual nursing cost per patient per year for satellite haemodialysis was £6452.

Home haemodialysis
For home haemodialysis, the cost of access and consumable supplies was assumed to be the same as for satellite and hospital haemodialysis. All the other costs varied for home haemodialysis, as described in separate sections below.

Training costs
The total training cost per patient was estimated to be £51.39. Data from the renal administrator at GUHT were used for the estimation of training cost. It was estimated that the training period would last for 8 weeks and that a whole-time-equivalent grade E nurse would be assigned during the dialysis session. The training cost per dialysis session during the training period was calculated to be £2.14. Assuming 3 dialysis sessions per week per patient, the training cost per patient was £51.36 (£2.14 × 3 sessions × 8 weeks). The impact of a longer training period was considered in the sensitivity analysis.

Building costs
Data from the renal administrator at GUHT were used to estimate building costs. Three examples of home conversion were used, and an average cost was computed. The equivalent annual cost was calculated by assuming the conversions would have a lifespan of 4 years, based on opinions from experts. The calculations resulted in a home building cost per patient per year of £1291.

Equipment/system set-up costs
The costs included in equipment/system set-up costs were:

- dialysis machines (including maintenance)
- water treatment systems.

A cost per home haemodialysis session was calculated based on data from EURODICE,[60] under the assumption that the patient was the sole user of the machine at home. An equivalent annual cost per machine (including repairs per year of £526.31) was calculated to be £2360 in 1998/99. Adjusting for inflation, the dialysis machine cost was £2514 in 2001/02.

Data from the renal administrator at GUHT were used to compute the water system cost, which included filters and maintenance based upon the salary cost of a technician visit (calculated at £122.40 per patient per year). The technician was assumed to make a 30-mile round trip (the target distance of the new renal satellite policy). The travel cost (calculated per mile[63] for vehicles up to 2000 cc and assuming an average use of 15,000 miles per year) was £102.80 per patient per year. Finally, an equivalent annual cost of £483.01 was calculated by taking the cost of the water system and amortising it for the estimated lifespan (10 years) of the water system at the appropriate discount rate (6%). The total annual water system cost, including spares and maintenance, was £708.21. The total equipment/system set-up cost per patient per year for the dialysis machine and water was £3233.

Nursing and medical staff costs
Data from Mackenzie and Mactier[54] and EURODICE[60] were used to estimate combined nursing and medical staff costs. The annual cost of staff for home haemodialysis was calculated by multiplying the cost of nursing and medical staff for hospital haemodialysis from EURODICE (£7540)[60] by the proportion of staff cost of home haemodialysis with respect to hospital haemodialysis (36.7%) reported by Mackenzie and Mactier.[54] The total staff cost per patient per year was calculated to be £2767.

Interdialytic complication costs
Data from Kirby and Vale[61] and Bremer and colleagues[17] were used to estimate the cost of interdialytic complications. The number of days in hospital per year was estimated at 13.4 days, based on the Bremer study.[17] The cost per day in hospital was obtained from Kirby and Vale,[61] and updated to 2001/02 prices to give a hospital cost from interdialytic complications per patient per year of £2768 (£206.57 × 13.4).

Intradialytic complication costs
The percentage of complications (including vomiting, cramping and hypotension) per dialysis session was obtained from Westlie and

colleagues.[31] Assuming constant complication rates and using the cost of resources reported by Kirby and Vale,[61] an intradialytic complication cost per patient per year was computed to be £65.34 (£6.27 + £51.22 + £7.84 rounded to nearest £0.01).

Summary of costs

Table 12 summarises the cost information described above. It also provides details of the primary source of information for each type of cost.

Transition probabilities

The transition probabilities (e.g. the probability of starting with home haemodialysis and switching to, for example, satellite haemodialysis or CAPD) are listed in *Table 13*. Not all the probabilities required were retrieved directly from the literature, because some were estimated by using the requirements of the Markov model that each row of the matrix of possible transitions should sum to one. As previously noted, CAPD, death and transplantation are taken as absorbing states in the model. Data from the UK Renal Registry[59] and the effectiveness review described in chapter 2 were used to estimate the transition probabilities. Risk of death was based on annual rates of mortality over the 5-year time horizon of the model for younger patients (aged less than 50 years) without any co-morbidity. These mortality rates were taken from Hellerstedt and colleagues[22] and were used for the base analysis of the Markov model. It was assumed that the mortality rates for satellite haemodialysis were the same as those for hospital haemodialysis (*Table 14*).

A sensitivity analysis was carried out on mortality rates. A weighted average mortality rate was computed for home and hospital haemodialysis for every year. Two studies were used to calculate this average: Hellerstedt and colleagues[22] and Mailloux and colleagues.[24] The weights were based upon the sample size of these studies. 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 (y) as a function of the number of years since starting treatment (x) were:

for hospital or satellite haemodialysis:
$y = -0.0950x + 0.9650$
for home haemodialysis:
$y = -0.06x + 1.0167$.

Due to the lack of data available for the base case analysis of the model, transfer probabilities from home haemodialysis to hospital haemodialysis and to satellite haemodialysis were taken as zero, and the transfer probabilities from hospital haemodialysis to home and satellite haemodialysis were also taken as zero. These assumptions were tested in the sensitivity analysis described below (*Sensitivity and subgroup analysis*). For the purposes of this study, it was assumed that mortality rates and transition probabilities were constant from the fifth year onwards. An example of the matrix of the transition probabilities is shown in *Table 15*, which reports the transition probabilities for the first year. Similar matrices for subsequent years are reported in appendix 15.

TABLE 12 *Summary of costs per patient per year for the dialysis modalities considered in the base case analysis*

	Hospital haemodialysis		Satellite haemodialysis		Home haemodialysis	
	Value (£)	**Reference**	**Value (£)**	**Reference**	**Value (£)**	**Reference**
Access costs	2,151.29	61	2,151.29	61	2,151.29	61
Training costs	0		0		51.29	60
Equipment/systems	1,027.14	60	1,027.14	60	3,233.00	17,60,63
Building costs	1,116.89	60	1,116.89	60	1,291.11	
Consumables for 3 sessions per week	7,143.44	60	7,143.44	60	7,143.44*	60
Medical staff	874.23	60	104.90	7,60	Included in nursing staff	
Nursing staff	6,664.78	60	6,452.16	7,60	2,766.87†	54,60
Interdialytic complications	3,119.19	17,61	3,119.19	17,61	2,768.30	17,61
Intradialytic complications	148.97	31,61	148.97	31,61	65.34	31,61
Total cost	**22,246**		**21,264**		**19,470**	

* *The cost of consumables for 6 sessions per week would be £14,287*
† *Medical and nursing staff costs are combined for home haemodialysis*

TABLE 13 *Transition probabilities*

Starting on home haemodialysis (HomH)
P1 = probability of starting in HomH and staying in HomH
P2 = probability of starting in HomH and transferring to HspH
P3 = probability of starting in HomH and transferring to SatH
P4 = probability of starting in HomH and transferring to CAPD
P5 = probability of starting in HomH and transferring to transplant
P6 = probability of starting in HomH and transferring to death
Starting on hospital haemodialysis (HspH)
P7 = probability of starting in HspH and transferring to HomH
P8 = probability of starting in HspH and staying in HspH
P9 = probability of starting in HspH and transferring to SatH
P10 = probability of starting in HspH and transferring to CAPD
P11 = probability of starting in HspH and transferring to transplant
P12 = probability of starting in HspH and transferring to death
Starting on satellite haemodialysis (SatH)
P13 = probability of starting in SatH and transferring to HomH
P14 = probability of starting in SatH and transferring to HspH
P15 = probability of starting in SatH and staying in SatH
P16 = probability of starting in SatH and transferring to CAPD
P17 = probability of starting in SatH and transferring to transplant
P18 = probability of starting in SatH and transferring to death

Probabilities for the different risk groups

The data presented thus far are for the base case of younger patients (aged less than 50 years and without serious co-morbidities). Mortality rates for diabetic patients were estimated from cumulative survival curves from Hellerstedt and colleagues.[22] Data from the review on effectiveness suggested that the risk of death for patients older than 65 years, compared with patients aged 40–45 years, lay within the interval 1.8 and 2.48 (*Table 16*). These two values were used to compute mortality rates for diabetic and non-diabetic patients older than 65 years. Based on data from the UK Renal Registry[59] 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 above.

Discounting

Following NICE guidelines for conducting health technology assessments,[64] discount rates of 6% and 1.5% per annum were applied to costs and health-related QoL values, respectively. Therefore, all benefits and costs that occur in the future will be given less weight than costs and benefits that occur in the present.

TABLE 14 *Survival rates for hospital and home haemodialysis patients, based on Hellerstedt and colleagues*[22]

Modality	Cumulative survival rates				
	Year 1	Year 2	Year 3	Year 4	Year 5
HspH	0.87	0.74	0.64	0.57	0.55
HomH	0.94	0.86	0.75	0.64	0.64

TABLE 15 *Markov model transition probabilities for first year on RRT*

Modality	Transition probability					
	HspH	SatH	HomH	CAPD	Transplant	Death
HspH	0.78*	0	0	0.06	0.03	0.13†
SatH	0	0.78*	0	0.06	0.03	0.13†
HomH	0	0	0.85*	0.06	0.03	0.06†
CAPD	0	0	0	1	0	0
Transplant	0	0	0	0	1	0
Death	0	0	0	0	0	1

* *Calculations based on the requirement that the added probabilities of the row in the matrix must equal 1*
† *Mortality rates obtained from Hellerstedt* et al.[22]

TABLE 16 *Mortality rates for different risk groups of adults, estimated from survival curves from Hellerstedt and colleagues*[22]*

Scenario	Modality	Mortality rate				
		Year 1	Year 2	Year 3	Year 4	Year 5
Diabetic patients aged less than 65 years	HspH HomH	0.17 0.1	0.19 0.27	0.09 0.07	0.06 0	0.08 0
Non-diabetic patients older than age 65 years (index for adjustment of age, 1.8)	HspH HomH	0.234 0.108	0.234 0.144	0.18 0.198	0.126 0.162	0.036 0
Non-diabetic patients older than age 65 years (index for adjustment of age, 2.48)	HspH HomH	0.312 0.144	0.312 0.192	0.24 0.264	0.168 0.216	0.048 0
Diabetic patients older than age 65 years (index for adjustment of age, 1.8)	HspH HomH	0.306 0.18	0.342 0.486	0.162 0.126	0.108 0	0.144 0
Diabetic patients older than age 65 years (index for adjustment of age, 2.48)	HspH HomH	0.408 0.24	0.456 0.648	0.216 0.168	0.144 0	0.192 0

* *Due to the small number of people in the study, the mortality rates for the later years are likely to be of limited validity*

Outcomes

The Markov model incorporates effectiveness data in terms of both quantity and quality of life. Appropriate QoL adjustment weights (e.g. values ranging from 0 for death to 1 for full health) obtained from the literature are used to weight the time in each state within the model. The summation of time spent in each health state is used to estimate life expectancy weighted by QoL in order to obtain estimated QALYs. QoL weights were taken from the study by de Wit.[42] The author reported values (± SD) of 0.66 ± 0.29 and 0.81 ± 0.24 for the comparison of hospital and satellite haemodialysis. These estimates were based on valuations obtained using the EQ-5D instrument and using the UK general population tariff developed for this instrument. In the model, it was assumed that home haemodialysis would be assigned the same QoL weight as satellite haemodialysis. The model assumed that all patients were in the same underlying health state prior to treatment or entry into the model. This is an important caveat in interpreting the results of the evaluation.

In 1988, Churchill[34] used a TTO approach to derive a QoL weight for home and hospital haemodialysis. The TTO scores for home and hospital haemodialysis were 0.49 and 0.43, respectively. As these data indicate that home haemodialysis was associated with a 13.95% higher QoL, this rate was applied to the data from de Wit[42] for satellite haemodialysis (0.82) to give a value for home haemodialysis of 0.92.

Further sensitivity analysis was conducted to facilitate comparison with the industry submissions. In this sensitivity analysis, the data from Churchill alone were used.[34] The values used were: 0.49 for home haemodialysis, 0.43 for hospital haemodialysis, and between 0.43 and 0.49 for satellite haemodialysis.

Sensitivity and subgroup analysis

In addition to the sensitivity analysis on mortality rates and QoL described above, sensitivity analysis was performed for the staffing levels of home and satellite haemodialysis, the inclusion of travel costs and the allowances for home haemodialysis. Finally, due to the paucity of data on outcomes, sensitivity analysis was used to consider the implications of equal survival and/or QoL provided by treatment with the different modalities.

For variations in home haemodialysis staffing, the impact on cost and cost per QALY of the provision of a carer who would help to set up home haemodialysis sessions was considered. The rationale behind this analysis is that such care may make it possible for home dialysis to be received by stable patients who do not have

someone fit, able and willing to act as a carer. In this analysis, a grade A carer is assigned for the length of the dialysis session and to assist with set-up and clearing up afterwards. Under this option, the cost of medical and nursing staff per patient per year was £4187.

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 be of widely different sizes and have different clinical and nursing staffing levels. In the sensitivity analysis, two extreme options were considered: (1) a satellite unit with a level of staffing similar to that of a hospital unit and (2) a satellite unit with minimal nursing and clinical cover (which might be better described as a minimal care unit). In the first option, the cost of staff per patient per year was assumed to be the same as in a hospital unit, and in the second, it was assumed to be the same as in home haemodialysis.

A further sensitivity analysis was performed based on the assumption that there were no differences in outcomes between the different dialysis modalities. Although strenuous efforts were made to identify studies that adjusted for case mix between home, hospital and satellite haemodialysis, it is not clear that the methods adopted by the studies were adequate. It is conceivable that, in functional terms, home haemodialysis of equal duration and frequency to dialysis provided in a hospital or satellite unit would provide the same outcomes.

The final piece of sensitivity analysis conducted relates to the inclusion of two additional cost elements. The first is the cost of travelling to hospital, and the second is the cost of any carers' allowance. In terms of travel costs, care must be exercised because some or all of these costs could be borne by the patient or the NHS. The second additional cost of carers' allowance relates to home haemodialysis and in societal terms represents a transfer from the state to the patient and their carer. From the perspective of personal social services, however, it represents a cost; and from the perspective of the patient and carer, it represents income.

Costs relating to the health service for patient transport were derived from the EURODICE study.[60] Patient travel questions were included in the EURODICE patient questionnaires. Further data were also collected for Aberdeen, UK (one of the centres in the EURODICE study). Travel costs were estimated in a three-stage process. First, information was collected on the mode of transport to the dialysis unit for each patient. Second, the distance travelled to the unit (i.e. for a one-way journey) was obtained using a patient's postcode as a basis. Finally, a cost was calculated based on the distance travelled to the unit, assuming the mode of transport was an ambulance. This value was then doubled in order to include the cost of the return journey.

In order to accurately estimate travel costs, it was important to establish the number of patients who were sharing patient transport (73% of urban patients and 66% of rural patients shared transport) so that the total cost for a trip could be divided by the number of patients in the ambulance. The cost of a mile for the patient transport was obtained from the Scottish Ambulance Service. This value was calculated on the average (Scottish Ambulance) allowance of £0.337 per mile.

In order to allow some generalisability to the rest of the UK, the data have been split by urban versus rural setting. Urban setting relates to individuals who live close to the city (e.g. no more than 20 miles from the dialysis unit in Aberdeen). Rural setting refers to those living outside the city, and in some cases will involve well over 1 hour of travel to the unit. The cost per session for urban patients was £5.14, and the cost for rural patients was £28.33 (which reflects the greater distance travelled and that fewer patients shared transport). Assuming three sessions per week, the annual travel costs for hospital haemodialysis were £802 and £4435 for urban and rural patients, respectively. Home haemodialysis patients would also incur some travelling costs because they would have regular clinic visits every 3 months; hospital haemodialysis patients would also have to make three additional clinic visits per year. Assuming the same travel cost for a clinic visit, the total travel costs per year for home haemodialysis were £21 and £114, and for hospital haemodialysis £822 and £4549, for urban and rural patients, respectively.

Patients receiving haemodialysis at home may receive a disability allowance (if aged under 65 years) or an attendance allowance. Attendance allowance varies between £37.00 and £55.30 per week (£1924 and £2876 per year) and is assessed on the basis of need. Disability allowance varies between £29.30 and £98.95 per week (£1524 and £4885 per year). Sensitivity analysis was conducted by incorporating these estimates into the cost of home haemodialysis

and assuming hospital haemodialysis patients would not receive these allowances solely because they required dialysis.

Results

The estimates of cost, transition probabilities and QoL weights for time spent in each of the states of haemodialysis are summarised in *Table 17*. These data were entered into the Markov model, and the present value of costs and QALYs (discounted at 6% and 1.5%, respectively) for each intervention were calculated by running the model for 5 and 10 cycles (i.e. for a 5- or 10-year follow-up). This section presents the main cost-effectiveness and sensitivity analysis results in terms of incremental cost per QALY estimates.

Main results

The results of the base case analysis, in which the duration and frequency of haemodialysis are the same for all three settings, are shown in *Table 18*. The first part of the table provides information on the cost and QALY results for the three haemodialysis modalities. Costs for home haemodialysis, satellite haemodialysis and hospital haemodialysis increase relatively quickly over time because the costs of dialysis are incurred in every cycle. The central rows of *Table 18* provide information on the net costs and QALYs of home haemodialysis compared with the other modalities. Negative values for either net costs or net QALYs mean that home haemodialysis is the dominant modality (i.e. it is the least costly and provides more QALYs).

Home haemodialysis dominates hospital haemodialysis over the time horizon considered (i.e. it is both more effective and less costly). The costs in the first year of home haemodialysis were lower than the costs of satellite haemodialysis, but the cumulative discounted costs of home haemodialysis after 1 year exceed the costs of satellite haemodialysis. The gain in utility from home haemodialysis compared with satellite haemodialysis is not substantial because the base analysis assumes the same QoL weight for both modes of dialysis. Therefore, the gain in utility is caused by the increase in survival of home haemodialysis patients compared with satellite haemodialysis patients. Finally, the incremental cost per QALY for home haemodialysis compared with satellite haemodialysis was estimated at £2215 and £3914 for the 5- and 10-year follow-up periods, respectively.

Table 19 presents data similar to that presented in *Table 18,* the main difference being that, with short daily or nocturnal home haemodialysis, the costs of consumables change because the number of sessions per week increases, and EPO requirements and adverse events decrease. Data reported in chapter 2 (*Results*) suggest that EPO requirements may be reduced by 50% compared with hospital haemodialysis, and adverse events decrease by 45% compared with the standard of 4-hour sessions 3 times per week. In this new scenario, home haemodialysis does not dominate hospital haemodialysis, and the incremental cost per QALY for home haemodialysis compared with satellite haemodialysis is £32,753 and £28,669 for the 5- and 10-year follow-up periods, respectively. The incremental cost per QALY for home haemodialysis relative to hospital haemodialysis is £8307 and £8585 at 5 and 10 years.

The daily haemodialysis scenario was further developed. Data identified by the review of effectiveness reported in chapter 2 suggest that daily haemodialysis patients have better outcomes than those who receive haemodialysis of standard duration and frequency (based on the review by Mohr and colleagues,[12] although there is uncertainty surrounding the magnitude of this improvement). A sensitivity analysis was carried out relative to the QoL of patients on daily home haemodialysis. QoL weights for home haemodialysis were varied between 0.81 and 0.9. As would be expected, the incremental cost per QALY for home haemodialysis compared with satellite haemodialysis decreased as the QoL weights assigned to daily haemodialysis increased (*Figure 3*). A similar figure could be produced for home haemodialysis compared with hospital haemodialysis, although home haemodialysis would appear more favourable.

Cost-effectiveness for different risk groups

Diabetic patients aged less than 50 years

Using data from Hellerstedt and colleagues,[22] an analysis was carried out for a cohort of diabetic patients with a median age of 43.5 years. Mortality rates were retrieved from this study to assess the impact of diabetes in the final outcome of the model. In this new scenario, home haemodialysis dominates both hospital and satellite haemodialysis. The total discounted cost at 5 years for home haemodialysis was £39,749, and the total effectiveness was 2.37 QALYs (*Table 20*).

TABLE 17 *Summary of variables used in the base case analysis*[*]

Area	Definition	Value	Source/notes
Costs			
Prior cost of HspH	Initial costs of HspH (includes access costs)	£2,151	See *Table 12* for further details
Prior cost of SatH	Initial costs of SatH (includes access costs)	£2,151	See *Table 12* for further details
Prior cost of HomH	Initial costs of HomH (includes access costs)	£2,203	See *Table 12* for further details
Cost of HspH	Annual cost of HspH	£20,095	See *Table 12* for further details
Cost of SatH	Annual cost of SatH	£19,113	See *Table 12* for further details
Cost of HomH	Annual cost of HomH	£17,267	See *Table 12* for further details
Probabilities			
Transition HomH to transplant	Proportion of the cohort that moves from HomH to transplant at the end of a cycle	0.03	Value from the UK Renal Registry[59]
Transition HomH to CAPD	Proportion of the cohort that moves from HomH to CAPD at the end of a cycle	0.06	Value from the UK Renal Registry[59]
Transition HomH to HomH	Proportion of the cohort that stays in HomH at the end of a cycle	See appendix 15	Estimated from the UK Renal Registry[59] and Hellerstedt *et al.*[22]
Transition HomH to SatH	Proportion of the cohort that moves from HomH to SatH at the end of a cycle	0	See section on *Transition probabilities*
Transition HomH to HspH	Proportion of the cohort that moves from HomH to HspH at the end of a cycle	0	See section on *Transition probabilities*
Transition HomH to death	Proportion of the cohort that moves from HomH to death at the end of a cycle	See appendix 15	Derived from Hellerstedt *et al.*[22]
Transition HspH to transplant	Proportion of the cohort that moves from HspH to transplant at the end of a cycle	0.03	Value from the UK Renal Registry[59]
Transition HspH to CAPD	Proportion of the cohort that moves from HspH to CAPD at the end of a cycle	0.06	Value from the UK Renal Registry[59]
Transition HspH to SatH	Proportion of the cohort that moves from HspH to SatH at the end of a cycle	0	See section on *Transition probabilities*
Transition HspH to HspH	Proportion of the cohort that stays in HspH at the end of a cycle	See appendix 15	Estimated from the UK Renal Registry[59] and Hellerstedt *et al.*[22]
Transition HspH to death	Proportion of the cohort that moves from HspH to death at the end of a cycle	See appendix 15	Derived from Hellerstedt *et al.*[22]
Transition SatH to transplant	Proportion of the cohort that moves from SatH to transplant at the end of a cycle	0.03	Value from the UK Renal Registry[59]
Transition SatH to CAPD	Proportion of the cohort that moves from SatH to CAPD at the end of a cycle	0.06	Value from the UK Renal Registry[59]
Transition SatH to HomH	Proportion of the cohort that moves from SatH to HomH at the end of a cycle	0	See section on *Transition probabilities*
Transition SatH to SatH	Proportion of the cohort that stays in SatH at the end of a cycle	See appendix 15	Estimated from the UK Renal Registry[59] and Hellerstedt *et al.*[22]
Transition SatH to HspH	Proportion of the cohort that moves from SatH to HspH at the end of a cycle	0	See section on *Transition probabilities*
Transition SatH to death	Proportion of the cohort that moves from SatH to death at the end of a cycle	See appendix 15	Derived from Hellerstedt *et al.*[22]
Quality of life			
Weight HomH	QoL weight for 1 cycle in the HomH state	0.81	Based on valuations derived from the general population. Values from de Wit[42]
Weight HspH	QoL weight for 1 cycle in the HspH state	0.66	
Weight SatH	QoL weight for 1 cycle in the SatH state	0.81	

[*] *Technical notes about how these data were used in the model are provided in appendix 16*

TABLE 18 *Incremental cost-effectiveness results for home haemodialysis compared with satellite and hospital haemodialysis: base case analysis*

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 10
Total costs						
SatH	£16,215	£26,564	£34,473	£40,739	£46,001	£62,054
HomH	£16,049	£26,891	£35,074	£41,250	£46,551	£63,717
HspH	£16,938	£27,819	£36,133	£42,722	£48,254	£65,131
QALYs						
SatH	1.03	1.51	1.89	2.20	2.48	3.43
HomH	1.08	1.64	2.08	2.42	2.73	3.86
HspH	0.84	1.23	1.54	1.80	2.02	2.80
Extra costs for HomH versus:						
SatH	–£166	£327	£601	£510	£550	£1,663
HspH	–£889	–£927	–£1,059	–£1,472	–£1,703	–£1,415
QALYs gained by HomH versus:						
SatH	0.06	0.13	0.19	0.22	0.25	0.42
HspH	0.25	0.41	0.54	0.62	0.71	1.06
Incremental cost per QALY for HomH versus:						
SatH	HomH dominant	£2,472	£3,204	£2,358	£2,215	£3,914
HspH	HomH dominant	HomH dominant	HomH dominant	HomH dominant	HomH dominant	HomH dominant

TABLE 19 *Incremental cost-effectiveness results for short daily or nocturnal home haemodialysis* compared with satellite and hospital haemodialysis*

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 10
Total costs						
SatH	£16,215	£26,564	£34,473	£40,739	£46,001	£62,054
HomH	£18,416	£31,112	£40,693	£47,925	£54,133	£74,232
HspH	£16,938	£27,819	£36,133	£42,722	£48,254	£65,131
QALYs						
SatH	1.03	1.51	1.89	2.20	2.48	3.43
HomH	1.08	1.64	2.08	2.42	2.73	3.86
HspH	0.84	1.23	1.54	1.80	2.02	2.80
Extra costs for HomH versus:						
SatH	£2,201	£4,547	£6,221	£7,185	£8,131	£12,179
HspH	£1,478	£3,293	£4,560	£5,203	£5,878	£9,101
QALYs gained by HomH versus:						
SatH	0.06	0.13	0.19	0.22	0.25	0.42
HspH	0.25	0.41	0.54	0.62	0.71	1.06
Incremental cost per QALY for HomH versus:						
SatH	£39,397	£34,396	£33,147	£33,213	£32,753	£28,669
HspH	£6,006	£8,011	£8,488	£8,332	£8,307	£8,585

* *Although the modalities of short daily and nocturnal home haemodialysis have been assigned the same cost, in reality there may be some differences in the quantities of consumables used*

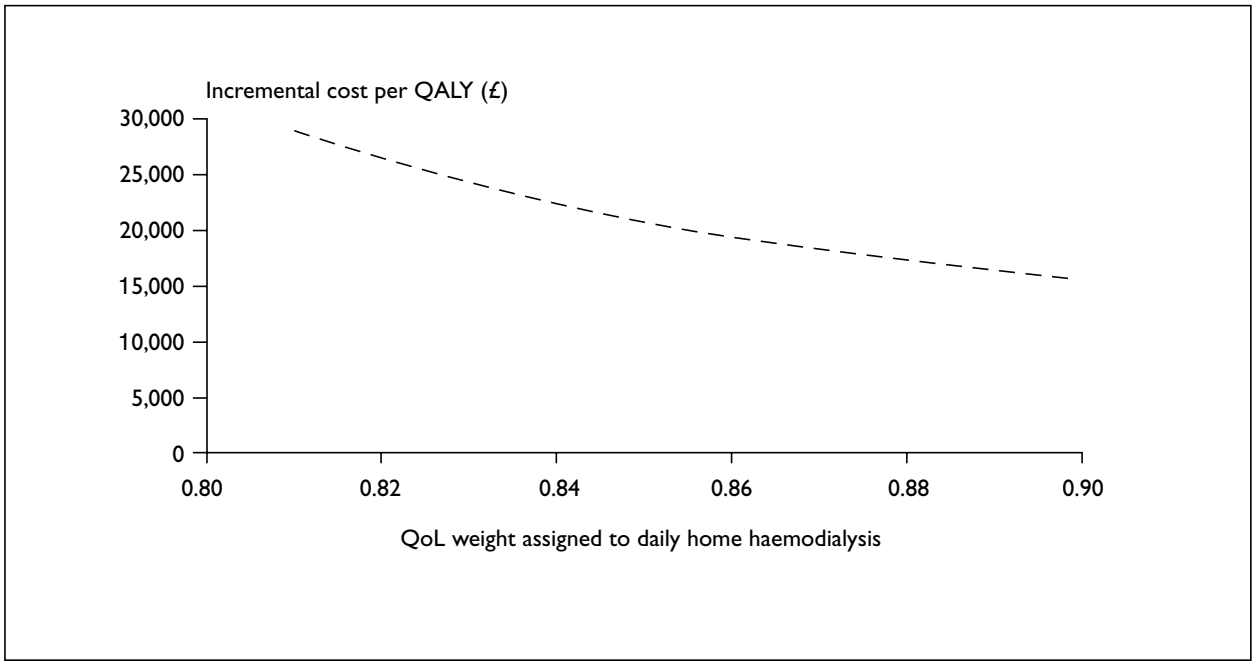

FIGURE 3 *Incremental cost (£) per QALY of daily home haemodialysis compared with satellite haemodialysis*

TABLE 20 *Incremental cost-effectiveness results for home haemodialysis compared with hospital and satellite haemodialysis for diabetic patients with a median age of 43.5 years*

	Year 1	Year 2	Year 3	Year 4	Year 5
Total costs					
SatH	£15,494	£24,558	£31,569	£37,191	£41,593
HomH	£15,397	£23,364	£29,677	£35,097	£39,749
HspH	£16,180	£25,709	£33,080	£38,991	£43,620
QALYs					
SatH	1.00	1.41	1.75	2.04	2.27
HomH	1.05	1.46	1.80	2.10	2.37
HspH	0.81	1.15	1.43	1.66	1.85
Extra costs for HomH versus:					
SatH	–£97	–£1,194	–£1,892	–£2,094	–£1,844
HspH	–£783	–£2,345	–£3,403	–£3,895	–£3,870
QALYs gained by HomH versus:					
SatH	0.06	0.04	0.04	0.06	0.10
HspH	0.24	0.31	0.37	0.44	0.52
Incremental cost per QALY for HomH versus:					
SatH	HomH dominant	HomH dominant	HomH dominant	HomH dominant	HomH dominant
HspH	HomH dominant	HomH dominant	HomH dominant	HomH dominant	HomH dominant

Diabetic patients aged over 65 years
Using data from Hellerstedt and colleagues,[22] an analysis was carried out for a cohort of diabetic patients older than 65 years. Mortality rates for diabetic patients were retrieved from this study and adjusted for an index (1.8) to include the extra risk associated with age (*Table 21*). In this new scenario, home haemodialysis dominates the other modalities after 2 years. The total discounted cost after a 5-year follow-up for home haemodialysis was £27,982, and the total effectiveness was 1.74 QALYs.

Due to the uncertainty surrounding the precise magnitude of the increased risk of death for these patients, the analysis was repeated using a mortality inflator of 2.48 (*Table 22*). In this new scenario, home haemodialysis dominates both hospital and satellite haemodialysis within 4 years of follow-up, though the incremental cost-effectiveness ratio fluctuates for home versus satellite haemodialysis.

Patients older than 65 years without diabetes
Using data from Hellerstedt and colleagues,[22] an analysis was carried out for a cohort of non-diabetic patients older than 65 years. Mortality rates were retrieved from this study and adjusted for an index (1.8) to include the extra risk associated with age (*Table 23*). After a 5-year follow-up period, the incremental cost per QALY for home haemodialysis compared with hospital haemodialysis was estimated to be £3927. In this new scenario, the total discounted cost at 5 years for home haemodialysis was £39,366, and the total effectiveness was 2.34 QALYs.

To reflect the uncertainty surrounding the precise extra risk faced by patients over age 65 years, the analysis was repeated using a mortality inflator of 2.48 (*Table 24*). After a follow-up of 5 years, the incremental cost per QALY for home haemodialysis compared with hospital haemodialysis was estimated to be £7071. The total discounted cost at 5 years for home haemodialysis was £34,552, and the total effectiveness was 2.08 QALYs.

Sensitivity analysis results

Variations in QoL weights

A sensitivity analysis was conducted in which a range of higher values were assumed for QoL in home haemodialysis. As described previously (*Outcomes*), a 13.95% increase in the QoL weight was assigned to home haemodialysis, giving a weight of 0.92. In this situation, hospital haemodialysis was dominated by home haemodialysis. The incremental cost per QALY of home haemo-

TABLE 21 *Incremental cost-effectiveness results for home haemodialysis compared with hospital and satellite haemodialysis for diabetic patients older than 65 years: age adjustment of 1.8*

	Year 1	Year 2	Year 3	Year 4	Year 5
Total costs					
SatH	£13,042	£18,878	£22,996	£26,111	£28,363
HomH	£14,094	£18,851	£22,369	£25,389	£27,982
HspH	£13,601	£19,737	£24,067	£27,342	£29,710
QALYs					
SatH	0.89	1.16	1.36	1.51	1.63
HomH	0.99	1.23	1.42	1.59	1.74
HspH	0.72	0.94	1.10	1.23	1.33
Extra costs for HomH versus:					
SatH	£1,052	–£27	–£627	–£722	–£381
HspH	£493	–£886	–£1,697	–£1,953	–£1,727
QALYs gained by HomH versus:					
SatH	0.10	0.07	0.06	0.07	0.11
HspH	0.26	0.29	0.31	0.35	0.41
Incremental cost per QALY for HomH versus:					
SatH	£10,466	HomH dominant	HomH dominant	HomH dominant	HomH dominant
HspH	£1,861	HomH dominant	HomH dominant	HomH dominant	HomH dominant

TABLE 22 *Incremental cost-effectiveness results for home haemodialysis compared with hospital and satellite haemodialysis for diabetic patients older than 65 years: age adjustment of 2.48*

	Year 1	Year 2	Year 3	Year 4	Year 5
Total costs					
SatH	£11,203	£15,080	£17,618	£19,452	£20,694
HomH	£13,117	£15,815	£17,703	£19,324	£20,716
HspH	£11,668	£15,744	£18,412	£20,341	£21,647
QALYs					
SatH	0.81	0.98	1.11	1.20	1.27
HomH	0.94	1.08	1.18	1.27	1.35
HspH	0.66	0.80	0.90	0.98	1.03
Extra costs for HomH versus:					
SatH	£1,914	£735	£85	–£128	£22
HspH	£1,449	£71	–£709	–£1,017	–£931
QALYs gained by HomH versus:					
SatH	0.13	0.09	0.07	0.07	0.08
HspH	0.28	0.28	0.28	0.29	0.32
Incremental cost per QALY for HomH versus:					
SatH	£14,277	£7,913	£1,196	HomH dominant	£254
HspH	£5,116	£257	HomH dominant	HomH dominant	HomH dominant

TABLE 23 *Incremental cost-effectiveness results for home haemodialysis compared with hospital and satellite haemodialysis for non-diabetic patients older than 65 years: age adjustment of 1.8*

	Year 1	Year 2	Year 3	Year 4	Year 5
Total costs					
SatH	£14,340	£22,113	£27,467	£31,426	£34,691
HomH	£15,267	£24,708	£31,050	£35,525	£39,366
HspH	£14,966	£23,139	£28,767	£32,930	£36,363
QALYs					
SatH	0.94	1.30	1.56	1.76	1.93
HomH	1.05	1.53	1.87	2.12	2.34
HspH	0.77	1.06	1.27	1.44	1.58
Extra costs for HomH versus:					
SatH	£927	£2,595	£3,583	£4,099	£4,676
HspH	£301	£1,569	£2,282	£2,595	£3,004
QALYs gained by HomH versus:					
SatH	0.10	0.22	0.30	0.35	0.41
HspH	0.28	0.47	0.59	0.68	0.76
Incremental cost per QALY for HomH versus:					
SatH	£9,219	£11,570	£11,760	£11,552	£11,494
HspH	£1,092	£3,369	£3,843	£3,810	£3,927

TABLE 24 *Incremental cost-effectiveness results for home haemodialysis compared with hospital and satellite haemodialysis for non-diabetic patients older than 65 years: age adjustment of 2.48*

	Year 1	Year 2	Year 3	Year 4	Year 5
Total costs					
SatH	£12,934	£19,017	£22,862	£25,553	£27,742
HomH	£14,681	£23,133	£28,284	£31,656	£34,552
HspH	£13,488	£19,883	£23,926	£26,755	£29,056
QALYs					
SatH	0.88	1.16	1.35	1.48	1.60
HomH	1.02	1.45	1.72	1.91	2.08
HspH	0.72	0.95	1.10	1.21	1.30
Extra costs for HomH versus:					
SatH	£1,747	£4,116	£5,422	£6,104	£6,810
HspH	£1,193	£3,250	£4,358	£4,901	£5,495
QALYs gained by HomH versus:					
SatH	0.13	0.29	0.37	0.43	0.48
HspH	0.30	0.50	0.62	0.70	0.78
Incremental cost per QALY for HomH versus:					
SatH	£13,031	£14,426	£14,462	£14,279	£14,160
HspH	£4,011	£6,490	£6,976	£6,978	£7,071

dialysis compared with satellite haemodialysis was £983 and £1869 at 5 and 10 years, respectively.

Using the QoL valuations from Churchill[34] of 0.49 for home haemodialysis, 0.49 for satellite haemodialysis and 0.43 for hospital haemodialysis, it was found that hospital haemodialysis was dominated by home haemodialysis, and the incremental cost per QALY at 5 years for home haemodialysis versus satellite haemodialysis was £1804.

Varying the QoL provided by satellite haemodialysis from 0.43 to 0.49 gave an incremental cost per QALY of home compared with satellite haemodialysis at 5 years of £1804–3650. The data for a 5-year follow-up are reported in *Table 25*.

Variations in home haemodialysis staffing

A sensitivity analysis was conducted to assess the impact of an assistant helping with home haemodialysis. The results indicate that home haemodialysis dominates hospital haemodialysis, as before, but that the magnitude of the incremental cost per QALY for home compared with satellite haemodialysis was £16,914 at 5 years and £15,830 at 10 years.

Satellite haemodialysis with clinical cover

A sensitivity analysis was conducted to assess the impact of clinical cover in a large satellite unit. The study by Drey and colleagues[8] suggests that some satellite units have extensive clinical cover. Assuming satellite haemodialysis has a cost of medical and nursing staff per patient per year similar to that of hospital haemodialysis (£7539 per patient per year), home haemodialysis dominated both satellite and hospital haemodialysis at both 5 and 10 years.

TABLE 25 *Incremental cost per QALY of home haemodialysis versus satellite haemodialysis at different QoL weights for satellite haemodialysis for a 5-year follow-up*[*]

	QoL weight for SatH						
	0.43	0.44	0.45	0.46	0.47	0.48	0.49
Incremental cost per QALY	£1804	£1970	£2169	£2414	£2721	£3118	£3650

[*] *QoL weight for home haemodialysis held constant at 0.49*

Satellite haemodialysis with minimal clinical cover

A satellite unit could conceivably be set up as a minimal care facility where the presence of trained staff is at a minimum. Assuming a cost of medical and nursing staff per patient per year similar to that of home haemodialysis (£2766), the incremental cost per QALY was £37,242 and £31,879 for home haemodialysis compared with satellite haemodialysis at 5 and 10 years, respectively. If a minimum care facility satellite unit provided the same outcomes as home haemodialysis, then it would be the dominant option (less costly and as effective).

Variations in mortality rates

Three sensitivity analyses were conducted to assess varying assumptions about the mortality rates. The first one used the weighted average mortality rates computed for home and hospital/satellite haemodialysis that were reported above (*Transition probabilities*). Hospital haemodialysis was again dominated by home haemodialysis. The incremental cost per QALY of home haemodialysis compared with satellite haemodialysis was £7784 at 5 years and £9351 at 10 years.

Variation in home haemodialysis mortality rates

A second sensitivity analysis was carried out to assess the impact that different mortality rates for home haemodialysis would have on the incremental cost per QALY of home haemodialysis compared with hospital haemodialysis. The base case mortality rates for hospital haemodialysis were used. *Table 26* provides information on the cost and QALY results for home and hospital haemodialysis. Annual mortality rates for home haemodialysis were held constant over the 5-year follow-up.

Assumption of equal effectiveness

If both survival and QoL were the same, then home haemodialysis would be less costly than dialysis provided in the other settings. Even if only survival was the same, it is likely that QoL from home haemodialysis could still be higher. This scenario is only likely to increase the dominance of home haemodialysis over hospital haemodialysis and to make home haemodialysis dominant over satellite haemodialysis throughout the post-treatment period.

Inclusion of transport and allowances to home haemodialysis patients

Based on the data outlined above (*Sensitivity and subgroup analysis*), the travel costs for home and hospital haemodialysis patients (assuming satellite haemodialysis has the same cost as hospital haemodialysis) in an urban setting (no more than 20 miles from the unit) and a rural setting (more than 20 miles from the unit) are shown in *Table 27*.

The estimated additional cost of attendance or disability allowance per person receiving home haemodialysis is reported in *Table 28*. In this analysis, people receiving either satellite or hospital haemodialysis were assumed not to be in receipt of these allowances. If any of these people were to receive these allowances, then the net impact on the cost difference between home haemodialysis and satellite or hospital haemodialysis would be reduced.

The data on travel costs (*Table 27*) and the data on allowances (*Table 28*) can be combined with the data on the costs of the modalities

TABLE 26 *Incremental cost per QALY for home haemodialysis compared with hospital haemodialysis for different home haemodialysis mortality rates*

	Mortality rate for HomH patients					
	1%	**2%**	**3%**	**4%**	**5%**	**10%**
Total costs						
HomH	£56,474	£54,881	£53,330	£51,821	£50,351	£43,572
HspH	£48,254	£48,254	£48,254	£48,254	£48,254	£48,254
QALYs						
HomH	3.27	3.18	3.10	3.02	2.90	2.57
HspH	2.02	2.02	2.02	2.02	2.02	2.02
Extra costs for HomH versus:						
HspH	£8,220	£6,627	£5,076	£3,567	£2,097	–£4,682
QALYs gained by HomH versus:						
HspH	1.25	1.16	1.08	1.00	0.88	0.55
Incremental cost per QALY for HomH versus:						
HspH	£6,576	£5,713	£4,700	£3,567	£2,383	HomH dominant

TABLE 27 *Travel costs for the different modalities, split by urban or rural setting*

Setting	Modality	Travel cost				
		Year 1	Year 2	Year 3	Year 4	Year 5
Urban	HspH & SatH	£605	£1,050	£1,390	£1,659	£1,885
	HomH	£17	£30	£39	£47	£53
Rural	HspH & SatH	£3,348	£5,811	£7,692	£9,181	£10,432
	HomH	£91	£163	£217	£257	£292

TABLE 28 *Additional costs of home haemodialysis under different assumptions about the amount of disability or attendance allowance paid*

Allowance for HomH per year	Additional cost of HomH				
	Year 1	Year 2	Year 3	Year 4	Year 5
£1,523 (low)	£1,221	£2,177	£2,899	£3,444	£3,911
£2,875 (middle)	£2,305	£4,111	£5,473	£6,501	£7,384
£4,885 (high)	£3,917	£6,984	£9,299	£11,046	£12,546

and their outcomes, reported in *Table 18*. This combination provides the estimated cost-effectiveness of home haemodialysis compared with the other haemodialysis modalities for patients who face different travel costs and can claim different levels of allowances (*Table 29*).

As *Table 29* shows, the inclusion of transport costs increases the cost advantage enjoyed by home haemodialysis over hospital haemodialysis. Furthermore, home haemodialysis becomes less costly and more effective than satellite haemodialysis in both a rural and an urban setting.

The inclusion of allowances paid to home haemodialysis patients would make home haemodialysis no longer a dominant option over hospital haemodialysis and would dramatically increase the incremental cost per QALY. When both travelling costs and the cost of allowances are considered, the incremental cost per QALY is reduced; however, for people who face relatively low travelling costs to visit their haemodialysis unit, the incremental cost per QALY is still relatively high. In contrast, for rural patients, home haemodialysis is still essentially dominant relative to both satellite and hospital haemodialysis, except when allowances at the upper end of the range are considered.

Other sensitivity analysis

Other sensitivity analysis on the estimates of cost was also performed. The principal variables involved were the cost of dialysis machines and the length of the training period for home haemodialysis. Variations of other plausible ranges for these variables had little impact on cost.

Summary of modelling cost-effectiveness and utility

The results presented here are based on various sources of data and assumptions. In total, the results suggest that home haemodialysis is a more cost-effective method of dialysis than hospital haemodialysis (lower cost and more benefits) and that home haemodialysis provides additional benefits at modest additional cost compared with satellite haemodialysis. The results in the latter comparison are due primarily to the assumption of longer survival from home haemodialysis compared with satellite haemodialysis. These results are therefore subject to considerable uncertainty over the magnitude of any QoL and survival gains, and the results ultimately depend upon the data identified in chapter 2. Strenuous efforts were made to identify the most robust data available, but the quality of the included studies is such that it is not possible to be sure that there are no differences in survival between the different modalities of haemodialysis. In addition, the results that are favourable to home haemodialysis are based on data derived from a highly selected group of patients who, given current trends in the provision of RRT, may represent only a small proportion of the total population of haemodialysis patients.

Even if there are no meaningful differences in survival and QoL, there may still be patient preferences for haemodialysis in different settings. In such a situation, home haemodialysis is the least costly alternative in terms of NHS treatment costs and, for those who prefer home haemodialysis,

TABLE 29 *Incremental cost per QALY of home haemodialysis compared with satellite haemodialysis under different assumptions for travel costs (rural/urban) and different levels of allowances for home haemodialysis patients*

Scenario	Comparator	Incremental cost per QALY for HomH				
		Year 1	Year 2	Year 3	Year 4	Year 5
Setting						
Urban	SatH	HomH dominant	HomH dominant	HomH dominant	HomH dominant	HomH dominant
	HspH	HomH dominant	HomH dominant	HomH dominant	HomH dominant	HomH dominant
Rural	SatH	HomH dominant	HomH dominant	HomH dominant	HomH dominant	HomH dominant
	HspH	HomH dominant	HomH dominant	HomH dominant	HomH dominant	HomH dominant
Allowances						
Low	SatH	£18,881	£18,939	£18,652	£18,277	£17,969
	HspH	£1,350	£3,040	£3,425	£3,158	£3,120
Medium	SatH	£38,286	£33,567	£32,368	£32,408	£31,958
	HspH	£5,754	£7,745	£8,216	£8,054	£8,029
High	SatH	£67,143	£55,299	£52,755	£53,418	£52,751
	HspH	£12,303	£14,734	£15,338	£15,333	£15,324
Urban setting with different allowances						
Low allowances	SatH	£8,355	£11,223	£11,453	£10,826	£10,589
	HspH	HomH dominant	£558	£910	£576	£531
Medium allowances	SatH	£27,760	£25,852	£25,169	£24,957	£24,579
	HspH	£3,365	£5,263	£5,701	£5,472	£5,440
High allowances	SatH	£56,617	£47,583	£45,556	£45,966	£45,371
	HspH	£9,914	£12,253	£12,823	£12,751	£12,735
Rural setting with different allowances						
Low allowances	SatH	HomH dominant	HomH dominant	HomH dominant	HomH dominant	HomH dominant
	HspH	HomH dominant	HomH dominant	HomH dominant	HomH dominant	HomH dominant
Medium allowances	SatH	HomH dominant	HomH dominant	HomH dominant	HomH dominant	HomH dominant
	HspH	HomH dominant	HomH dominant	HomH dominant	HomH dominant	HomH dominant
High allowances	SatH	£8,839	£12,577	£12,924	£12,167	£11,907
	HspH	HomH dominant	£994	£1,424	£1,040	£994

it is the most cost-effective modality. However, the addition of travel costs (some or all of which may be borne by the NHS) and the cost of allowances for home haemodialysis patients (borne by local authorities) may change this situation.

The precise impact of inclusion of the cost of allowances is difficult to estimate. In part it depends upon the size of the allowances and in part upon the number of hospital haemodialysis patients also in receipt of these allowances. The analysis presented in the *Results* section of this chapter (page 48) assumed that no hospital or satellite haemodialysis patients received an allowance. This assumption is plausible for low-risk patients, but is less plausible for higher-risk patients, who make up an increasing proportion of the dialysis population. The greater the proportion of hospital and satellite patients who receive an attendance or disability allowance, then, other things being equal, the more cost-effective is home haemodialysis.

Chapter 5

Implications for other parties

QoL for family and carers

The data reported in chapter 2 suggest that the QoL of people receiving haemodialysis in their own home appears to be greater than the QoL of those undergoing hospital or satellite haemodialysis. An increase in the frequency and duration of dialysis, facilitated by home haemodialysis, may enable those with ESRF to feel better. The use of daily slow nocturnal home haemodialysis may have the added benefit of enabling work outside the home or, in the case of children, result in less disruption to their education.

The data reported in chapter 2 on the QoL of family and carers, however, are mixed. For example, McGee[25] reported that the spouses of home haemodialysis patients may be less satisfied with the location of haemodialysis, while Soskolne and De Nour[30] reported that the spouses of home haemodialysis patients reported less psychological distress. The data for the parents of children receiving home haemodialysis suggested that the parents had more disruption to their social contacts.[27] Reports from patient groups emphasise the possibility that home haemodialysis can become a burden to the carers, especially if there is limited possibility for respite, because caring for someone on dialysis can be a considerable source of stress.

Financial impact on patients and others

Financial impact on patients and their families/carers

The data presented in chapter 2 (*Assessment of effectiveness*) suggest that home haemodialysis patients are more likely to be able to work than hospital haemodialysis patients.[21] In addition, home haemodialysis patients avoid the costs of transport to and from the dialysis unit.

In comparison with treatment by hospital haemodialysis, home haemodialysis may decrease the likelihood that a carer can carry out paid (and unpaid) work. It is difficult to judge the net impact of this factor, because home haemodialysis patients are eligible for attendance allowance if they are aged over 65 years or disability allowance if aged under 65 years. They may also receive a reduction in council tax if one of the rooms in their house is used for dialysis and/or storage. These allowances may not compensate fully for the loss of any earnings, but they may be especially important for a family with two potential wage earners who cannot work due to ill health and being a carer.

Using data from the EURODICE study on time on dialysis, waiting and travelling, and setting up/clearing away after a home haemodialysis session, it is possible to estimate the weekly time commitment of patients and carers on the different dialysis modalities (full details of the method of estimation are included in appendix 16). *Table 30* summarises the expected number of hours per week that a patient might spend on dialysis, travelling to dialysis sessions, time in a unit (but not on dialysis), and preparing for or clearing up after a home haemodialysis session. For dialysis patients, the largest single component is the time spent on dialysis, although during nocturnal dialysis, the patient would ideally be sleeping. For the patient, the time spent setting up and clearing away after a home haemodialysis session is roughly equivalent to the time spent travelling or being in the dialysis unit but not receiving dialysis. The time a carer may devote to a patient on dialysis and in setting up and clearing away after a dialysis session is potentially different. For nocturnal home haemodialysis, no addition to the time has been added for carer time during a dialysis session, although any disruption to the carer's sleep may be disproportionately important.

Without more detailed information on what activities a carer sacrifices to provide this care, the opportunity cost of this time (the benefit forgone had the time been used for other desirable activities) is difficult to determine. One approach to indirectly elicit the opportunity cost of this time is to look at the value implied by allowances that are available for carers. For example, if £10 allowances were paid per week to provide care and 2 hours of care were provided

TABLE 30 *Estimated time per week devoted to the process of haemodialysis by patient and carer*[*]

Modality (weekly frequency and duration)	Estimated time per week (hours)	
	Patient	Carer
HomH (3 sessions of 4.5 hours each)	18.00	18.00
Nocturnal HomH (6 sessions of 7 hours each)	51.00[†]	9.00[‡]
Short daily HomH (6 sessions of 2 hours each)	21.00	21.00
SatH (3 sessions of 4.5 hours each)	20.29	0.00[§]
HspH (3 sessions of 4.5 hours each)	20.29	0.00[§]

[*] *Excluding other time that a carer may spend caring for the needs of the person with ESRF*
[†] *Including time when the patient would ideally be sleeping*
[‡] *Excluding time when the patient receives haemodialysis. If this time were included, the total time per week that the carer may spend is 51 hours*
[§] *Excluding any time when the carer may be involved in transport*

per week, then this implies that the value of 1 hour of care is £5. Using the data on the allowances for home haemodialysis carers reported in the first column of *Table 28,* the implied value per hour of time ranges from £1.63 to £5.22 for standard home haemodialysis, £3.25 to £10.47 for nocturnal haemodialysis and £1.39 to £4.47 for short daily haemodialysis. The higher implied values per hour of carer time are based upon the upper estimate of allowances for carers. It is likely that, to obtain these higher allowances, home haemodialysis patients would require care over and above that required solely for dialysis. If this were the case, then the implied valuations are too high.

Financial impact on local authorities

Home haemodialysis can result in cost-shifting from the NHS onto patients and local authorities. The impact to patients is described in the preceding section, but if home haemodialysis patients are more likely to obtain allowances than patients of a similar age and co-morbidity seen in a hospital or satellite unit, then this extra cost will be borne by local authorities.

Factors relevant to NHS policy

There is increasing pressure on renal services because of the growing number of people who are receiving RRT. It appears likely that both home and satellite haemodialysis are less costly than hospital haemodialysis, so an increase in these modalities of dialysis could mitigate the anticipated net cost increases of RRT to the NHS. In particular, judicious use of home and satellite haemodialysis may help alleviate the increasing pressure on hospital units.

The success of home and satellite haemodialysis is reliant on the quality of support provided to patients. Home haemodialysis programmes require oversight by specialist nurses, who are in short supply. Similarly, satellite haemodialysis units may require more skilled nurses than a hospital unit in order to compensate for the limited medical cover provided. Furthermore, there may be an element of cost-shifting in those satellite units attached to acute hospitals, because medical cover might be provided by the hospital in which the satellite unit is based, rather than the hospital within which the main renal unit is located.

Currently, home haemodialysis is used in only a very small proportion of cases. The data reported in chapters 2–4 suggest that home haemodialysis may provide better outcomes at lower costs to the NHS. Although the data on outcomes are from non-randomised studies with a highly selected group of patients, even if outcomes were broadly similar, costs to the NHS would be lower. However, a significant burden of cost is shifted onto patients, carers and local authorities.

The provision of home haemodialysis is not evenly distributed across the country. In some areas, the proportion of patients receiving home haemodialysis is substantially higher. In some cases, this is because the logistics of organising hospital or satellite haemodialysis is too great, and in very remote rural areas, home haemodialysis may be the only viable option for those who, in other circumstances, might not be offered this modality.

For patients who are stable on haemodialysis, home haemodialysis might not be an option because they may have no access to a carer. This may be a particular issue for those aged over

65 years, and also for women whose partners may be less willing or able to provide care. In the *Sensitivity analysis results* section of chapter 4, a sensitivity analysis was presented looking at the provision of a carer by the NHS. In some situations, the additional costs of this carer may be considered worthwhile.

A crude estimate of the number of new patients potentially eligible for home haemodialysis could be as high as 1500 patients per year. In many cases, however, those most eligible for home haemodialysis are also likely to be the ones most eligible for transplantation.

Chapter 6
Discussion

The results of the studies included in this review indicate that home haemodialysis is generally more effective than hospital dialysis, and also more effective than satellite unit dialysis, but modestly so. People being dialysed at home tend to experience a better QoL, in terms of functional ability and well-being, than those being dialysed in hospital. There is some evidence, however, that their partners tend to be less satisfied, both with home dialysis and also with the increased dependency placed upon them. Compared with hospital haemodialysis, people on home dialysis generally have better survival rates, have less hospitalisations, experience fewer intra-dialytic adverse events (such as headaches and cramps) and are more likely to be in full-time employment. A number of studies reported statistically significant differences in some outcomes, such as blood pressure control, in favour of home dialysis. In many other outcomes, for example, those associated with QoL, differences were more modest but still mostly favoured home dialysis, and could be considered to be potentially worthwhile.

Only four studies compared home with satellite unit haemodialysis. One study reported that home haemodialysis patients experienced a better QoL than satellite unit patients and were more likely to be in full-time employment but were also likely to experience more hospitalisations. One study reported comparable survival rates between the home and satellite unit haemodialysis patients, while another reported better survival rates for the home haemodialysis group. The only study reporting details of technique survival suggested that those being dialysed in satellite units achieved a longer median technique survival time than those on home dialysis.

Given its relative effectiveness and cost-effectiveness, the question of whether undergoing haemodialysis at home is acceptable to patients and their carers/families is an important one. Irrespective of its availability, the acceptability of home haemodialysis will be a major factor in any decision by those eligible for it on whether or not to choose this form of treatment.

The primary studies took place in a number of different settings, mostly in the USA (14 studies), with others taking place in Germany, Canada, France, Israel, New Zealand and the UK. The participants comprised men and women of a wide range of ages, and children. The participants' ethnic background was primarily white and secondarily black, and they had varying degrees of co-morbid conditions. The sociodemographic and case-mix diversity of the study participants may suggest that the findings are generalisable to other populations and settings.

However, 22 of the 23 included primary studies were observational studies, which, unlike RCTs, are susceptible to known and unknown confounding factors that can bias the results. The lack of randomisation raises serious concerns over the internal validity of the primary studies. Eleven studies were small in size, with less than 100 participants. The total numbers of people in the studies who were receiving home haemodialysis (at least 1760 patients, 15%) and satellite unit haemodialysis (at least 1258 patients, 11%) were small in comparison to the number of people being dialysed in hospital units (at least 8380 patients, 74%). Sociodemographic characteristics and co-morbidities were generally not evenly balanced between the participant groups, although six studies with survival as an outcome attempted to adjust for participant baseline differences by using the Cox proportional hazards regression model. In many of the studies, the home or hospital/satellite unit haemodialysis intervention was not well reported in terms of the equipment used and the duration and frequency of dialysis. For these reasons, any suggestion that the findings are generalisable must be at best tentative.

The industry submission that was reviewed concluded that home haemodialysis resulted in improved survival and health outcomes at lower cost, though this assessment was not based on a systematic review of the literature. According to a systematic review of economic evaluations pertaining to RRT, the evidence is overwhelmingly in favour of lower total costs (defined as treatment costs plus costs of treatment-associated events) for home haemodialysis, compared with for hospital dialysis, reflecting the fact that staff costs are reduced.

Only six of these economic studies, however, had strong study designs, so patient selection bias may still exist. In particular, the exact cost advantage is difficult to ascertain due to potential selection of healthier patients for home haemodialysis. Despite the initial high costs of home haemodialysis due to set-up and training costs, the payback period for these higher costs relative to hospital haemodialysis appears to be roughly 14 months. The payback period is therefore shorter than the survival of some home-based patients as well as shorter than the average wait for a transplant. Different forms of satellite units may vary considerably in cost, depending on the degree of staffing intensity and the ability to maximise continuous use of the machines. Not surprisingly, the treatment costs of satellite units were lower than hospital haemodialysis and higher than home haemodialysis. The very limited literature on QALY measurement shows higher QoL for home or satellite dialysis patients, relative to hospital haemodialysis patients.

The assessment of frequency favoured short daily or nocturnal home haemodialysis over hospital haemodialysis, because outcomes would be better and costs are likely to be lower once expected reductions in hospitalisation rates are considered. It is important to note, however, that this review was not targeted to provide an assessment of the incremental cost-effectiveness of the benefits and costs of haemodialysis 3 times per week versus daily haemodialysis in the home.

The results of the modelling exercise agree with those from the literature. For low-risk adults (the base case analysis), home haemodialysis is less costly than satellite haemodialysis, and satellite haemodialysis is less costly than hospital haemodialysis. The principal reason for this difference is the lower staffing requirements of home and satellite haemodialysis, though satellite haemodialysis in particular requires a certain amount of medical oversight, and data for properly costing satellite dialysis were limited. In contrast, the provision of short daily and nocturnal home haemodialysis was more costly than hospital haemodialysis. The principal reason for this is the additional consumables required. Both short daily and nocturnal home haemodialysis were modelled for 6 sessions per week, which in effect means that the cost of most of the consumables is double that of standard home haemodialysis.

The data for adults at medium and high risk (characterised by those over age 65 years without and with diabetes, respectively) were very limited, but suggested that adults over age 65 years without diabetes who were treated at home were more costly (they survive longer and incur more costs), while for those over 65 years with diabetes, the picture was more mixed. The two factors that the results were most sensitive to were (1) the inclusion of travel costs, which could be substantial for rural patients, particularly those receiving hospital haemodialysis, and (2) the cost to local authorities of allowances to carers of home haemodialysis patients. Both these factors alone or in combination greatly influenced cost.

In terms of cost per QALY, the results of the economic model generally mirrored those from the literature for younger fitter patients without serious co-morbidities who received haemodialysis for 4–5 hours 3 times per week. The main difference between the results of the model and the literature was that, over a 5-year period, the model indicated that home haemodialysis did not dominate satellite haemodialysis, but the additional cost per QALY was modest. The limited data available suggest that the additional cost per QALY of short daily and nocturnal home haemodialysis, compared with satellite haemodialysis, was more than £30,000 over 5 years. The additional cost per QALY, compared with hospital haemodialysis, was more modest but still approximately £8500 after 5 years.

The review attempted to ascertain the data relating to children, and adults at low, medium and high risk. Estimates of cost-effectiveness for children could not be calculated due to the lack of data, and only very limited data were available for adults at medium and high risk (the base case represents low-risk adults). What data were available suggest that home haemodialysis may still be a viable option for higher-risk patients, although it is likely that the risks associated with haemodialysis may be considered too great for vulnerable patients, especially as the lack of data means these risks may not be accurately represented in the model.

In order to reflect the considerable uncertainty surrounding estimates of cost, QALYs and cost per QALY, sensitivity analysis was conducted on the cost of home haemodialysis (cost of the machine and length of the training period), the staffing requirements for satellite unit haemodialysis (to reflect the different ways such units could be organised), the level of benefits each modality of haemodialysis might provide, travel costs and the cost of allowances. Of these sensitivity analyses, the two that influenced the estimates of cost per QALY the most were travel costs and the cost of

providing allowances for carers of patients on home haemodialysis. For those facing the lowest travel costs (i.e. living closest to the dialysis unit) and receiving the highest level of allowance (i.e. the most disabled), the incremental cost per QALY of home haemodialysis compared with hospital haemodialysis was approximately £12,000 at 5 years. For the comparison of home haemodialysis with satellite unit haemodialysis, the incremental cost per QALY was between £45,000 and £50,000 at 5 years.

Although strenuous efforts were made to find the most robust evidence available, the data used in the model have limitations, so the results of the model need to be treated with some caution. For example, very detailed data on the cost of haemodialysis were obtained from recently conducted economic evaluations primarily on the cost of hospital haemodialysis, and additions and amendments were required to reflect the costs of home and satellite haemodialysis. Furthermore, the data on which QoL estimates and transition probabilities were based were very limited. As discussed earlier, most of the included studies were non-randomised and therefore susceptible to bias. Similarly, no usable data were identified to determine the chance of changing from home haemodialysis to hospital or satellite haemodialysis.

The focus of the economic model has been on costs and cost per QALY from the perspective of the NHS. The inclusion of costs of allowances was an attempt to widen this perspective. It is important to note that these allowances, while representing a cost to a local authority, are an income to the patient and carer. To some extent, they help compensate for the very considerable burden of care that is transferred from the hospital or satellite unit onto the home haemodialysis patient and carer. The data reported in chapter 5 (*Financial impact on patients and their families/carers*) suggest that the time per week devoted simply to the provision of the dialysis itself can be considerable.

Factors that may influence the number of people eligible for home haemodialysis are age, whether the cause of ESRF was diabetes or multisystem failure as opposed to other causes, and the likelihood of receiving a transplant. If younger adults, and children, are much more likely to receive renal transplants than those over age 75 years, and those between age 65 and 74 years with diabetes or multisystem failure are not offered home haemodialysis, then a crude approximation suggests that about 1500 people per year who are currently offered RRT might be eligible for home haemodialysis. Many of these people, however, might be unsuitable for home haemodialysis because of the severity of their condition or the lack of someone willing and able to act as a carer.

It is important to note that a new generation of home haemodialysis machines is under development but could not be analysed in this review. This new generation of machines should improve ease of use, with features such as automatic set-up and rinsing, automatic sterilisation, automated haemodialysis proportioning units and the possibility of remote monitoring (by staff in a central unit) of patients undergoing home haemodialysis. The new machines may reduce the rate of complications in the home and reduce the need for carer involvement, thereby reducing the level of family participation needed (which is often seen as a factor lessening the attractiveness of home versus satellite unit dialysis). The new generation of machines is only likely to increase the advantages offered by home versus hospital haemodialysis and may also lead to a situation of a clearer advantage of home versus satellite unit dialysis. However, this potential advantage will depend in part on the cost of these new machines.

Chapter 7
Conclusions

The incremental cost per QALY for home haemodialysis compared with hospital haemodialysis is modest, but more substantial compared with satellite unit haemodialysis, although this comparison is made under the assumption that satellite unit haemodialysis is associated with a QoL similar to that associated with home haemodialysis. If the association is relaxed, the incremental cost per QALY is more modest.

Expanding home and satellite haemodialysis services may provide a method of coping with the increased number of people requiring RRT, with less additional resources required than would be needed to expand hospital haemodialysis units. Currently, home haemodialysis is very rarely used, and the extent to which it can be used is limited by the number of patients suitable for such treatment with a relative or friend who can be present at each dialysis session. Although the evidence for home haemodialysis is very limited, the expansion of home haemodialysis may improve the well-being of patients and allow them to maintain employment by dialysing at a time suitable to them. Home haemodialysis also facilitates more frequent and/or longer dialysis sessions, which may improve patient well-being but at increased cost.

Home haemodialysis may also save on patient travel costs. The saving may be considerable if patients live far from the base unit. Home haemodialysis may, however, add considerably to the stress on carers and families (particularly for longer or more frequent dialysis). The net effect on a family's income is uncertain because it depends upon what, if any, paid employment the carer gives up. For these reasons, the expansion of the current home dialysis programme might be limited. Some of the stress placed on unpaid carers and the dialysis patient's family could be removed if paid carers were employed to assist with dialysis. This option would increase the cost per patient but might allow otherwise unsuitable patients to receive home haemodialysis.

Although dialysis may be performed in the home, support is required from staff in the main unit. Given the shortage of trained nurses, the expansion of home haemodialysis programmes may be difficult to achieve without undertaking additional nurse-training efforts. Undersupported programmes may not achieve the same level of benefits as those identified from the literature.

Recommendations for research

Further prospective comparative studies are needed for low-, medium- and high-risk adults, and for children, on the effectiveness and cost-effectiveness of home versus satellite unit haemodialysis. This expanded research should consider outcomes such as the QoL of patients and carers, hospitalisation rates, employment/school status, technique failure, access failure, survival, adverse events, measures of anaemia and biochemical indices of renal disease. Analysis of the newer machines, directed at the home haemodialysis population with respect to the above outcomes, should also be undertaken as part of this research. Account should also be taken of the likelihood of transplantation for each patient group, particularly children, because the investment in home conversion may not be worthwhile for some patients. Further qualitative research is also needed on the acceptability to patients and their carers/families of home haemodialysis as a form of treatment.

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Contributions of the authors

Graham Mowatt, Laura Wyness and Luke Vale completed the review of effectiveness. Sally Stearns conducted the review of economic evaluations. Juan Perez conducted the economic evaluation under supervision by Luke Vale. Cynthia Fraser developed and ran the search strategies and obtained papers. Alison MacLeod and Conal Daly provided advice and commented on drafts of the review.

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Appendix 1

Major developments in haemodialysis therapy

1944 – Introduction by Kolff and Berk of haemodialysis for renal failure, using rotating drum dialyser

1960 – Development of Teflon® arteriovenous shunt

1960 – Development of Kiil reusable parallel-plate dialyser

1960 – Introduction of chronic haemodialysis by Scribner and colleagues

1961 – First attempt to perform haemodialysis in the home (Japan)

1962 – First satellite dialysis unit opened in Seattle

1964 – Introduction of Brescia–Cimino subcutaneous arteriovenous fistula

1964–65 – First series of patients on home dialysis (Seattle, Boston and London)

1960s – Frequency of haemodialysis established at 3 times per week

1960s – Development of twin-coil dialyser by Kolff and Watschinger

1960s – Design of hollow-fibre dialyser

1970s – Development of first system that combined all the components (dialysate preparation, blood pump and monitors) into one system

1980s – First dialysis machines with ultra-filtration control

1986 – Introduction of EPO

1994 – Introduction of nightly nocturnal haemodialysis (Ontario)

Appendix 2

Literature search strategies

1. Ovid multifile search: MEDLINE 1966 to 5 October 2001, EMBASE 1980 to 2001 (week 46), HealthSTAR 1975 to 2000, CINAHL 1982 to October 2001

1 hemodialysis,home/
2 home dialysis/
3 hemodialysis/
4 exp continuous arteriovenous hemodialysis/
5 exp continuous venovenous hemodialysis/
6 renal replacement therapy/
7 continuous renal replacement therapy/
8 renal dialysis/
9 Hemodiafiltration/
10 kidney failure,chronic/
11 exp uremia/
12 kidney,artificial/
13 hemodialysis units,hospital/
14 dialysis centers/
15 dialysis patients/
16 (hemodia$ or haemodia$ or dialy$).tw.
17 ((kidney? or renal) adj2 (replac$ or artificial or extracorporeal or disease? or failure? Or sufficien$ or insufficien$)).tw.
18 esrd.tw.
19 ur?emi$.tw.
20 or/3-19
21 home care services/
22 home care services,hospital-based/
23 community health services/
24 home nursing/
25 home nursing,professional/
26 (home or domicilliary or community).tw.
27 night care/
28 (nocturnal or night).tw.
29 ((slow or daily or regimen?) adj2 (hemodia$ or haemodia$ or dialy$)).tw.
30 or/21-29
31 1 or 2 or (20 and 30)
32 randomized controlled trial.pt.
33 controlled clinical trial.pt.
34 clinical trial.pt.
35 clinical trials/
36 exp controlled study/
37 nonrandomized trials/
38 intervention studies/
39 random allocation/
40 random assignment/
41 case-control studies/
42 nonequivalent control group/
43 evaluation studies/
44 comparative studies/
45 comparative study/
46 experiment$.tw.
47 impact.tw.
48 intervention?.tw.
49 chang$.tw.
50 evaluat$.tw.
51 effect?.tw.
52 (randomised or randomized).tw.
53 case control.tw.
54 controls.tw.
55 compar$.tw
56 (control adj (group? or subject? or patient?)).tw.
57 animal/
58 human/
59 57 not 58
60 or/32-56
61 60 not 59
62 31 and 61
63 (home adj1 (hemodia$ or haemodia$ or dialy$)).ti.
64 62 or 63
65 meta-analysis.pt.
66 meta analysis/
67 review.pt.
68 systematic review.pt.
69 (meta or synthesis or literature or published).ab.
70 extraction or medline or selection or sources).ab.
71 trials or review or reviewed).ab.
72 articles or english or language).ab.
73 randomized or trial? or controlled).hw.
74 r/65-73
75 comment or letter or editorial).pt.
76 4 not (59 or 75)
77 31 and 76
78 4 or 77
79 remove duplicates from 78

2. PREMEDLINE (Ovid) 13 December 2001

1 hemodia$ or haemodia$ or dialy$).tw.
2 ((kidney? or renal) adj2 (replac$ or artificial or extracorporeal or disease? or failure? or sufficien$ or insufficien$)).tw.
3 esrd.tw.
4 ur?emi$.tw.

5 or/1-4
6 (home or domicilliary or community).tw
7 (nocturnal or night).tw
8 (slow or daily or regimen?) adj2 (hemodia$ or haemodia$ or dialy$)).tw.
9 or/6-8
10 5 and 9
11 randomized controlled trial.pt.
12 controlled clinical trial.pt.
13 clinical trial.pt.
14 experiment$.tw.
15 impact.tw.
16 intervention?.tw.
17 chang$.tw.
18 evaluat$.tw.
19 effect?.tw.
20 (randomised or randomized).tw
21 case control.tw.
22 controls.tw.
23 compar$.tw
24 (control adj (group? or subject? or patient?)).tw.
25 or/11-24
26 10 and 25
27 (home adj1 (hemodia$ or haemodia$ or dialy$)).ti.
28 26 or 27
29 meta-analysis.pt.
30 review.pt.
31 (meta or synthesis or literature or published).ab.
32 (extraction or medline or selection or sources).ab.
33 (trials or review or reviewed).ab.
34 (articles or english or language).ab.
35 or/29-34
36 (comment or letter or editorial).pt.
37 35 not 36
38 10 and 37
39 28 or 38

3. BIOSIS (Edina) 1985 to October 2001

((ti: (home n h?emodialysis)) or ti: (home n dialysis))
or ((((((al: (slow n dialysis)) or al: (daily n dialysis))
or al: (regimen? n dialysis)) or ((al: (daily n h?emodialysis))
or al: (slow n h?emodialysis)))
and
((((al: (night)) or al: (noctural)) or (((al: (home))
or al: (domicilliary))
or al: (community)))
and
((((al: (esrd)) or al: (uremia)) or al: (end-stage renal disease))
or (((al: (hemodialysis)) or al: (haemodialysis) or al: (dialysis))))))
and
((((al: (effect$)) or (((al: (experiment$)) or al: (impact))
or al:(chang$))) or (((al: (intervention?))
or al: (evaluat$)) or al: (compar$)))
or (((al: (random$)) or al: (trial?)) or al: (control$))))

4. SCI (Web of Science) 1981 to October 2001

(hemodialysis or haemodialysis or dialysis) and home

5. The Cochrane Library (Issue 3, 2001) and NRR (Issue 3, 2001)

1 HEMODIALYSIS-HOME:ME
2 (HOME:KY next DIALYSIS:KY)
3 HEMODIALYSIS:ME
4 HEMODIALYSIS:KY
5 RENAL-REPLACEMENT-THERAPY:ME
6 (RENAL:KY next (REPLACEMENT:KY next THERAPY:KY))
7 RENAL-DIALYSIS:ME
8 (RENAL:KY next DIALYSIS:KY)
9 HEMODIAFILTRATION:ME
10 HEMODIAFILTRATION:KY
11 KIDNEY-FAILURE-CHRONIC:ME
12 (KIDNEY:KY next (FAILURE:KY next CHRONIC:KY))
13 UREMIA*:ME
14 UREMIA:KY
15 KIDNEY-ARTIFICIAL:ME
16 (KIDNEY:KY next ARTIFICIAL:KY)
17 HEMODIALYSIS-UNITS-HOSPITAL:ME
18 (KIDNEY* near ((((((REPLAC* or ARTIFICIAL) or EXTRACORPOREAL) or DISEASE*) or FAILURE*) or SUFFICIEN*) or INSUFFICIEN*))
19 (RENAL near ((((((REPLAC* or ARTIFICIAL) or EXTRACORPOREAL) or DISEASE*) or FAILURE*) or SUFFICIEN*) or INSUFFICIEN*))
20 ((HEMODIA*:TI or HAEMODIA*:TI) or DIALY*:TI)
21 ((HEMODIA*:AB or HAEMODIA*:AB) or DIALY*:AB)
22 ((ESRD:TI or UREMI*:TI) or URAEMI*:TI)
23 ((ESRD:AB or UREMI*:AB) or URAEMI*:AB)
24 ((((((((((((((((((((#3 or #4) or #5) or #6) or #7) or #8) or #9) or #10) or #11) or #12) or #13) or #14) or #15) or #16) or #17) or #18) or #19) or #20) or #21) or #22) or #23)
25 HOME-CARE-SERVICES:ME
26 HOME-CARE-SERVICES-HOSPITAL-BASED:ME

27 HOME-NURSING:ME
28 (HOME:KY next CARE:KY)
29 COMMUNITY-HEALTH-SERVICES:ME
30 (COMMUNITY:KY next HEALTH:KY)
31 (HOME:KY next NURSING:KY)
32 ((HOME:TI or DOMICILLIARY:TI) or COMMUNITY:TI)
33 ((HOME:AB or DOMICILLIARY:AB) or COMMUNITY:AB)
34 NIGHT-CARE:ME
35 (NIGHT:KY next CARE:KY)
36 (NOCTURAL:TI or NIGHT:TI)
37 (NOCTURAL:AB or NIGHT:AB)
38 (((SLOW:TI or DAILY:TI) or REGIMEN*:TI) near HEMODIA*:TI)
39 (((SLOW:AB or DAILY:AB) or REGIMEN*:AB) near HEMODIA*:AB)
40 (((SLOW:TI or DAILY:TI) or REGIMEN*:TI) near HAEMODIA*:TI)
41 (((SLOW:AB or DAILY:AB) or REGIMEN*:AB) near HAEMODIA*:AB)
42 (((SLOW:TI or DAILY:TI) or REGIMEN*:TI) near DIALY*:TI)
43 (((SLOW:AB or DAILY:AB) or REGIMEN*:AB) near DIALY*:AB)
44 ((((((((((((((((((#25 or #26) or #27) or #28) or #29) or #30) or #31) or #32) or #33) or #34) or #35) or #36) or #37) or #38) or #39) or #40) or #41) or #42) or #43)
45 #24 and #44)
46 ((#1 or #2) or #45)

6. HMIC 1979 to 2001

(dialysis or hemodialysis or haemodialysis) and home
or
((dialysis or haemodialysis or hemodialysis) and (nocturnal or night))
or
((renal or kidney) adj (disease or failure)) and (treatment or therapy or dialysis or haemodialysis or hemodialysis)

7. British Library Inside December 2001

(dialysis or hemodialysis or haemodialysis) and home

8. NLM Gateway December 2001

hemodialysis,home (MeSH)
or
(hemodialysis or dialysis) and home

9. Clinical Trials, Current Controlled Trials, ReFeR December 2001

hemodialysis or haemodialysis or dialysis

10. World Wide Web: Northern Light December 2001

home dialysis or home hemodialysis

Appendix 3

Study eligibility form

Home haemodialysis versus hospital or satellite haemodialysis

Study eligibility form

Paper number: _____ **Assessor initials:** _____

Study identifier
(surname of first author + year of publication)

Type of study
Q1. Is the study a randomised controlled trial, controlled clinical trial, prospective comparative observational study or systematic review of these study designs?

Yes / Unclear → Go to Next question
No → **Exclude**

Participants in the study
Q2. Did the participants in the study have end-stage renal failure?

Yes / Unclear → Go to Next question
No → **Exclude**

Interventions in the study
Q3. Did one group receive haemodialysis at home?

Yes / Unclear → Go to Next question
No → **Exclude**

Q4. Did another group receive haemodialysis in a hospital or satellite unit?

Yes / Unclear → Go to Next question
No → **Exclude**

Outcomes in the study
Q5. Did the study report haemoglobin/haematocrit or biochemical indices of renal disease or Kt/V or protein catabolic rate (PCR) or blood pressure or complications (including interdialytic) or hospitalisation rate or technique failure or quality of life or mortality?

Yes / Unclear → **Include**, subject to clarification of 'unclear' points
No → **Exclude**

Final decision Include / Unclear / Exclude

Contains potentially relevant economic information Yes / Unclear / No

Appendix 4

List of identified articles in non-English language

Akiba T, Ogawa Y, Mizuguchi J, Yamada T, Ishihara T. Future of home hemodialysis for the improvement of quality of life of patients with end-stage renal disease. *Jpn J Artif Organs* 1998;**2**:821–6.

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Appendix 5

Data abstraction form

Home haemodialysis versus hospital or satellite haemodialysis for people with end-stage renal failure

Data extraction form

Administration details
Paper number: _____ Extractor initials: ____ Date information extracted:_____

Study identifier: _____
(surname of first author + year of publication)

Number of trials included in this paper: _____
(if more than one, complete separate extraction forms
for each, and add letters A, B, C, etc. to the study identifier)

Paper numbers of other trials with which this may link: _____ _____ _____ _____

Details of comparisons evaluated

	Tick if YES
Home haemodialysis versus hospital haemodialysis	☐
Home haemodialysis versus satellite haemodialysis	☐

Other notes on comparisons:

Study Design
RCT ☐ Controlled Clinical Trial ☐ Prospective Comparative Observational Study ☐ Systematic Review (of above study designs) ☐ Other_____

Characteristics of the participants
Source of participants:
Distance of participants from the (hospital/satellite) dialysis unit:
Time taken to travel to (hospital/satellite) dialysis unit:

Method of recruitment: (Consecutive, etc.)				
Dates for recruitment:				
Characteristic	**Home dialysis**	**Hospital dialysis**	**Satellite dialysis**	**All**
Age (mean, range)				
Gender				
Ethnicity				
Length of time on dialysis prior to start of trial				
Are all these characteristics roughly balanced between the groups?				
Proportion at risk in each group (adults at low/ moderate/high risk, children)				
Are at risk groups identifiable separately from the rest of the participants throughout the trial?				
Other notes on the participants				

Characteristics of the intervention				
Location of trial centre(s):				
Duration of trial:				
Who provided assistance with home dialysis process (e.g. spouse, nurse, etc.)?				
Characteristic	**Home dialysis**	**Hospital dialysis**	**Satellite dialysis**	**Notes**
Make and model of dialysis machine used				
Duration of dialysis sessions (hours)				
Dialysis frequency (number of sessions per week)				
Dialyser type (Synthetic/ cellulose/ modified cellulose) (Low/high flux)				
Dialysis flow rate				
Blood flow rate				
Ultrafiltration (litres per dialysis treatment)				
Dialysis composition (bicarbonate or acetate)				
Dialyser reuse (yes/no)				
Concomitant interventions (interventions given to both groups in addition to haemodialysis): _____ _____				

*Outcomes (*indicates primary outcome)*				
	Home dialysis	**Hospital dialysis**	**Satellite dialysis**	**Notes**
Haemoglobin				
Haematocrit				
Erythropoietin (EPO) used? Dosage?				
Biochemical indices of renal disease *(pre-dialysis session at end of trial or latest follow-up):* **Serum potassium** **Calcium** **Phosphate** **Albumin** **Alkaline phosphatase** **Parathyroid hormone** **Parathyroidectomy** **Evidence of renal bone disease** (radiological or histopathological)				

Outcomes (cont.)				
	Home dialysis	**Hospital dialysis**	**Satellite dialysis**	**Notes**
Dialysis adequacy: **Kt/V** (prescribed/ achieved) **Urea reduction ratio (URR)** **Protein catabolic rate (PCR)**				
Blood pressure (pre-dialysis session at end of trial or latest follow-up)				
Number of anti-hypertensive drugs used				
Hospitalisation rate (days per patient per year)*				
Technique failure*				
Quality of life* (e.g. SF-36)				
Employment/ school status*				
Time before return to work/school				
Mortality				

Outcomes (cont.)				
	Home dialysis	**Hospital dialysis**	**Satellite dialysis**	**Notes**
Interdialytic complications: **Nausea/ vomiting** **Hypotension** **Cramping** **Headaches** ***Other:***				
Complications: **Access failure*** **Infection** ***Other:***				
For person assisting with the home dialysis process, time away from usual activities:				

Other comments

Date form last revised: 18 January 2002

Appendix 6

Quality assessment checklist for systematic reviews

Home haemodialysis versus hospital or satellite haemodialysis

Quality assessment checklist for systematic reviews

Assessor initials:

Study identifier:
(surname of first author + year of publication)

1. Were the search methods used to find evidence (primary studies) on the primary question(s) stated?

NO	
PARTIALLY	
YES	

Comments:

2. Was the search for evidence reasonably comprehensive?

NO	
PARTIALLY	
YES	

Following done:	
Language restrictions	Yes/No
Handsearching	Yes/No
Reference lists	Yes/No
Authors contacted	Yes/No

Comments:

3. Were the criteria used for deciding which studies to include in the review reported?

NO	
PARTIALLY	
YES	

Author specifies:	
Type of study	Yes/No
Participants	Yes/No
Intervention(s)	Yes/No
Outcome(s)	Yes/No

Comments:

4. Was bias in the selection of articles avoided?

NO	
PARTIALLY	
YES	

Author specifies:	
Explicit selection criteria used	Yes/No
Independent screening of full text by at least two reviewers	Yes/No

Comments:

5. Were the criteria used for assessing the validity of the studies that were reviewed reported?

NO	
PARTIALLY	
YES	

Author specifies:	
Criteria used to assess methodological quality	Yes/No

Comments:

6. Was the validity of all of the studies referred to in the text assessed using appropriate criteria (either in selecting studies for inclusion or in analysing the studies that are cited)?

NO	
PARTIALLY	
YES	

Author specifies:	
Assessments of included studies using explicit criteria reported	Yes/No

Comments:

7. Were the methods used to combine the findings of the relevant studies (to reach a conclusion) reported?

NO	
PARTIALLY	
YES	

Author specifies:		
Meta-analysis	Outcome of interest	Yes/No
	Model used	Yes /No
	Test for heterogeneity	Yes/No
Qualitative	Why meta-analysis inappropriate	Yes/No
	How then made sense of data	Yes/No
Both	Sensitivity analysis	Yes/No

Comments:

8. Were the findings of the relevant studies combined appropriately relative to the primary question the review addresses?

NO	
PARTIALLY	
YES	

Interventions homogeneous	Yes/No
Outcome measures homogeneous	Yes/No
Participants homogeneous	Yes/No
How unit analysis errors were handled	Yes/No
Settings comparable	Yes/No

Comments:

9. Were the conclusions made by the author(s) supported by the data and/or the analysis reported in the review?

NO	
PARTIALLY	
YES	

Conclusions consistent with results	Yes/No
Conclusions do not go beyond the data	Yes/No
No evidence not interpreted as no effect	Yes/No
Strength of recommendations for practice of evidence (uncertainty)	Yes/No
Recommendations for research consistent with identified shortcomings	Yes/No

Comments:

10. Overall, how would you rate the scientific quality of this review?

Extensive flaws		Major flaws		Minor flaws		Minimal flaws
1	2	3	4	5	6	7

Comments:

Appendix 7

Quality assessment checklist for primary studies

Home haemodialysis versus hospital or satellite haemodialysis for people with end-stage renal failure

Quality assessment checklist

Paper number: _____

Study identifier:
(surname of first author + year of publication)

_____

Assessor initials: _____

Date form completed: _____

Reporting

1. *Is the hypothesis/aim/objective of the study clearly described?*

Yes	1
No	0

2. *Are the main outcomes to be measured clearly described in the Introduction or Methods section?*

   If the main outcomes are first mentioned in the Results section, the question should be answered no.

Yes	1
No	0

3. *Are the characteristics of the patients included in the study clearly described?*

   In cohort studies and trials, inclusion and/or exclusion criteria should be given. In case–control studies, a case definition and the source for controls should be given.

Yes	1
No	0

4. *Are the interventions of interest clearly described?*

   Treatments and placebo (where relevant) that are to be compared should be clearly described.

Yes	1
No	0

5. *Are the distribution of principal confounders in each group of subjects to be compared clearly described?*

   A list of principal confounders is provided.

Yes	2
Partially	1
No	0

6. *Are the main findings of the study clearly described?*

   Simple outcome data (including denominators and numerators) should be reported for all major findings so that the reader can check the major analyses and conclusions. (This question does not cover statistical tests, which are considered below.)

Yes	1
No	0

continued

7. *Does the study provide estimates of the random variability in the data for the main outcomes?*

In non-normally distributed data, the interquartile range of results should be reported. In normally distributed data, the standard error, standard deviation or confidence intervals should be reported. If the distribution of the data is not described, it must be assumed that the estimates used were appropriate and the question should be answered yes.

Yes	1
No	0

8. *Have all important adverse events that may be a consequence of the intervention been reported?*

This should be answered yes if the study demonstrates that there was a comprehensive attempt to measure adverse events. (A list of possible adverse events is provided.)

Yes	1
No	0

9. *Have the characteristics of patients lost to follow-up been described?*

This should be answered yes where there were no losses to follow-up or where losses to follow-up were so small that findings would be unaffected by their inclusion. This should be answered no where a study does not report the number of patients lost to follow-up.

Yes	1
No	0

10. *Have actual probability values been reported (e.g. 0.035 rather than < 0.05) for the main outcomes, except where the probability value is less than 0.001?*

Yes	1
No	0

External validity

All the following criteria attempt to address the representativeness of the findings of the study and whether they may be generalised to the population from which the study subjects were derived.

11. *Were the subjects asked to participate in the study representative of the entire population from which they were recruited?*

The study must identify the source population for patients and describe how the patients were selected. Patients would be representative if they comprised the entire source population, an unselected sample of consecutive patients or a random sample. Random sampling is only feasible where a list of all members of the relevant population exists. Where a study does not report the proportion of the source population from which the patients are derived, the question should be answered as unable to determine.

Yes	1
No	0
Unable to determine	0

12. *Were those subjects who were prepared to participate representative of the entire population from which they were recruited?*

The proportion of those asked who agreed should be stated. Validation that the sample was representative would include demonstrating that the distribution of the main confounding factors was the same in the study sample and the source population.

Yes	1
No	0
Unable to determine	0

continued

13. *Were the staff, places and facilities where the patients were treated representative of the treatment the majority of patients received?*

For the question to be answered yes, the study should demonstrate that the intervention was representative of that in use in the source population. The question should be answered no if, for example, the intervention was undertaken in a specialist centre unrepresentative of the hospitals most of the source population would attend.

Yes	1
No	0
Unable to determine	0

Internal validity – bias

14. *Was an attempt made to blind study subjects to the intervention they have received?*

For studies where the patients would have no way of knowing which intervention they received, this should be answered yes.

Yes	1
No	0
Unable to determine	0

15. *Was an attempt made to blind those measuring the main outcomes of the intervention?*

Yes	1
No	0
Unable to determine	0

16. *If any of the results of the study were based on 'data dredging', was this made clear?*

Any analyses that had not been planned at the outset of the study should be clearly indicated. If no retrospective unplanned subgroup analyses were reported, then answer yes.

Yes	1
No	0
Unable to determine	0

17. *In trials and cohort studies, do the analyses adjust for different lengths of follow-up of patients, or in case–control studies, is the time period between the intervention and outcome the same for cases and controls?*

Where follow-up was the same for all study patients, the answer should be yes. If different lengths of follow-up were adjusted for by, for example, survival analysis, the answer should be yes. Studies where differences in follow-up are ignored should be answered no.

Yes	1
No	0
Unable to determine	0

18. *Were the statistical tests used to assess the main outcomes appropriate?*

The statistical tests used must be appropriate to the data. For example non-parametric methods should be used for small sample sizes. Where little statistical analysis has been undertaken but where there is no evidence of bias, the question should be answered yes. If the distribution of the data (normal or not) is not described, it must be assumed that the estimates used were appropriate and the question should be answered yes.

Yes	1
No	0
Unable to determine	0

19. *Was compliance with the intervention/s reliable?*

Where there was non-compliance with the allocated treatment or where there was contamination of one group, the question should be answered no. For studies where the effect of any misclassification was likely to bias any association to the null, the question should be answered yes.

Yes	1
No	0
Unable to determine	0

continued

20. *Were the main outcome measures used accurate (valid and reliable)?*

For studies where the outcome measures are clearly described, the question should be answered yes. For studies which refer to other work or that demonstrate the outcome measures are accurate, the question should be answered yes.

Yes	1
No	0
Unable to determine	0

Internal validity – confounding (selection bias)

21. *Were the patients in different intervention groups (trials and cohort studies) or were the cases and controls (case–control studies) recruited from the same population?*

For example, patients for all comparison groups should be selected from the same hospital. The question should be answered unable to determine for cohort and case–control studies where there is no information concerning the source of patients included in the study.

Yes	1
No	0
Unable to determine	0

22. *Were study subjects in different intervention groups (trials and cohort studies) or were the cases and controls (case–control studies) recruited over the same period of time?*

For a study which does not specify the time period over which patients were recruited, the question should be answered as unable to determine.

Yes	1
No	0
Unable to determine	0

23. *Were study subjects randomised to intervention groups?*

Studies which state that subjects were randomised should be answered yes, except where method of randomisation would not ensure random allocation. For example, alternate allocation would score no because it is predictable.

Yes	1
No	0
Unable to determine	0

24. *Was the randomised intervention assignment concealed from both patients and healthcare staff until recruitment was complete and irrevocable?*

All non-randomised studies should be answered no. If assignment was concealed from patients but not from staff, it should be answered no.

Yes	1
No	0
Unable to determine	0

25. *Was there adequate adjustment for confounding in the analyses from which the main findings were drawn?*

This question should be answered no for trials if: the main conclusions of the study were based on analyses of treatment rather than intention to treat; the distribution of known confounders in the different treatment groups was not described; or the distribution of known confounders differed between the treatment groups but was not taken into account in the analyses. In non-randomised studies, if the effect of the main confounders was not investigated or confounding was demonstrated but no adjustment was made in the final analyses, the question should be answered as no.

Yes	1
No	0
Unable to determine	0

continued

26. Were losses of patients to follow-up taken into account?

If the numbers of patients lost to follow-up are not reported, the question should be answered as unable to determine. If the proportion lost to follow-up was too small to determine main findings, the question should be answered yes.

Yes	1
No	0
Unable to determine	0

Power

27. Was a power calculation provided?

Yes	
No	

Checklist summary

Sub-scale	**Score**
Reporting	
External validity	
Internal validity – bias	
Internal validity – confounding	
Total score	

Date form last revised: 18 January 2002

Appendix 8

List of principal confounders and possible adverse events

Home haemodialysis versus hospital or satellite haemodialysis for people with end-stage renal failure

Supplementary information for quality assessment checklist

Question 5. List of principal confounders

- Age
- Gender
- Ethnicity
- Length of time on dialysis prior to start of trial
- Co-morbidities:
  - Diabetes mellitus
  - Ischaemic heart disease
    - Angina (exercise test, thallium scan, etc.)
    - Myocardial infarction (heart attack)
    - Coronary artery bypass graft (CABG)
    - Percutaneous transluminal coronary angioplasty
    - Congestive cardiac failure
    - Cerebrovascular disease (previous stroke)
    - Peripheral vascular disease
    - Chronic pulmonary disease
    - Chronic liver disease
    - Malignancy (excluding skin cancer)
    - Possibly hypertension
- Risk status:
  - Low risk:
    Age < 70 years and no co-morbid illness
  - Medium risk:
    Age 70–80 years
    OR any age with one co-morbid illness
    OR < 70 years with diabetes
  - High risk:
    Age > 80 years
    OR any age with two co-morbidities
    OR any age with cardiopulmonary disease
    OR any age with visceral cancer

Question 8. List of possible adverse events

- Technique failure
- Mortality
- Intradialytic complications:
  - Nausea/vomiting
  - Hypotension
  - Cramping
  - Headaches
- Other complications:
  - Access failure
  - Infection

Appendix 9

List of included studies

* Where more than one reference is given under a study identifier, the primary reference is preceded by an asterisk.

Arkouche *et al.*, 1999
Arkouche W, Traeger J, Delawari E, Sibai-Galland R, Abdullah E, Galland R, *et al.* Twenty-five years of experience with out-center hemodialysis. *Kidney Int* 1999;**56**:2269–75.

Bremer *et al.*, 1989
Bremer BA, McCauley CR, Wrona RM, Johnson JP. Quality of life in end-stage renal disease: a reexamination. *Am J Kidney Dis* 1989;**13**:200–9.

Cameron *et al.*, 2000
Cameron JI, Whiteside C, Katz J, Devins GM. Differences in quality of life across renal replacement therapies: a meta-analytic comparison. *Am J Kidney Dis* 2000;**35**:629–37.

Capelli *et al.*, 1985
Capelli JP, Camiscioli TC, Vallorani RD, Bobeck JD. Comparative analysis of survival on home hemodialysis, in-center hemodialysis and chronic peritoneal dialysis (CAPD-IPD) therapies. *Dial Transplant* 1985;**14**:38–52.

Churchill, 1988
Churchill DN. The effect of treatment modality on the quality of life for patients with end-stage renal disease. In: Khanna R, editor. Advances in CAPD. Toronto: Peritoneal Dialysis Bulletin Inc.; 1988; p. 63–5.

Courts & Boyette, 1998
Courts NF, Boyette BG. Psychosocial adjustment of males on three types of dialysis. *Clin Nurs Res* 1998;**7**:47–63.

Covic, 1998
Covic A. Impact of the renal replacement therapy (RRT) modality on autonomic nervous system function. *Nephrol Dial Transplant* 1998;**13**:A112.

Freeman & Richards, 1979
Freeman RM, Richards CJ. Studies on sulfate in end-stage renal disease. *Kidney Int* 1979;**15**:167–75.

Hart & Evans, 1987
* Hart LG, Evans RW. The functional status of ESRD patients as measured by the Sickness Impact Profile. *J Chronic Dis* 1987;**40**(Suppl 1):117S–136S.

Evans RW, Manninen DL, Garrison LP Jr, Hart LG, Blagg CR, Gutman RA, *et al.* The quality of life of patients with end-stage renal disease. *N Engl J Med* 1985;**312**:553–9.

Hellerstedt *et al.*, 1984
Hellerstedt WL, Johnson WJ, Ascher N, Kjellstrand CM, Knutson R, Shapiro FL, *et al.* Survival rates of 2,728 patients with end-stage renal disease. *Mayo Clin Proc* 1984;**59**:776–83.

Jacobs & Selwood, 1995
Jacobs C, Selwood NH. Renal replacement therapy for end-stage renal failure in France: current status and evolutive trends over the last decade. *Am J Kidney Dis* 1995;**25**:188–95.

Livesley, 1981
Livesley WJ. Factors associated with psychiatric symptoms in patients undergoing chronic hemodialysis. *Can J Psychiatry* 1981;**26**:562–6.

Mailloux *et al.*, 1996
* Mailloux LU, Kapikian N, Napolitano B, Mossey RT, Bellucci AG. Home hemodialysis: patient outcomes during a 24-year period of time from 1970 through 1993. *Adv Ren Replace Ther* 1996;**3**:112–19.

Mailloux LU, Bellucci AG, Napolitano B, Kapikian N, Mossey R, Vernace M, *et al.* Home (Ho) Hemodialysis (HD) patients (Pts) exhibit superior survivals (SUR). *J Am Soc Nephrol* 1995;**6**:547.

Mailloux LU, Bellucci AG, Napolitano B, Mossey T, Wilkes BM, Bluestone PA. Survival estimates for 683 patients starting dialysis from 1970 through 1989: identification of risk factors for survival. *Clin Nephrol* 1994;**42**:127–35.

Mailloux LU, Bellucci AG, Mossey T, Napolitano B, Moore T, Wilkes BM, *et al.* Predictors of survival in patients undergoing dialysis. *Am J Med* 1988;**84**:855–62.

McGee, 1981
McGee MG. Familial response to chronic illness: the impact of home versus hospital dialysis. *J Am Assoc Nephrol Nurses Tech* 1981;**8**:9–12.

McGregor *et al.*, 2001
McGregor DO, Buttimore AL, Lynn KL, Nicholls MG, Jardine DL. A comparative study of blood pressure control with short in-center versus long home hemodialysis. *Blood Purif* 2001;**19**:293–300.

Mohr *et al.*, 2001
Mohr PE, Neumann PJ, Franco SJ, Marainen J, Lockridge R, Ting G. The case for daily dialysis: its impact on costs and quality of life. *Am J Kidney Dis* 2001;**37**:777–89.

Page & Weisberg, 1991
Page S, Weisberg MB. Marital and family characteristics of home and hospital dialysis patients. *Loss Grief Care* 1991;**5**(1–2):33–45.

Parsons & Harris, 1997
Parsons DS, Harris DCH. A review of quality of life in chronic renal failure. *Pharmacoeconomics* 1997;**12** (2 Pt 1):140–60.

Piltz-Kirkby & Fox, 1982
Piltz-Kirkby M, Fox MA. Support systems as a factor in hemodialysis. *Nephrol Nurse* 1982;**4**:19–26.

Price *et al.*, 1978
Price JD, Ashby KM, Reeve CE. Results of 12 years' treatment of chronic renal failure by dialysis and transplantation. *Can Med Assoc J* 1978;**118**:263–6.

Reichwald-Klugger *et al.*, 1984
* Reichwald-Klugger E, Tieben-Heibert A, Korn R, Stein L, Weck K, Maiwald G, *et al.* Psychosocial adaptation of children and their parents to hospital and home hemodialysis. *Int J Pediatr Nephrol* 1984;**5**:45–52.

Reichwald-Klugger E, Weck K, Korn R, Bonzel KE, Scharer K. Psychosocial adaptation of children and their parents to hospital and home hemodialysis. *Dial Transplant* 1986;**15**:453–9.

Rubin *et al.*, 1989
Rubin J, Hsu H, Bower J. Survival on dialysis therapy: one center's experience. *Am J Med Sci* 1989;**297**:80–90.

Schreiber & Huber, 1985
Schreiber WK, Huber W. Psychological situation of dialysis patients and their families. *Dial Transplant* 1985;**14**:696–8.

Soskolne & De Nour, 1987
* Soskolne V, De Nour AK. Psychosocial adjustment of home hemodialysis, continuous ambulatory peritoneal dialysis and hospital dialysis patients and their spouses. *Nephron* 1987;**47**:266–73.

De Nour AK, Soskolne V. Comparison of adjustment of home dialysis to center dialysis patients. *Kidney Int* 1985;**28**:337.

Westlie *et al.*, 1984
Westlie L, Umen A, Nestrud S, Kjellstrand CM. Mortality, morbidity, and life satisfaction in the very old dialysis patient. *Trans Am Soc Artif Intern Organs* 1984;**30**:21–30.

Williams *et al.*, 1983
Williams GW, Weller JM, Ferguson CW, Forsythe SB, Wu SC. Survival of endstage renal disease patients: age-adjusted differences in treatment outcomes. *Kidney Int* 1983;**24**:691–3.

Woods *et al.*, 1996
Woods JD, Port FK, Stannard D, Blagg CR, Held PJ. Comparison of mortality with home hemodialysis and center hemodialysis: a national study. *Kidney Int* 1996;**49**:1464–70.

Appendix 10

Detailed quality assessment results for included systematic reviews and primary studies

Study identifier (systematic reviews)	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
Cameron *et al.*, 2000[13]	Yes	Partially	Yes	Yes	Yes	Yes	Yes	No	Yes	5
Jacobs & Selwood, 1995[11]	Yes	Partially	Partially	No	No	No	No	Partially	Partially	3
Mohr et al., 2001[12]	No	Partially	Partially	No	No	No	Partially	Partially	Yes	3
Parsons & Harris, 1997[14]	Yes	Partially	Partially	No	No	No	No	Yes	Yes	4

Study identifier (primary studies)	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22	Q23	Q24	Q25	Q26	Q27
Arkouche *et al.*, 1999[16]	1	1	0	1	0	0	1	0	1	1	1	0	1	0	0	1	1	1	1	1	1	0	0	0	0	1	No
Bremer *et al.*, 1989[17]	1	1	1	0	2	1	1	0	1	0	1	1	1	0	0	1	1	1	1	1	1	0	0	0	0	0	No
Capelli *et al.*, 1985[18]	1	1	0	1	1	1	1	0	1	0	0	0	1	0	0	1	1	1	1	1	1	1	0	0	1	1	No
Churchill, 1988[34]	1	1	0	0	1	0	1	0	0	0	0	0	0	0	0	1	0	1	1	1	1	0	0	0	0	0	No
Courts & Boyette, 1998[19]	1	1	1	0	1	1	1	0	1	1	0	0	0	0	0	1	1	1	1	1	0	0	0	0	1	1	No
Covic, 1998[20]	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	No
Freeman & Richards, 1979[35]	1	1	0	1	0	1	1	0	0	0	0	0	1	0	0	1	0	0	1	1	0	0	0	0	0	0	No
Hart & Evans, 1987[21]	1	1	1	0	2	1	1	0	0	0	0	0	1	0	0	1	1	1	0	1	0	0	0	0	1	0	No
Hellerstedt *et al.*, 1984[22]	1	1	0	0	0	1	0	0	1	1	0	1	1	0	0	1	1	0	0	0	1	1	0	0	1	1	No
Livesley, 1981[23]	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1	0	1	1	0	0	0	0	0	No
Mailloux *et al.*, 1996[24]	1	1	0	0	1	1	1	0	1	1	1	1	1	0	0	1	1	1	1	1	1	1	0	0	1	1	No
McGee, 1981[25]	1	1	0	0	0	1	1	0	1	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	1	No
McGregor *et al.*, 2001[15]	1	1	1	1	2	1	1	0	1	1	0	0	0	0	0	1	1	1	1	1	0	0	1	0	1	1	Yes
Page & Weisberg, 1991[36]	1	1	0	0	1	0	1	0	1	1	0	0	1	0	0	1	0	1	1	1	1	0	0	0	1	0	No
Piltz-Kirkby & Fox, 1982[37]	1	1	1	0	0	0	1	0	1	1	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	No
Price *et al.*, 1978[26]	1	1	0	0	0	0	0	0	1	0	0	0	1	0	0	1	0	0	1	1	1	0	0	0	0	1	No
Reichwald-Klugger *et al.*, 1984[27]	1	1	1	0	1	1	1	1	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	No
Rubin *et al.*, 1989[28]	1	1	1	0	1	1	0	0	0	1	0	0	1	0	0	1	0	1	0	1	1	1	0	0	1	0	No
Schreiber & Huber, 1985[29]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1	1	0	0	0	0	No
Soskolne & De Nour, 1987[30]	1	1	1	0	1	1	1	0	1	0	0	0	1	0	0	1	1	1	1	1	0	0	0	0	0	0	No
Westlie *et al.*, 1984[31]	1	1	0	0	1	1	1	1	1	1	0	0	1	0	0	1	0	1	1	1	0	1	0	0	0	1	No
Williams *et al.*, 1983[32]	1	1	0	0	0	0	1	0	0	0	1	0	1	0	0	1	0	1	1	1	1	1	0	0	1	0	No
Woods *et al.*, 1996[33]	1	1	1	0	2	0	1	0	0	1	1	1	1	0	0	1	1	1	1	1	0	1	0	0	1	0	No

Q, question

Appendix 11

Characteristics of included studies

This appendix includes information taken directly from the included studies, therefore the term 'in-centre haemodialysis' has been retained, whereas in the main text of the report, 'in-centre' was changed to 'hospital'.

Study and method	Participants	Interventions	Outcomes	Notes
Arkouche *et al.*, 1999[16] Country: France Comparative observational study (retrospective) Modalities included: home haemodialysis, self-care haemodialysis	All participants *n* = 471. Home haemodialysis *n* = 231, self-care units *n* = 240. Source of participants: Association pour l'Utilisation du Rein Artificiel (AURAL), Hôpital Eduard Herriot, Lyon, France. All patients: age at start of haemodialysis (mean), 43.5 years; range, 18–78 years; 339 men, 132 women. Cause of ESRD: diabetic (5%), renal vascular diseases (12%), chronic glomerulonephritis (45%), overall other causes including interstitial nephritis, polycystic kidney disease and other known causes (34%), unknown causes (4%). Inclusion criteria: length of time on dialysis prior to start of trial – at least 3 months in AURAL facilities. Exclusion criteria: patients coming from other centres or other modalities of dialysis or who returned to dialysis after transplantation failure	Home haemodialysis versus self-care unit. Duration of study: January 1974 to December 1997. Person who provided assistance with home dialysis: often the spouse. Both modalities: duration and frequency of dialysis sessions – 4–6 hours, 3 times per week; dialyser type – unmodified cellulosic membrane until 1988, replaced by modified cellulosic or synthetic high-flux membrane; dialysate flow rate – 500 ml/minute; blood flow rate – 250–350 ml/minute; dialysis composition – acetate buffer replaced by bicarbonate in 1990; dialyser not reused	Mortality, survival, causes of death	Statistical method used: survival curves were drawn using the Kaplan–Meier method. Cox proportional hazard analysis was performed
Bremer *et al.*, 1989[17] Country: USA Comparative observational study (prospective) Modalities included: home haemodialysis, self-assisted in-centre haemodialysis, staff-assisted in-centre haemodialysis, CAPD, first transplant, failed transplant, second or later transplant. 957 patients selected, 44 patients dropped because they did not meet criteria, 10 who returned questionnaires were excluded	All participants *n* = 489. Home haemodialysis *n* = 47, self-assisted in-centre haemodialysis *n* = 41, staff-assisted in-centre haemodialysis *n* = 105. Source of participants: 59 centres in Network 24 of the ESRD Programme, USA. Mean age (SD): home dialysis, 53.2 (12.9) years; self-assisted, 54.5 (11.4) years; staff-assisted, 57.1 (13.4) years. Gender: home dialysis, 51% men, 49% women; self-assisted, 54% men, 46% women; staff-assisted, 51% men, 49% women. Ethnicity: home dialysis, 81% white, 19% non-white; self-assisted, 63% white, 37% non-white; staff-assisted, 62% white, 38% non-white. Mean years of education (SD): home dialysis, 12.9 (2.9); self-assisted, 12.0 (2.5); staff-assisted, 11.2 (2.5). Inclusion criteria: at least 18 years of age, medically stable and receiving their current form of treatment for at least 90 days prior to start of trial. Primary diagnosis (%): interstitial – home dialysis 15%, self-assisted 5%, staff-assisted 16%; polycystic – home dialysis 17%, self-assisted 12%, staff-assisted 6%; glomerulonephritis – home dialysis 28%, self-assisted 37%, staff-assisted 26%; hypertensive – home dialysis 22%, self-assisted 32%, staff-assisted 26%; systemic lupus – home dialysis 0%, self-assisted 2%, staff-assisted 0%; diabetes – home dialysis 4%, self-assisted 5%, staff-assisted 16%; other diagnoses – home dialysis 13%, self-assisted 7%, staff-assisted 10%. Mean co-morbid index (SD): home dialysis, 2.2 (1.6); self-assisted, 1.9 (1.2); staff-assisted, 2.7 (1.8)	Home haemodialysis versus self-assisted in-centre haemodialysis and staff-assisted in-centre haemodialysis. Self-administered questionnaire	QoL (objective and subjective measures), hospitalisation rate, employment status	Statistical method used: non-parametric statistical analysis (χ^2 tests for the difference between proportions), dummy variable multiple regression analyses, multiple classification analyses (MCA) to control for case-mix differences across treatment groups, Fisher's protected *t*-test

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Study and method	Participants	Interventions	Outcomes	Notes
Cameron *et al.*, 2000[13] Systematic review Modalities included: home haemodialysis, in-centre haemodialysis, CAPD, renal transplantation Source of studies: MEDLINE, PsycINFO, CINAHL, personal reference databases and bibliographies of retrieved articles Dates for search: studies published before August 1998 Inclusion criteria: (1) studies including at least one quantitative comparison between at least two modes of treatment, (2) studies including at least one measure of psychological well-being or emotional distress, (3) studies using a prospective research design, (4) studies involving adult patients at least 18 years of age, and (5) studies reporting the information necessary to calculate or estimate effect sizes 49 studies included	Inclusion criteria: at least 18 years of age	Home haemodialysis versus in-centre haemodialysis. 77 treatment comparisons involving emotional distress and 66 treatment comparisons involving psychological well-being	QoL (emotional distress and psychological well-being)	Statistical method used: summary effect sizes and 95% CIs calculated. Sensitivity analyses using weighted analysis of variance (ANOVA) and correlation undertaken to determine whether observed treatment-group differences were systematically related to study characteristics, such as case mix, research design or methodological rigour
Capelli *et al.*, 1985[18] Country: USA Comparative observational study (prospective) Modalities included: home haemodialysis, in-centre haemodialysis, CAPD	All participants $n = 454$. Home haemodialysis $n = 64$, in-centre dialysis $n = 276$. Source of participants: Our Lady of Lourdes Medical Center, Camden, New Jersey, USA. Dates for recruitment: 1 January 1974 to 31 December 1981. Mean age at onset of therapy (SD): home dialysis, 44.2 (13.4) years; in-centre dialysis, 52.0 (16.1) years. Gender: home dialysis, 44 men (68.8%), 20 women (31.3%); in-centre dialysis, 172 men (62.3%), 104 women (37.7%). Ethnicity: white – home dialysis, 51 patients, and in-centre dialysis, 176 patients; black – home dialysis, 12 patients, and in-centre dialysis, 99 patients; Hispanic – home dialysis, 0 patients, and in-centre dialysis, 0 patients; oriental – home dialysis, 1 patient, and in-centre dialysis, 1 patient. Diabetic status: home dialysis, 3 diabetic patients (4.7%); in-centre dialysis, 41 diabetic patients (14.9%). Length of time on dialysis prior to start of trial: home dialysis – mean time of 3.5 months of training at centre before discharge to home haemodialysis	Home haemodialysis versus in-centre haemodialysis. Duration of trial: 1 January 1974 to 31 December 1981. Both modalities: make and model of dialysis machine – EMSCO Ex 21, 23, 25 or TRIEX I, II or L, extracorporeal; duration and frequency of sessions – 4–5 hours, 3 times per week; dialyser type – either coil or hollow fibre	Mortality, survival	Statistical method used: Kaplan–Meier survival analysis and life-table actuarial analysis of patient survival, Cox proportional hazards regression model

continued

Study and method	Participants	Interventions	Outcomes	Notes
Churchill, 1988[34] Country: Canada Comparative observational study (prospective) Modalities included: home/self-care haemodialysis, in-centre haemodialysis, CAPD, transplantation	All participants *n* = 194. Home/self-care haemodialysis *n* = 36, in-centre haemodialysis *n* = 38. Source of participants: St Joseph's Hospital, Hamilton, Ontario, Canada. Age (mean): home/self-care dialysis, 47 years; in-centre dialysis, 52 years. Co-morbidity: 8% of home/self-care group had diabetes, 10% of in-centre group had diabetes; 12.7% of home/self-care group had other co-morbidities, 21.4% of in-centre group had other co-morbidities. Education: home/self-care group had 12.8 years of education, in-centre group had 11.5 years of education	Home/self-care haemodialysis versus in-centre haemodialysis. Duration of trial: 4–6 weeks	QoL, using TTO instrument. The TTO was administered to 194 participants and then a second time 4–6 weeks later to 171 of the original 194 participants who had not had clinically discernible changes in health status or QoL	With the TTO instrument, the participant is asked to consider his/her life during the preceding 2–3 weeks, focusing on the effect of ESRD and its treatment on physical activities, social activities, ability to work and how the participant feels about his/herself. The TTO score is the ratio between the years of full health considered equivalent to a lifetime of ESRD, and the expected lifetime with ESRD. The TTO scale ranges from 0 to 1.0, with 0 considered equivalent to death and 1 equivalent to full health
Courts & Boyette, 1998[19] Country: USA Comparative observational study (prospective) Modalities included: home haemodialysis, in-centre haemodialysis, peritoneal dialysis	All participants *n* = 15. Home haemodialysis *n* = 5, in-centre *n* = 5. Source of participants: two mid-sized cities in southern USA. Age (mean): home dialysis, 47.6 years; in-centre dialysis, 47.8 years. Gender: both modalities, all men. Ethnicity: white – home dialysis, 2 patients, and in-centre dialysis, 3 patients; black – home dialysis, 3 patients, and in-centre dialysis, 2 patients. Educational levels of in-centre group slightly higher than those of home dialysis group. Co-morbidity: home dialysis – 1 diabetic patient recovering from an amputation, 1 patient with cancer; in-centre dialysis – 2 patients experiencing additional medical complications. Inclusion criteria: men	Home haemodialysis versus in-centre haemodialysis. Spouse provided assistance with home dialysis. Semi-structured interview plus following instruments used: Clinical Anxiety Score, Generalised Contentment Scale, Haemodialysis Stressor Scale, PAIS Self Report	QoL (psychosocial adjustment), employment status	

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Study and method	Participants	Interventions	Outcomes	Notes
Covic, 1998[20] Country: UK and/or Romania Comparative observational study (prospective) Abstract only Modalities included: home haemodialysis, standard haemodialysis, CAPD, renal transplantation	All participants *n* = 198. Home haemodialysis *n* = 33, standard haemodialysis *n* = 84. Sex distribution and age were similar between the groups. Exclusion criteria: diabetes, heart failure, amyloidosis, medication influencing the autonomous nervous system, and anti-hypertensives were stopped for 2 weeks	8-hour home haemodialysis versus 4-hour standard haemodialysis	Autonomic dysfunction tests and biochemical parameters, including Valsalva's test, orthostasis test, cold pressor test, 30:15 ratio, heart rate variation, haemoglobin (g/l), HCO_3 (mEq/l), Kt/V	
Freeman & Richards, 1979[35] Country: USA Comparative observational study (prospective) Modalities included: home haemodialysis, satellite unit haemodialysis	All participants *n* = 52. Home haemodialysis *n* = 29, satellite unit dialysis *n* = 23. Source of participants: Iowa, USA. Age (mean): home group, 49 years, satellite unit group, 46 years. Length of time on dialysis prior to start of trial (mean): home group, 25 months; satellite unit group, 28 months	Home haemodialysis (sorbent cartridge) versus satellite unit haemodialysis (standard single pass). Make and model of dialysis machine used: home group, Redy machine by CCI Life Systems Inc.; satellite unit group, Cobe Centry Delivery System. Duration of dialysis sessions: home group, 6 hours; satellite unit group, 6 hours. Dialyser type: home group, sorbent cartridge dialysis system; satellite unit group, standard single pass dialysis, Gambro 13.5-μ dialyser. Dialysis flow rate: home group, 200 ml/minute; satellite unit group, 500 ml/minute. Blood flow rate: home group, 250 ml/minute; satellite unit group, 250 ml/minute. Dialyser reuse: home group, yes; satellite unit group, no	Differences in sulphate removal between sorbent cartridge dialysis and single pass dialysis; differences in other blood chemistry determinations; influence of residual urinary excretion on serum sulphate concentration; stability of the concentration of serum sulphate in patients one month from the next; influence of long-term haemodialysis of either type on serum sulphate concentration; alkaline phosphatase	Alkaline phosphatase was from retrospective analysis of the data

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Study and method	Participants	Interventions	Outcomes	Notes
Hart & Evans, 1987[21] Country: USA Comparative observational study (prospective) Modalities included: home haemodialysis, in-centre haemodialysis, continuous peritoneal dialysis, renal transplantation Data for the analysis was collected as part of a large multicentre study – the National Kidney Dialysis and Kidney Transplantation Study (NKDKTS)	All participants *n* = 859. Home haemodialysis *n* = 287 (33%), in-centre haemodialysis *n* = 347 (40%). Source of participants: 11 dialysis and transplantation centres, USA. Age (mean): home dialysis, 47.0 years; in-centre dialysis, 51.9 years. Gender: home dialysis, 64.1% men, 35.9% women; in-centre dialysis, 50.0% men, 50.0% women. Ethnicity: black – home dialysis, 8.7%, and in-centre dialysis, 42.5%; white – home dialysis, 86.4%, and in-centre dialysis, 53.5%; other – home dialysis, 4.9%, and in-centre dialysis, 4.0%. School years completed (mean): home dialysis, 12.8 years; in-centre dialysis, 11.5 years. Years with ESRD (mean): home dialysis, 5.3 years; in-centre dialysis, 4.0 years. Length of time on current modality (complete months, mean): home dialysis, 45.7 months; in-centre dialysis, 37.7 months. Co-morbid conditions: diabetic renal condition – home dialysis, 8.2%, and in-centre dialysis, 10.1%; last transplant failure – home dialysis, 19.5%, and in-centre dialysis, 13.3%; angina, myocardial infarction – home dialysis, 12.7%, and in-centre dialysis, 21.4%; other cardiovascular problem – home dialysis, 23.6%, and in-centre dialysis, 31.7%; respiratory disease – home dialysis, 4.6%, and in-centre dialysis, 14.4%; neurological problems and cerebrovascular problems – home dialysis, 10.9%, and in-centre dialysis, 22.0%; gastrointestinal problems – home dialysis, 9.5%, and in-centre dialysis, 12.6%; musculoskeletal disorders – home dialysis, 22.5%, and in-centre dialysis, 29.6%; infection – home dialysis, 2.8%, and in-centre dialysis, 4.7%; hepatitis – home dialysis, 2.8%, and in-centre dialysis, 4.7%; haematological problems other than anaemia – home dialysis, 2.5%, and in-centre dialysis, 4.1%; spinal abnormality – home dialysis, 5.3%, and in-centre dialysis 10.3%	Home haemodialysis versus in-centre haemodialysis. Data obtained from patients, medical records and a healthcare provider familiar with the patient's functional status. Information from the patient was obtained by a 90-minute personal interview and the SIP instrument. Overall response rate: nearly 90%	QoL (functional status), employment status	Statistical method used: *t*-test, Pearson product moment correlation coefficient, standard linear regression analysis, multiple regression analysis

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Study and method	Participants	Interventions	Outcomes	Notes
Hellerstedt *et al.*, 1984[22] Country: USA Comparative observational study (prospective) Modalities included: home haemodialysis, in-centre haemodialysis, living related donor transplantation, cadaver transplantation No patients were lost to follow-up	All participants *n* = 2728. Home dialysis patients: 148 without diabetes and 40 with diabetes. In-centre patients: 1259 without diabetes and 540 with diabetes. Source of participants: 29 dialysis facilities and three renal transplantation centres in ESRD Network 7, USA. Dates for recruitment: 1 January 1978 to 30 June 1983. Age (mean) of patients without diabetes: home dialyses, 64 years; in-centre dialysis, 54 years. Age (mean) of patients with diabetes: home dialysis, 56 years; in-centre dialysis, 50 years. Exclusion criteria: patients who died during the first month of scheduled long-term dialysis	Home haemodialysis versus in-centre haemodialysis	Survival, causes of death .	Treatment modality groups were not mutually exclusive Statistical method used: life-table method for survival rates, univariate analyses to determine patient survival by risk factor. Significant relationships were determined by χ^2 analysis
Jacobs & Selwood, 1995[11] Country: France Systematic review Modalities included: home haemodialysis, in-centre or self-care/limited-care haemodialysis, CAPD, continuous cyclic peritoneal dialysis, intermittent peritoneal dialysis, renal transplantation	Source of participants: France. Dates for recruitment: 1982–92. According to data from 83% of the treatment facilities in continental France, about 22,800 patients were reported to the European Dialysis and Transplant Association–European Renal Association (EDTA–ERA) Registry as alive under some mode of RRT as of December 1992: 6% treated by home haemodialysis, 55% treated by in-centre or self-care/limited-care haemodialysis. Cause of ESRF (all patients): primary glomerulonephritis, 25% in 1982, 19% in 1991; chronic pyelonephritis, 16% in 1982, 9% in 1991; vascular disease, 14% in 1982, 20.5% in 1991; polycystic kidney disease, 95% in 1982, 95% in 1991; diabetic nephropathy in 7% 1982, 13% in 1991	Home haemodialysis versus in-centre or self-care/limited-care haemodialysis. Analyses of data collected annually by the EDTA–ERA Registry, the French National Registry for Patients with ESRF, the annual report of the France–Transplant Association, and the ECHO–Nantes National Registry for Out-of-Centre Dialysis Patients. Duration of trial: 1982–92	Survival	

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Study and method	Participants	Interventions	Outcomes	Notes
Livesley, 1981[23] Country: UK Comparative observational study (prospective) Modalities included: home haemodialysis and in-centre haemodialysis	All participants *n* = 85. Home haemodialysis *n* = 51, in-centre haemodialysis *n* = 34. Source of participants: Royal Infirmary of Edinburgh, UK. All participants: mean age (range), 43.3 (15–69) years; gender, 56 men and 29 women; marital status, 70.6% married, 22.4% single, 2.3% divorced, 1.2% separated, 2.3% widowed and 1.2% co-habiting; mean length of time (SD) on dialysis prior to start of trial, 3.03 (2.75) years, with range of 2 months to 13.7 years. Exclusion criteria: of 91 patients attending the unit, 6 patients were excluded (2 patients too ill to assess, 2 unable to follow instructions, 1 died, 1 transplanted before assessment)	Home haemodialysis versus in-centre haemodialysis. Information obtained from personal interview and the following instruments: General Health Questionnaire, Middlesex Hospital Questionnaire	QoL (depression), employment status	
Mailloux *et al.*, 1996[24] Country: USA Comparative observational study (prospective) Modalities included: home haemodialysis, in-centre haemodialysis, CAPD, in-centre peritoneal dialysis	Home haemodialysis *n* = 74, in-centre haemodialysis *n* = 687. Source of participants: North Shore University Hospital, New York, USA. Dates of recruitment: 1 January 1970 to 31 December 1993. Age (median): home dialysis, 44 years; in-centre dialysis, 59 years. Gender: home dialysis – 51 men, 23 women; in-centre dialysis – not stated. Ethnicity: home dialysis – white, 67 patients, and black, 6 patients; in-centre dialysis – not stated. Both modalities: length of time on dialysis prior to start of trial – at least 90 days. ESRD diagnosis: diabetes mellitus – home dialysis, 4%, and in-centre dialysis, 22%; chronic glomerulonephritis – home dialysis, 51%, and in-centre dialysis, 30%; adult polycystic kidney disease – home dialysis, 22%, and in-centre dialysis, 7%; renal vascular disease – home dialysis, 0%, and in-centre dialysis, 15%; tubulointerstitial diseases – home dialysis, 14%, and in-centre dialysis, 11%; other renal diagnoses – home dialyses, 7%, and in-centre dialysis, 12%; hypertension – home dialysis, 3%, and in-centre dialysis, 4%. Distribution of risk factors at start of dialysis (*n*): hypertension – home dialysis, 37, and in-centre dialysis, 509; prior cerebrovascular accident or transient heart attack – home dialysis, 1, and in-centre dialysis, 17; abnormal electrocardiogram or documented myocardial infarction – home dialysis, 12, and in-centre dialysis, 427; congestive heart failure – home dialysis, 4, and in-centre dialysis, 232; pre-existing cardiac disease – home dialysis, 9, and in-centre dialysis, 334; low serum albumin – home dialysis, 5, and in-centre dialysis, 126; atherosclerotic peripheral vascular disease – home dialysis, 5, and in-centre dialysis, 306. Inclusion criteria: patients had to be older than 15 years of age and on dialysis for at least 90 days	Home haemodialysis versus in-centre haemodialysis. Duration of trial: 1 January 1970 to 31 December 1993, with follow-up to 31 December 1994	Survival, mortality	Statistical method used: product-limit method, log-rank test, Kruskal–Wallis, χ^2 tests, Cox proportional hazards regression model

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Study and method	Participants	Interventions	Outcomes	Notes
McGee, 1981[25] Country: USA Comparative observational study (prospective) Modalities included: home haemodialysis, hospital haemodialysis	Home haemodialysis n = 28, hospital haemodialysis n = 22. Participants were spouses of home haemodialysis and hospital haemodialysis patients. Source of participants: two selected hospitals that strongly encouraged home dialysis, one selected hospital that offered hospital dialysis only. Length of time on dialysis prior to start of trial: at least 1 month	Home haemodialysis versus hospital haemodialysis. Assistance with home dialysis process provided by spouse. Spouses of patients were approached by interviewer/social worker and asked to participate in study – 90% of spouses agreed to take part. Structured interview schedule was administered to spouse in person, if possible, otherwise mailed (to 30% of respondents)	QoL (location of dialysis and spouse's satisfaction with location of dialysis; location of dialysis and spouse's perception of patient's dependence on them; location of dialysis and attitude toward dialysis)	Statistical method used: χ^2 test, Fisher's Exact Probability Test, Gamma or Yule's Q
McGregor *et al.*, 2001[15] Country: New Zealand Prospective randomised crossover trial Modalities included: home haemodialysis, in-centre haemodialysis	All participants n = 9. Mean age (range): 48 (23–63) years. Gender: 4 men, 5 women. Ethnicity: Caucasian, 8 patients; Polynesian, 1 patient. Length of time on dialysis prior to start of trial: 25.3 months (range, 13–72 months). All participants were without residual renal function and had native arteriovenous fistulae, were non-smokers, were on a salt-restricted diet (< 90 mmol/day), and took a constant dose of calcium carbonate and ferrous gluconate throughout; 5 of 9 patients were receiving EPO (6000 units/week) throughout the study. Inclusion criteria: patients had to have been on home dialysis for more than 6 months, to be dialysing more than 6 hours 3 times weekly, to be on no anti-hypertensive drugs and to have a mean predialysis blood pressure during the previous month of < 160/90 mmHg. Exclusion criteria: patients with diabetes mellitus, overt cardiac disease, prior nephrectomy or any recent illness	Long home haemodialysis versus short in-centre haemodialysis. Duration of trial: 8 weeks on each treatment modality (crossover trial). Before commencing the study, each patient had a trial run of short haemodialysis to ensure an eKt/V urea value similar to his/her eKt/V value when on home dialysis. Make and model of dialysis machine used: home dialysis, not stated; in-centre dialysis, Fresenius 2008A volume-controlled HD machine. Duration of dialysis sessions: home dialysis, 6–8 hours; hospital dialysis, dialysis time decreased by 40% (i.e. from 8 to 4.5 hours, from 7 to 4 hours, from 6 to 3.5 hours). Dialysis frequency: home dialysis, 3 sessions per week; in-centre dialysis, 3 sessions per week. Dialyser type: home dialysis, 0.8-m^2 Cuprophan dialyser (Renak REO8H, Kawasumi, Japan); in-centre dialysis, 1.5-m^2 cuprophan dialyser (Renak RE15H, Kawasumi, Japan). Blood flow rate: home dialysis, 200 ml/minute (Cobe C2); in-centre dialysis, 300–350 ml/minute. Dialysis composition: home dialysis, acetate buffer (sodium 138 mmol/l, calcium 1.6 mmol/l); in-centre dialysis, bicarbonate buffer (sodium 138 mmol/l, calcium 1.3 mmol/l)	Haematocrit, biochemical indices of renal disease (calcium, phosphate, albumin), eKt/V, blood pressure pre- and postdialysis, interdialytic complications (hypotension), weight, QoL (uraemia-related symptoms, physical suffering, interference with social activities, burden on family)	Statistical method used: ANOVA with repeated measures was used to examine changes during the two treatments. Mean values of parameters measured only once in each phase were compared with paired Student's t-test or Wilcoxon test. Spearman's test was used to determine correlations between neurohormones

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Study and method	Participants	Interventions	Outcomes	Notes
Mohr *et al.*, 2001[12] Systematic review Literature search from 1969 for both published and unpublished studies Modalities included: home haemodialysis, in-centre haemodialysis	All participants *n* = 197. Source of participants: 60 reports from 13 daily dialysis programmes around the world since 1969 and discussions with principal investigators in the largest ongoing programmes in North America to obtain more recent but unpublished data	Short daily or nocturnal haemodialysis versus conventional in-centre haemodialysis 3 times per week. Impact on QoL (instruments used: SF-36, Nottingham Health Profile, SIP, Beck Depression Inventory, KDQOL ESRD-targeted areas, Dialysis-Related Symptoms). Duration of dialysis sessions: short daily dialysis, 1.5–2 hours; nocturnal dialysis, 6–10 hours; in-centre dialysis, not stated. Dialysis frequency: short daily dialysis, 5–7 times per week; nocturnal dialysis, 5–7 times per week; in-centre dialysis, 3 times per week	QoL, number of anti-hypertensive drugs used, hospitalisation rate	
Page & Weisberg, 1991[36] Country: USA Comparative observational study (prospective) Modalities included: home haemodialysis, in-centre haemodialysis	All participants: patients *n* = 42, partners *n* = 37. Source of participants: Mt Carmel Mercy Hospital, Detroit, Michigan, USA. Age (mean): home group, 41.77 years; in-centre group, 55.75 years; all partners, 42.18 years. Gender (all participants): 14 men, 29 women (sic). Length of time on dialysis prior to start of trial (all participants): 18.21 months. Co-morbidity: home group, 3 participants with diabetes; in-centre group, 3 participants with diabetes. 43% of the partners were spouses, with the remainder being sons, daughters, siblings, parents or friends. Most patients earned US$10,000 or less annually and had at least a high school education	Home haemodialysis versus in-centre haemodialysis	QoL, measured using the FES and MATE Scale	FES: 100-item self-report scale using a true–false format. The respondent describes his/her family based on three basic aspects – a relationship dimension, a personal growth dimension and a systems maintenance dimension MATE: contains 45 items with a 6-point scale for each. The scale measures the degree of satisfaction and sensitivity the respondent feels toward someone with whom he/she is involved in an intimate relationship. The basic dimensions of the MATE Scale concern inclusion behaviour, inclusion feelings, control behaviour, control feelings and affection. Statistical tests used: ANOVA, multivariate ANOVA, Stepdisc

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Study and method	Participants	Interventions	Outcomes	Notes
Parsons & Harris, 1997[14] Systematic review Modalities included: home haemodialysis, satellite unit haemodialysis, in-centre haemodialysis, CAPD, transplantation Search strategy: literature search on MEDLINE, covering years from 1985 to 1996, and annual reports of the ANZDATA	From children to elderly people	Home haemodialysis versus in-centre haemodialysis	Subjective QoL measured by Campbell's Index of Well-Being, General Affect Scale, Overall Life Satisfaction Scale. Objective QoL measured by modified Karnofsky Index. Employment status	Campbell's Index of Well-Being: scale from 2.1 to 14.7 (higher score indicates greater well-being) General Affect Scale: scale from 1 to 7 (higher score indicates better general affect) Overall Life Satisfaction Scale: scale from 1 to 7 (higher score indicates greater satisfaction) MATE Scale: evaluates several dimensions of intimate, close relationships
Piltz-Kirkby & Fox, 1982[37] Country: USA Comparative observational study (prospective) Modalities included: home haemodialysis, in-centre haemodialysis	All participants n = 49. Home group n = 24, in-centre group n = 25. All participants were over 18 years of age. Age (mean): home group, 44 years; in-centre group, 52 years. Gender: Home group, 16 men (65%), 8 women (35%); in-centre group, 14 men (56%), 11 women (44%). Martial status: 71% of home group and 72% of in-centre group were married. Education: 39% of home group and 44% of in-centre group were high school graduates. Earning > US$20,000 per year: home group, 46%; in-centre group, 27%. Length of time on dialysis prior to start of trial: home group, 20 patients (83%) on dialysis for more than 2 years; in-centre group, 13 patients (52%) on dialysis for more than 2 years. Most participants lived in a house (83% of home group, 72% of in-centre group). Key person for emotional support: home group – spouse for 16 patients (67%), self for 1 patient (4%); in-centre group – spouse for 14 patients (55%), daughter for 5 patients (18%), self for 6 patients (24%). Mean distance (SD) from the nearest treatment centre: home group, 31 (25) miles; in-centre group, 23 (17) miles	Home versus in-centre haemodialysis	QoL (home environmental support), measured by a questionnaire addressing three aspects of support systems: information giving, material aid and services, emotional support. Employment status	Questionnaire combines two 4-point Likert scales. The first scale measures the importance that the respondent places on a given statement about health, care or support. The second scale measures the respondent's satisfaction with that statement. The Importance Scale ranges from 'extremely important' to 'not important', and the Satisfaction Scale ranges from 'very satisfied' to 'very unsatisfied'

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Study and method	Participants	Interventions	Outcomes	Notes
Price *et al.*, 1978[26] Country: Canada Comparative observational study (retrospective) Modalities included: home haemodialysis, in-centre haemodialysis, peritoneal dialysis, renal transplantation	All participants *n* = 305. Home haemodialysis *n* = 93, in-centre dialysis *n* = 166. Source of participants: Vancouver General Hospital, Canada. Home dialysis patients lived up to 1600 km from the in-centre unit. Dates of recruitment: November 1964 to November 1976. Age (all participants): mean, 37 years, 6 months; range, 13 months to 70 years. Gender (all participants): 203 men, 102 women. Inclusion criteria: all patients with established chronic renal failure in whom dialysis was begun with a view to it being long-term therapy; for the first 2 years of the programme, only patients between the ages of 12 and 50 years were selected for treatment. Exclusion criteria: patients with acute or chronic renal failure who received dialysis temporarily while being assessed for the correct diagnosis or medical suitability and who did not subsequently enter a long-term programme of dialysis; among patients returning to a given form of therapy after receiving another type of treatment, the data for the second or subsequent period of the first type of therapy were excluded	Home haemodialysis versus in-centre dialysis: in-centre haemodialysis began in 1964, and home haemodialysis began in 1969	Survival, mortality	Statistical method used: life-table method
Reichwald-Klugger *et al.*, 1984[27] Country: Germany Comparative observational study (prospective) Modalities included: home haemodialysis, hospital haemodialysis	All participants *n* = 20. Home haemodialysis *n* = 10, hospital haemodialysis *n* = 10. Source of participants: University Children's Hospitals in Heidelberg and Munster, Germany. Mean age (range): home dialysis – 12 years, 1 month (7 years, 7 months, to 17 years, 7 months); hospital dialysis – 14 years, 1 month (9 years, 2 months, to 19 years, 8 months). Gender: home dialysis, 7 men, 3 women; hospital dialysis, 5 men, 5 women. Mean length of time (range) from first dialysis to psychosocial assessment: home dialysis, 17 months (2–53 months); hospital dialysis, 28 months (7–52 months). Exclusion criteria: children < 5 years of age	Home haemodialysis versus hospital haemodialysis. Semi-structured interviews/questionnaires aimed at: (1) the patient, (2) his/her parents, (3) his/her educator. The interviews took place at the patient's home or at school. They were carried out within several sessions, each lasting 1–2 hours. Mean duration (range) of dialysis sessions: home dialysis, 7 hours (5.5–9.0 hours); hospital dialysis, 4.3 hours (3.5–5.0 hours)	QoL (burden of patients, burden of parents, compliance, educational problems for parents, school activity)	

continued

Study and method	Participants	Interventions	Outcomes	Notes
Rubin *et al.*, 1989[28] Country: USA Comparative observational study (prospective) Modalities included: early home haemodialysis, haemodialysis in a free-standing facility, CAPD	All participants *n* = 1216. Early home dialysis (started home dialysis within 180 days of initiation of dialysis) *n* = 90; late home dialysis (started home dialysis > 180 days after initiation of dialysis) *n* = 60; free-standing facility *n* = 954. Source of participants: University of Mississippi Medical Center and nine Kidney Care Incorporated Dialysis facilities, Mississippi, USA. Dates for recruitment: 1 January 1967 to 15 June 1986. Mean age (SD): early home dialysis, 40 (2) years; late home dialysis, 36 (2) years; free-standing facility, 52 (1) years. Gender: early home dialysis, 51% men, 49% women; late home dialysis, 57% men, 43% women; free-standing facility, 51% men, 49% women. Ethnicity: early home dialysis, black 48%, white 52%; late home dialysis, black 70%, white 30%; free-standing facility, black 77%, white 23%. Married: early home dialysis, 69%; late home dialysis, 75%; free-standing facility, 40%. Aetiology of renal failure: diabetes mellitus – home dialysis, 4%, and free-standing facility, 65%; hypertension – home dialysis, 3%, and free-standing facility, 90%; polycystic kidney disease – home dialysis, 16%, and free-standing facility, 74%; chronic interstitial nephritis – home dialysis, 16%, and free-standing facility, 68%; chronic glomerulonephritis – home dialysis, 16%, and free-standing facility, 67%; diagnosis unknown – home dialysis, 11%, and free-standing facility, 67%	Early home dialysis versus late home dialysis or dialysis in a free-standing facility. Make and model of dialysis machine used: machinery standardised within facilities. Duration and frequency of dialysis sessions: home dialysis, average of 4 hours, 3 times per week; free-standing facility, average of 4 hours, 3 times per week. Dialysis composition: dialysate standardised within facilities	Mortality, length of treatment, technique survival	Statistical method used: Kaplan–Meier survival plots, Mantel's procedure for calculating Gehan's generalised Wilcoxon test, Cox proportional hazards regression model
Schreiber & Huber, 1985[29] Country: Germany Comparative observational study (prospective) Modalities included: home haemodialysis, in-centre haemodialysis	Home haemodialysis patients *n* = 132, their significant others *n* = 120; in-centre haemodialysis patients *n* = 137, their significant others *n* = 103. Source of participants: vicinity of Heidelberg, Germany, including seven home dialysis training and/or treatment centres. Significant others were: partner/spouse – home dialysis, 88%, and in-centre dialysis, 89%; parent – home dialysis, 8%, and in-centre dialysis, 6%; child – home dialysis, 1%, and in-centre dialysis, 2%; brother/sister – home dialysis, 1%, and in-centre dialysis, 1%; others – home dialysis, 2%, and in-centre dialysis 1%	Home haemodialysis versus in-centre haemodialysis. Mailed questionnaire	QoL (stresses, psychological well-being)	Statistical method used: factor analysis (principal component analysis with rotation according to the Varimax principle)

continued

Study and method	Participants	Interventions	Outcomes	Notes
Soskolne & De Nour, 1987[30] Country: Israel Comparative observational study (prospective) Modalities included: home haemodialysis, hospital haemodialysis, CAPD Of the 36 home haemodialysis patients fitting the criteria, 32 (89%) were interviewed and 4 (11%) refused. The final home haemodialysis study group included 29 couples. The comparison group was composed of married hospital dialysis patients, individually matched to a subject by sex, age, ethnic origin, education and time on dialysis. The spouses of the matched hospital patients served as a comparison group for the spouses of patients on home haemodialysis	All participants *n* = 252. Home haemodialysis patients *n* = 29, their spouses *n* = 29; hospital haemodialysis patients *n* = 29, their spouses *n* = 29. Source of participants: Israel. Mean age (SD): home dialysis patients, 52.5 (9.4) years, and their spouses 50.2 (10.1) years; hospital dialysis patients, 54.0 (8.7) years, and their spouses, 51.5 (9.5) years. Gender: home dialysis patients, 25 men, 4 women; hospital dialysis patients, 25 men 25, 4 women. Ethnicity (all participants): Jewish. Mean years of education (SD): home dialysis patients, 11.3 (4.0) years, and their spouses 12.4 (3.9) years; hospital dialysis patients, 11.6 (3.9) years, and their spouses, 10.4 (4.8) years. Mean length of time (SD) on dialysis prior to start of trial: home dialysis, 64.4 (40.3) months; hospital dialysis, 68.7 (58.4) months. Inclusion criteria: all the married Jewish patients and spouses on home haemodialysis and CAPD in Israel. Exclusion criteria: patients who had been on haemodialysis for < 6 months or CAPD for < 3 months	Home haemodialysis versus hospital haemodialysis. In addition to interviews, the following two instruments were distributed to all patients and spouses: BSI, PAIS. Assistance with home dialysis process provided by spouse	QoL (satisfaction with place of dialysis, vocational rehabilitation, personal health evaluation, BSI, PAIS). Employment status	BSI: 53 items, score from 0 to 4 (higher numbers indicate more distress) PAIS: 45 items, score from 0 to 3 (higher numbers indicate more problems). Statistical method used: *t*-test for matched pairs, McNemar and Wilcoxon tests for matched samples when comparing the patients to their controls, and statistical tests for independent samples when comparing home dialysis spouses to their hospital dialysis controls

continued

Study and method	Participants	Interventions	Outcomes	Notes
Westlie *et al.*, 1984[31] Country: USA Comparative observational study (prospective) Modalities included: home haemodialysis, in-centre haemodialysis	Home haemodialysis n = 26 (33%), in-centre haemodialysis n = 53 (67%). Dates of recruitment: week of 1 September 1984. Mean age (SD): home dialysis, 74.5 (0.7) years, and range, 70–82 years; in-centre dialysis, 75.2 (0.6) years, and range, 70–84 years. Ethnicity: white – home dialysis, 24 patients, and in-centre dialysis, 49 patients; black – home dialysis, 1 patient, and in-centre dialysis, 3 patients; native American – home dialysis, 1 patient, in-centre dialysis, 1 patient. Mean duration (SD) on dialysis: home dialysis, 40.9 (4.6) months, and range, 3–90 months; in-centre dialysis, 26.5 (3.0) months, and range, 1–109 months. Marital status: married – home dialysis, 20 patients, and in-centre dialysis, 27 patients; widowed – home dialysis, 4 patients, and in-centre dialysis, 18 patients; single – home dialysis, 1 patient, and in-centre dialysis, 5 patients; divorced – home dialysis, 1 patient, and in-centre dialysis, 3 patients. Most common diagnoses of patients: diabetes mellitus – home dialysis, 11.5%, and in-centre dialysis, 11.3%; nephrosclerosis – home dialysis, 30.7%, and in-centre dialysis, 32.1%; chronic glomerulonephritis – home dialysis, 19.2%, and in-centre dialysis, 11.3%; polycystic kidney disease – home dialysis, 7.7%, and in-centre dialysis, 9.4%; chronic pyelonephritis – home dialysis, 3.8%, and in-centre dialysis, 7.5%; other diagnoses – home dialysis, 27%, and in-centre dialysis, 28.3%. Inclusion criteria: aged 70 years or older. Exclusion criteria: 3 patients were excluded because they were confused and ill	Home haemodialysis versus in-centre haemodialysis	Haematocrit, biochemical indices of renal disease, blood pressure, interdialytic complications, weight loss, QoL (living characteristics, social contact, activity, enjoyment, perceived health, physical performance)	Statistical method used: Student's t-test and the χ^2 test were used for evaluation of statistical significance
Williams *et al.*, 1983[32] Country: USA Comparative observational study (prospective) of renal transplantation Modalities included: home haemodialysis, in-centre haemodialysis, renal transplantation	All participants n = 2396. Home haemodialysis n = 261, in-centre haemodialysis n = 1560. Source of participants: 36 ESRD facilities and 12 transplantation centres in Michigan, USA. Dates of recruitment: January 1974 to December 1978. Mean age (SD): home dialysis, 51.31 (15.31) years; all participants, 47 (16.5) years. Gender (all participants): 58% men, 42% women. Ethnicity (all participants): 64% white, 34% black. Exclusion criteria: of 2493 patients, 70 were excluded due to imprecise starting dates of initial in-centre dialysis, and 27 were excluded because they had not received dialysis prior to first transplantation	Comparison of survival on the second treatment modality (home haemodialysis or transplantation), while evaluating survival on the first treatment modality (in-centre dialysis). The longest follow-up time for any patient was 6 years from the start of in-centre dialysis	Survival	Statistical method used: general method for life-table analysis (Crowley and Hu) using the Cox proportional hazards regression model

continued

Study and method	Participants	Interventions	Outcomes	Notes
Woods *et al.*, 1996[33] Country: USA Comparative observational study (retrospective) Intention-to-treat analysis Modalities included: home haemodialysis, in-centre haemodialysis	Home haemodialysis *n* = 70, in-centre haemodialysis *n* = 3102. Source of participants: 291 dialysis centres from 18 ESRD networks in the USA. Dates of recruitment: 1986 and 1987. Mean age (SD): home dialysis, 49 (16) years; in-centre dialysis 59 (16) years. Gender: home dialysis, 60% men, 40% women; in-centre dialysis, 51% men, 49% women. Ethnicity: white – home dialysis, 64%, and in-centre dialysis, 59%; other ethnicity – home dialysis, 36%, and in-centre dialysis, 41%. Less than 12 years of education – home dialysis, 20%; in-centre dialysis, 26.9%. Patient co-morbidity: diabetes as a cause of ESRD – home dialysis, 14%, and in-centre dialysis, 30%; active insulin therapy – home dialysis, 14.3%, and in-centre dialysis, 22.3%; active smoker – home dialysis, 12.9%, and in-centre dialysis, 16.7%; arrhythmia – home dialysis, 14.3%, and in-centre dialysis, 10.1%; COPD – home dialysis, 14.3%, and in-centre dialysis, 11.2%; congestive heart failure – home dialysis, 24.3%, and in-centre dialysis, 38.6%; myocardial infarction – home dialysis, 4.3%, and in-centre dialysis, 13.5%; obese – home dialysis, 11.4%, and in-centre dialysis, 22.5%; peripheral vascular disease – home dialysis, 12.9%, and in-centre dialysis, 17.8%; stroke – home dialysis, 2.9%, and in-centre dialysis, 10.1%. Exclusion criteria: patients younger than 18 years and older than 90 years were excluded from the sample so that the age range in the in-centre dialysis group was comparable to that of the home dialysis group; patients with a history of cardiac arrest, neoplasm with metastatic spread or hepatic cirrhosis, or who were felt to be clinically undernourished were excluded, because they were present at a substantially lower frequency in the home dialysis group	Comparison of patients training for self-care haemodialysis, either at home or in a dialysis unit, with that of in-centre haemodialysis patients. Follow-up information was available to the end of December 1992. Observations were censored at 1500 days after date of first treatment	Mortality, biochemical indices of renal disease, Kt/V, QoL	Statistical method used: Cox proportional hazards regression model

Appendix 12

Results of included studies

This appendix includes information taken directly from the included studies, therefore the term 'in-centre haemodialysis' has been retained, whereas in the main text of the report, 'in-centre' was changed to 'hospital'.

Quality of life

Study	Results	Notes
Bremer *et al.*, 1989[17]	***Objective QoL measures***	
	Hours of care per week: Home dialysis: 10.7 (6.8) In-centre dialysis, self-care: 13.9 (6.8) In-centre dialysis, staff-assisted: 16.8 (8.7)	Mean (SD)
	Hours of sleep per night: Home dialysis: 6.8 (1.6) In-centre dialysis, sel-care: 6.5 (1.6) In-centre dialysis, staff-assisted: 6.5 (1.7)	Mean (SD)
	Number of activities given up: Home dialysis: 1.2 (1.3) In-centre dialysis, self-care: 1.8 (1.8) In-centre dialysis, staff-assisted 1.3 (1.8)	Mean (SD)
	Level of pain: Home dialysis: 1.9 (0.6) In-centre dialysis, self-care: 2.1 (0.6) In-centre dialysis, staff-assisted: 2.0 (0.7)	Mean (SD) From 0, no pain, to 3, severe pain
	Days since intercourse: Home dialysis: 6.8 In-centre dialysis, self-care: 4.5 In-centre dialysis, staff-assisted: 180.5	Median
	Days since orgasm: Home dialysis: 7.3 In-centre dialysis, self-care: 4.8 In-centre dialysis, staff-assisted: 179.8	Median
	More tired: Home dialysis: 87 In-centre dialysis, self-care: 95 In-centre dialysis, staff-assisted: 90	Number of patients
	Subjective QoL measures Positive affect: Home dialysis: 3.6 (1.5) In-centre dialysis, self-care: 3.1 (1.5) In-centre dialysis, staff-assisted: 2.8 (1.5)	Mean (SD) Higher scores are better for all measures except Negative affect, for which lower scores are better
	Negative affect: Home dialysis: 1.4 (1.4) In-centre dialysis, self-care: 1.2 (1.1) In-centre dialysis, staff-assisted: 2.0 (1.6)	
	Affect balance: Home dialysis: 6.3 (1.9) In-centre dialysis, self-care: 6.1 (1.8) In-centre dialysis, staff-assisted: 5.0 (2.3)	

continued

Quality of life *contd*

Study	Results	Notes
contd Bremer *et al.*, 1989[17]	***Subjective QoL measures* contd** General affect: Home dialysis: 5.6 (1.3) In-centre dialysis, self-care: 5.4 (1.4) In-centre dialysis, staff-assisted: 4.9 (1.5) Well-being: Home dialysis: 11.8 (2.6) In-centre dialysis, self-care: 10.6 (3.3) In-centre dialysis, staff-assisted: 10.2 (3.1) Overall life: Home dialysis: 5.6 (1.6) In-centre dialysis, self-care: 4.8 (2.1) In-centre dialysis, staff-assisted: 5.0 (1.9) Hard/easy: Home dialysis: 4.5 (2.1) In-centre dialysis, self-care: 4.2 (2.0) In-centre dialysis, staff-assisted: 3.9 (2.2) Tied down/free: Home dialysis: 4.5 (2.2) In-centre dialysis, self-care: 4.9 (2.3) In-centre dialysis, staff-assisted: 4.2 (2.4) Helpless/independent: Home dialysis: 5.7 (1.5) In-centre dialysis, self-care: 5.9 (1.8) In-centre dialysis, staff-assisted: 5.3 (2.0)	
	Satisfactions Standard of living: Home dialysis: 6.0 (1.2) In-centre dialysis, self-care: 5.2 (2.1) In-centre dialysis, staff-assisted: 5.1 (2.0) Friends: Home dialysis: 6.2 (1.5) In-centre dialysis, self-care: 5.6 (1.8) In-centre dialysis, staff-assisted: 5.8 (1.6) Sex life: Home dialysis: 4.3 (2.5) In-centre dialysis, self-care: 4.3 (2.5) In-centre dialysis, staff-assisted: 4.1 (2.5) Health: Home dialysis: 4.4 (1.9) In-centre dialysis, self-care: 4.4 (2.1) In-centre dialysis, staff-assisted: 3.8 (2.3) Religion: Home dialysis: 5.7 (1.7) In-centre dialysis, self-care: 5.5 (1.8) In-centre dialysis, staff-assisted: 5.7 (2.0) Marriage: Home dialysis: 6.5 (1.0) In-centre dialysis, self-care: 6.4 (1.3) In-centre dialysis, staff-assisted: 5.9 (1.8) Children: Home dialysis: 4.1 (1.0) In-centre dialysis, self-care: 4.2 (0.8) In-centre dialysis, staff-assisted: 4.0 (1.0)	Mean (SD) Higher scores are better

continued

Quality of life *contd*

Study	Results	Notes
Cameron *et al.*, 2000[13]	***Summary results of treatment comparisons*** Emotional distress: In-centre dialysis versus home dialysis (11 studies): mean effect size, 0.16 (95% CI, 0.07 to 0.24); percentile rank, 56; fail-safe number, 70; tolerance level, 65 Psychological well-being: In-centre dialysis versus home dialysis (7 studies): mean effect size, –0.19 (95% CI, –0.73 to 0.35); percentile rank, 42; fail-safe number, 0; tolerance level, 45 ***Summary of differences between treatment groups on case-mix variables*** Emotional distress treatment comparisons: In-centre dialysis versus home dialysis (11 studies): age, 0.19 (8 studies); physical indicators, 0.22 (7 studies); employment, –0.26 (3 studies); education, –0.37 (5 studies); sex (men), –0.11 (7 studies) Psychological well-being treatment comparisons: In-centre dialysis versus home dialysis (7 studies): age, 0.21 (5 studies); physical indicators, 0.33 (7 studies); employment, –0.39 (2 studies); education, –0.25 (3 studies); sex (men), –0.25 (6 studies)	Effect size is significantly different from 0 Age: mean effect size (number of studies included in mean) Physical indicators and education: mean effect size is significantly different from 0 ($p < 0.05$) Physical indicators and sex (men): mean effect size is significantly different from 0 ($p < 0.05$)
Churchill, 1988[34]	TTO: Home/self-care haemodialysis: 0.49 In-centre haemodialysis: 0.43	TTO: scores range from 0 to 1, with 0 equivalent to death and 1 equivalent to full health
Courts & Boyette, 1998[19]	Clinical Anxiety Scale: Home dialysis: mean (SD), 10.4 (5.22); range, 3–17 In-centre dialysis: mean (SD), 30.6 (17.42); range, 14–48 Generalised Contentment Scale: Home dialysis: mean (SD), 20.4 (15.68); range, 2–39 In-centre dialysis: mean (SD), 41.2 (19.49); range, 14–62 PAIS–Self Report: Home dialysis: mean (SD), 46.6 (10.31); range, 39–62 In-centre dialysis: mean (SD), 68.2 (10.18); range, 57–95 Haemodialysis Stressor Scale: Home dialysis: mean, 20.4; range, 9–33 In-centre dialysis: mean, 63.8; range, 50–80	Clinical Anxiety Scale: scores range from 0 to 100 (higher scores indicate higher levels of anxiety; cut-off score of 30 indicates a high level of anxiety) Generalised Contentment Scale: score of 30 or above indicates depression, and score of 70 indicates suicidal risk PAIS–Self Report: lower scores indicate higher level of psychosocial adjustment to illness Haemodialysis Stressor Scale: lower scores indicate lower stressor perception

continued

Quality of life *contd*

Study	Results	Notes
Hart & Evans, 1987[21]	• SIP categories: Sleep and rest: Home dialysis: 15.5 [16.4] In-centre dialysis: 21.7 [22.0] Emotional behaviour: Home dialysis: 7.9 [8.0] In-centre dialysis: 8.5 [8.6] Body care and movement: Home dialysis: 4.6 [5.2] In-centre dialysis: 7.7 [7.7] Home management: Home dialysis: 14.7 [15.6] In-centre dialysis: 24.0 [23.7] Mobility: Home dialysis: 4.9 [5.5] In-centre dialysis: 10.4 [10.5] Social interaction: Home dialysis: 7.7 [7.5] In-centre dialysis: 11.4 [11.4] Ambulation: Home dialysis: 10.8 [11.9] In-centre dialysis: 16.3 [16.0] Alertness behaviour: Home dialysis: 6.4 [6.8] In-centre dialysis: 11.2 [11.8] Communication: Home dialysis: 2.4 [2.7] In-centre dialysis: 5.7 [5.7] Work: Home dialysis: 37.7 [39.1] In-centre dialysis: 45.0 [44.9] Recreation and pastimes: Home dialysis: 18.2 [19.0] In-centre dialysis: 23.7 [24.0] Eating: Home dialysis: 8.0 [8.1] In-centre dialysis: 10.2 [10.2]	Mean SIP scores [scores in brackets are for patients on current modality for 1 year or longer] SIP: standardised instrument consisting of 136 statements, scaled and weighted and divided into 12 categories, which measure sickness-related dysfunction along many dimensions; scores may range from 0 to 100 (a high score indicates poor functional status, and a low score indicates good functional status)
	Physical dimension: Home dialysis: 6.1 ± 0.58 [6.9 ± 0.70] In-centre dialysis: 10.3 ± 0.67 [10.3 ± 0.74]	Mean ± SEM Physical dimension consists of weighted scores from categories of body care and movement, mobility and ambulation
	Psychosocial dimension: Home dialysis: 6.4 ± 0.51 [6.5 ± 0.59] In-centre dialysis: 9.7 ± 0.64 [9.8 ± 0.72]	Mean ± SEM Psychosocial dimension consists of weighted scores from categories of emotional behaviour, social interaction, alertness behaviour and communication
	Total SIP: Home dialysis: 9.5 ± 0.54 [10.0 ± 0.64] In-centre dialysis: 13.9 ± 0.61 [13.9 ± 0.68]	Lower scores indicate less impairment

continued

Quality of life *contd*

Study	Results	Notes
Hart & Evans, 1987[21]	***Objective indicators of QoL*** Functional impairment: Home dialysis: 2.56 (1.19), unadjusted for case mix; adjusted mean, 2.63 In-centre dialysis: 3.11 (1.57), unadjusted for case mix; adjusted mean, 2.85	Mean (SD)
	Ability to work (% of patients): Home dialysis: 59.30%, unadjusted for case mix; adjusted, 54.80% In-centre dialysis: 37.20%, unadjusted for case mix; adjusted, 44.80%	
	Subjective indicators of QoL Well-being: Home dialysis: 11.12 (2.67), unadjusted for case mix; adjusted mean, 11.23 In-centre dialysis: 10.77 (2.73), unadjusted for case mix; adjusted mean, 10.56	Mean (SD) Index of Well-Being: range from 2.1 (low level of well-being) to 14.7 (high level of well-being)
	Psychological affect: Home dialysis: 5.42 (1.20), unadjusted for case mix; adjusted mean, 5.47 In-centre dialysis: 5.15 (1.31), unadjusted for case mix; adjusted mean, 5.09	Index of Psychological Affect: range from a low of 1.0 (completely dissatisfied) to a high of 7.0 (completely satisfied)
	Life satisfaction: Home dialysis: 5.19 (1.56), unadjusted for case mix; adjusted mean, 5.25 In-centre dialysis: 5.11 (1.69), unadjusted for case mix; adjusted mean, 4.99	Index of Overall Life Satisfaction: range from a low of 1.0 (completely dissatisfied) to a high of 7.0 (completely satisfied)
	Functional ability of patient • Karnofsky Scale category: No complaints; almost normal physical activity: Home dialysis: 59.1% In-centre dialysis: 44.7%	% of patient group
	Able to carry out normal physical activity at least part of the time: Home dialysis: 25.3% In-centre dialysis: 25.2%	
	Only able to carry out physical activity involving self-care: Home dialysis: 8.9% In-centre dialysis: 12.3%	
	Requires at least some assistance for care of bodily needs; may require special care; often debilitated: Home dialysis: 6.8% In-centre dialysis: 17.7%	
	Requires institutionalisation or hospitalisation; may be moribund: Home dialysis: 0.0% In-centre dialysis: 0.0%	
Livesley, 1981[23]	Middlesex Hospital Questionnaire depression subscale: Home dialysis: 4.3 Hospital dialysis: 2.7 ($p < 0.05$)	Middlesex Hospital Questionnaire: 48-item questionnaire gives a profile of scores on 6 subscales (higher score is worse)
	The other subscales were not significantly different	

continued

Quality of life *contd*

Study	Results	Notes
McGee, 1981[25]	Location of dialysis and spouse's satisfaction with location of dialysis: Home dialysis: satisfied *n* = 20 (74.1%); dissatisfied *n* = 7 (25.9%) In-centre dialysis: satisfied *n* = 20 (95.2%); dissatisfied *n* = 1 (4.8%) Location of dialysis and spouse's perception of patient's dependence on them: Home dialysis: dependent *n* = 28 (100%); not dependent *n* = 0 (0.0%) In-centre dialysis: dependent *n* = 17 (77.3%); not dependent *n* = 5 (22.7%) Location of dialysis and spouse's attitude toward dialysis, controlling for post-dialysis marital happiness: Happily married post-dialysis: Home dialysis: resent dialysis *n* = 5 (25%); do not resent dialysis *n* = 15 (75%) In-centre dialysis: resent dialysis *n* = 4 (38%); do not resent dialysis *n* = 9 (69.2%) Unhappily married post-dialysis: Home dialysis: resent dialysis *n* = 7 (87.5%); do not resent dialysis *n* = 1 (12.5%) In-centre dialysis: resent dialysis *n* = 2 (25%); do not resent dialysis *n* = 6 (75%)	Two respondents omitted because of incomplete answers
Mohr *et al.*, 2001[12]	***Impact of daily dialysis on QoL*** **Study: Kooistra *et al.*, *1998* (*n* = 13)** • SF-36 and Nottingham Health Profile subscales: Mental health: daily dialysis, value not reported; conventional or baseline, value not reported ($p < 0.05$) Vitality: daily dialysis, value not reported; conventional or baseline, value not reported ($p < 0.05$) Energy: daily dialysis, value not reported; conventional or baseline, value not reported ($p < 0.05$) **Study: Brissenden *et al.*, *1998* (*n* = 18)** • SIP subscales: Total: daily dialysis, 9.5; conventional or baseline, 14 ($p = 0.03$) Eating: daily dialysis, 3.7; conventional or baseline, 14.2 ($p = 0.003$) Household management: daily dialysis, 15; conventional or baseline, 25.6 ($p = 0.01$) Ambulation: daily dialysis, 11.1; conventional or baseline, 17.2 ($p = 0.07$) Mobility: daily dialysis, 2.9; conventional or baseline, 3.9 ($p = 0.08$) Social interaction: daily dialysis, 11.4; conventional or baseline, 16.4 ($p = 0.07$) • SF-36 subscales: Social functioning: daily dialysis, 79.2; conventional or baseline, 54.2 ($p = 0.006$) Physical functioning: daily dialysis, 69; conventional or baseline, 60.6 ($p = 0.008$) Role – physical: daily dialysis, 36.1; conventional or baseline, 39.2 ($p = 0.05$)	Only findings significant at 95% or greater (when available) are reported

continued

Quality of life *contd*

Study	Results	Notes
Mohr *et al.*, 2001[12]	***Impact of daily dialysis on QoL* contd** **Study: Brissenden *et al.* (*n* = 18)** • Back Depression Inventory subscale: Index: daily dialysis, 6; conventional or baseline, 8.5 (p = 0.02) **Study: Ting, 1999 (unpublished data) (*n* = 12)** • KDQOL subscales for ESRD-targeted areas: Symptoms/problems list: daily dialysis, 77.9; conventional or baseline, 64.3 (p = 0.011) Burden of kidney disease: daily dialysis, 66.2; conventional or baseline, 51.2 (p = 0.008) Cognitive function: daily dialysis, 89.3; conventional or baseline, 78.3 (p = 0.043) Sexual function: daily dialysis, 71.4; conventional or baseline, 57.7 (p = 0.012) Total: daily dialysis, 73.3; conventional or baseline, 62.7 (p < 0.001) • SF-36 subscales: Physical functioning: daily dialysis, 60.4; conventional or baseline, 47.1 (p = 0.024) General health: daily dialysis, 53.8; conventional or baseline, 36.7 (p = 0.023) Role – emotional: daily dialysis, 74.9; conventional or baseline, 58.3 (p = 0.026) Social functioning: daily dialysis, 80.3; conventional or baseline, 59.6 (p = 0.038) Energy–Fatigue: daily dialysis, 50.8; conventional or baseline, 27.7 (p = 0.006) Total: daily dialysis, 64.6; conventional or baseline 49.0 (p < 0.001) • Dialysis-Related Symptoms subscales: During dialysis: daily dialysis, 89.6; conventional or baseline, 78.1 (p = 0.001) Postdialysis: daily dialysis, 77.6; conventional or baseline, 62.9 (p = 0.019) **Study: Lockridge, 1999 (unpublished data) (*n* = 5)** • SF-36 subscales: Role – physical: daily dialysis, 85.0; conventional or baseline, 35.0 (p = 0.047) Vitality: daily dialysis, 74.0; conventional or baseline, 41.0 (p = 0.009)	
Page & Weisberg, 1991[36]	• FES subscales: Cohesion: Home patients: 7.14 (2.01); home partners: 7.40 (1.85) In-centre patients: 7.30 (1.26); in-centre partners: 7.60 (1.25) Conflict: Home patients: 2.18 (1.87); home partners: 1.20 (1.17) In-centre patients: 2.00 (1.21); in-centre partners: 2.59 (1.54) Expressiveness: Home patients: 6.09 (2.02); home partners: 6.15 (1.87) In-centre patients: 4.50 (1.24); in-centre partners: 4.53 (1.18) Independence: Home patients: 6.86 (1.32); home partners: 6.30 (1.34) In-centre patients: 6.85 (1.53); in-centre partners: 7.00 (1.37)	Mean (SD) FES: 100-item self-report scale using a true–false format. The respondent describes his/her family on three basic aspects: a relationship dimension, a personal growth dimension and a systems maintenance dimension

continued

Quality of life *contd*

Study	Results	Notes
Page & Weisberg, 1991[36]	• FES subscales *contd*: Achievement: Home patients: 6.05 (1.13); home partners: 5.40 (2.04) In-centre patients: 6.40 (1.10); in-centre partners: 6.00 (1.37) Intellect–Culture: Home patients: 6.32 (2.38); home partners: 5.60 (1.88) In-centre patients: 6.00 (1.56); in-centre partners: 5.82 (1.51) Active–Recreation: Home patients: 4.77 (1.90); home partners: 4.85 (1.73) In-centre patients: 5.95 (1.57); in-centre partners: 5.47 (1.55) Moral–Religion: Home patients: 6.59 (2.06); home partners: 6.60 (2.09) In-centre patients: 7.60 (1.43); in-centre partners: 7.24 (1.09) Organisation: Home patients: 5.82 (2.11); home partners: 5.80 (2.69) In-centre patients: 6.70 (1.45); in-centre partners: 6.53 (1.23) Control: Home patients: 4.45 (2.09); home partners: 4.05 (1.82) In-centre patients: 5.60 (1.05); in-centre partners: 5.71 (1.40) • MATE subscales: Inclusion behaviour I: Home patients: 3.95 (3.03); home partners: 2.11 (2.08) In-centre patients: 5.28 (2.44); in-centre partners: 2.13 (2.28) Inclusion behaviour II: Home patients: 3.00 (2.71); home partners: 3.11 (2.56) In-centre patients: 4.72 (2.40); in-centre partners: 3.13 (1.41) Inclusion feelings I: Home patients: 4.25 (3.19); home partners: 2.63 (2.36) In-centre patients: 6.33 (2.38); in-centre partners: 3.50 (2.22) Inclusion feelings II: Home patients: 3.65 (3.03); home partners: 3.05 (2.78) In-centre patients: 6.44 (2.64); in-centre partners: 4.88 (1.89) Control behaviour I: Home patients: 3.90 (2.63); home partners: 2.79 (2.97) In-centre patients: 5.72 (2.02); in-centre partners: 4.19 (2.26) Control behaviour II: Home patients: 4.40 (2.82); home partners: 2.79 (2.97) In-centre patients: 6.39 (2.23); in-centre partners: 4.75 (2.14) Control feelings I: Home patients: 5.00 (3.28); home partners: 3.05 (3.21) In-centre patients: 7.67 (1.68); in-centre partners: 5.88 (2.16) Control Feelings II: Home patients: 5.00 (2.88); home partners: 3.47 (3.34) In-centre patients: 7.17 (2.53); in-centre partners: 3.75 (2.29) Affection I: Home patients: 3.80 (3.43); home partners: 2.16 (2.52) In-centre patients: 6.28 (2.93); in-centre partners: 4.19 (2.40) Affection II: Home patients: 3.15 (3.38); home partners: 3.16 (3.08) In-centre patients: 6.56 (3.05); in-centre partners: 6.11 (2.11)	MATE: evaluates several dimensions of intimate, close relationships. Contains 45 items with a 6-point scale for each. The scale measures the degree of satisfaction and sensitivity the respondent feels toward someone with whom he/she is involved in an intimate relationship. The basic dimensions of the MATE concern inclusion behaviour, inclusion feelings, control behaviour, control feelings and affection

continued

Quality of life *contd*

Study	Results	Notes
Parsons & Harris, 1997[14]	Campbell's Index of Well-Being (adjusted for case mix): Home group: 11.2 In-centre group: 10.6 General Affect Scale: Home group: 5.5 In-centre group: 5.1 Index of Overall Life Satisfaction: Home group: 5.3 In-centre group: 5.0 ***Objective QoL – functional impairment*** Karnofsky Scale (adjusted for case mix): Home group: 73.7 In-centre group: 71.5 (Evans study, 1985) Percentage of patients with a score > 79 on the modified Karnofsky Scale: Home group: 79% Satellite unit group: 77% In-centre group: 68% (ANZDATA)	Campbell's Index of Well-Being: range from 2.1 to 14.7 (higher score indicates greater well-being) General Affect Scale: range from 1 to 7 (higher score indicates better general affect) Index of Overall Life Satisfaction: range from 1 to 7 (higher score indicates greater satisfaction)
Piltz-Kirkby & Fox, 1982[37]	Home dialysis clients had a higher level of support than in-centre dialysis clients, according to family emotional support indices (p = 0.0165 and 0.0017). The indices, compiled from five questionnaire items, combined clients' 'importance' and 'satisfaction' ratings for the following factors: trust and confidence in family members, family's interest and concern for you, availability of services from family when needed, family's understanding of your physician's instructions and plans for your care Both 'importance' measures and 'satisfaction' measures were significantly higher in the home group on the following items: • your family's interest and concern for you (p = 0.014 and 0.018, respectively) • availability of services from family when needed (p = 0.025 and 0.002, respectively) • trust and confidence in your dialysis assistant (p = 0.004 and 0.000, respectively) • your dialysis assistant's interest and concern for you (p = 0.012 and 0.002, respectively) • people available with whom to discuss medical and technical concerns (p = 0.05 and 0.027, respectively) The home dialysis group experienced greater satisfaction with 'people available with whom to discuss emotional concerns' (p = 0.005), 'skill and competence of your dialysis assistant' (p = 0.0003), and 'ease in obtaining health services' (p = 0.017). Home dialysis clients placed more importance on 'physical surroundings and facilities for your dialysis treatment' (p = 0.0116) Information: The home and in-centre groups were similar in their reports on the importance and satisfaction they experienced for 8 out of the 10 measurements relating to importance. The two groups differed in both the importance and satisfaction perceived with 'people available with whom to discuss medical and/or technical concerns'	The questionnaire addressed three aspects of family support systems: information giving, material aid and services, and emotional support. The questionnaire combined two 4-point Likert scales. The first scale measured the importance the client placed on a given statement about health, care or support. The second scale measured the client's satisfaction with that statement. The 'Importance' scale ranged from 'extremely important' to 'not important', and the 'Satisfaction' scale ranged from 'very satisfied' to 'very unsatisfied'

continued

Quality of life *contd*

Study	Results	Notes
Piltz-Kirkby & Fox, 1982[37]	Material aids and services: The home group seemed to have services more readily available. The home group was more satisfied with their 'ease in obtaining health services' and with 'availability of services from family when needed' than the in-centre group Emotional support: The home group perceived more emotional support from their family and from their dialysis assistant than the in-centre group. The major difference between the two groups was the level of emotional support received from the family and dialysis assistant	
Reichwald-Klugger *et al.*, 1984[27]	• Fears of and stress caused by 24 complications possibly occurring during dialysis in 10 home dialysis patients and 10 hospital dialysis patients (interviews and questionnaires): Disappearance of shunt/fistula murmur: Home dialysis: fear 3.5, stress 5.5 Hospital dialysis: fear 1, stress 8 Infection at shunt site: Home dialysis: fear, 2; stress, 2 Hospital dialysis: fear, 2.5; stress, 1.5 Trauma to shunt: Home dialysis: fear, 3.5; stress, 2 Hospital dialysis: fear, 2.5; stress, 1.5 Missed puncture: Home dialysis: fear, 6; stress, 11 Hospital dialysis: fear, 4; stress, 5.5 Pain in shunt region: Home dialysis: fear, 5; stress, 2 Hospital dialysis: fear, 5; stress, 16.5 Cardiac pains: Home dialysis: fear, 9.5; stress, 7.5 Hospital dialysis: fear, 6; stress, 9 Convulsions: Home dialysis: fear, 23; stress, 5.5 Hospital dialysis: fear, 7.5; stress, 3 Coagulation in dialyser or tubing system: Home dialysis: fear, 1; stress, 14 Hospital dialysis: fear, 7.5; stress, 14 Haemorrhagia at puncture site: Home dialysis: fear, 9.5; stress, 18 Hospital dialysis: fear, 9; stress, 5.5 Air in tubing system: Home dialysis: fear, 12.5; stress, 22.5 Hospital dialysis: fear, 10; stress, 20 Dizziness: Home dialysis: fear, 14.5; stress, 16.5 Hospital dialysis: fear, 11.5; stress, 11 Change in position of needle: Home dialysis: fear, 9.5; stress, 12 Hospital dialysis: fear, 11.5; stress, 14 Bleeding between two dialysis sessions: Home dialysis: fear, 14.5; stress, 24 Hospital dialysis: fear, 13.5; stress, 18	The values indicate the ranking position of each individual factor identified by the questionnaire. The 24 complications were ranked by the patients according to the level of fear and level of stress they caused, with 1 representing the most fear/stress on a scale of 1 to 24

continued

Quality of life *contd*

Study	Results	Notes
Reichwald-Klugger *et al.*, 1984[27]	• Fears of and stress caused by 24 complications possibly occurring during dialysis in 10 home dialysis patients and 10 hospital dialysis patients (interviews and questionnaires) *contd*: Needling: Home dialysis: fear, 7; stress, 19 Hospital dialysis: fear, 13.5; stress, 14 Drop in blood pressure: Home dialysis: fear, 9.5; stress, 16.5 Hospital dialysis: fear, 15.5; stress, 7 Blood leakage: Home dialysis: fear, 17; stress, 21 Hospital dialysis: fear, 15.5; stress, 20 Vomiting: Home dialysis: fear, 12.5; stress, 9.5 Hospital dialysis: fear, 17; stress, 4 Arterial/venous monitor alarm: Home dialysis: fear, 21.5; stress, 20 Hospital dialysis: fear, 18; stress, 24 Cephalalgia: Home dialysis: fear, 24; stress, 4 Hospital dialysis: fear, 19.5; stress, 11 Bleeding from puncture sites: Home dialysis: fear, 21.5; stress, 22.5 Hospital dialysis: fear, 19.5; stress, 23 Nausea: Home dialysis: fear, 18; stress, 9.5 Hospital dialysis: fear, 22; stress, 11 Abdominal pains: Home dialysis: fear, 16; stress, 15 Hospital dialysis: fear, 22; stress, 20 Pruritus: Home dialysis: fear, 20; stress, 13 Hospital dialysis: fear, 22; stress, 16.5 Arthralgia: Home dialysis: fear, 19; stress, 7.5 Hospital dialysis: fear, 24; stress, 22 • Stress factors of parents associated with dialysis treatment of their children: Home dialysis (n = 8): 1. Psychosocial stress by: – high degree of responsibility, 4 – fear of complications, 4 – constant fitness requirement, 3 – inability to relax, 2 2. Performance in puncture by parents, 6 3. Complete dependence of family life on dialysis treatment, 5 4. Educational problems, 4 Hospital dialysis (n = 10): 1. Feeling of restlessness, 8 2. Fear of complications, 7 3. Being bound, 5 4. Feelings of overcharge and helplessness, 4	

continued

Quality of life *contd*

Study	Results	Notes
Reichwald-Klugger *et al.*, 1984[27]	• Long-term changes in social contacts (answers from 8 home dialysis patients and 10 hospital dialysis patients and their parents: Disruption of social contacts of patients: Home dialysis: 3 Hospital dialysis: 8 Disruption of social contacts of parents: Home dialysis: 8 Hospital dialysis: 2 • Help and support perceived by parents to cope with dialysis stress: Home dialysis (n = 8): Optimism, mental strength, 5 Awareness of help in needling, 3 Cooperation and compliance of the patient, 3 Distraction by occupational work, 2 Hospital dialysis (n = 10): Habituation to stress, making the best of things, 7 Communication and contacts with friends, 5 Distraction by activities, 5 Hope for transplantation, 5	
Schreiber & Huber, 1985[29]	• Patient's significant other's ratings on changes in dialysis patient's psychological well-being after beginning dialysis treatment: More nervous: Home dialysis patients: 66% In-centre dialysis patients: 64% More anxious: Home dialysis patients: 53% In-centre dialysis patients: 66% More tense: Home dialysis patients: 74% In-centre dialysis patients: 68% More irritable: Home dialysis patients: 61% In-centre dialysis patients: 53% More self-confident: Home dialysis patients: 40% In-centre dialysis patients: 29% • Stresses on home and in-centre dialysis patients: Headaches, high blood pressure, convulsions during home dialysis: Home dialysis: high or moderate stress, 52.3%; low or no stress, 34.9%; ranking number, 2 In-centre dialysis: high or moderate stress, 69.2%; low or no stress, 22.3%; ranking number, 1 Time consumption of dialysis treatment: Home dialysis: high or moderate stress, 67.4%; low or no stress, 31.0%; ranking number, 1 In-centre dialysis: high or moderate stress, 52.3%; low or no stress, 40.0%; ranking number, 3	Lowest ranking number indicates largest stressor

continued

Quality of life *contd*

Study	Results	Notes
Schreiber & Huber, 1985[29]	• Stresses on home and in-centre dialysis patients *contd*: Uncertainties or fear of the future: Home dialysis: high or moderate stress, 59.1%; low or no stress, 39.4%; ranking number, 3 In-centre dialysis: high or moderate stress, 53.8%; low or no stress, 39.2%; ranking number, 4 Sleep disturbances: Home dialysis: high or moderate stress, 43.2%; low or no stress, 29.5%; ranking number, 5 In-centre dialysis: high or moderate stress, 58.4%; low or no stress, 23.8%; ranking number, 2 Worries by family members: Home dialysis: high or moderate stress, 53.0%; low or no stress, 34.1%; ranking number, 4 In-centre dialysis: high or moderate stress, 43.1%; low or no stress, 33.9%; ranking number, 5 Compliance to dietary prescriptions: Home dialysis: high or moderate stress, 34.9%; low or no stress, 61.3%; ranking number, 7 In-centre dialysis: high or moderate stress, 27.0%; low or no stress, 61.6%; ranking number, 8 Fear of complications during dialysis: Home dialysis: high or moderate stress, 27.3%; low or no stress, 37.1%; ranking number, 9 In-centre dialysis: high or moderate stress, 36.9%; low or no stress, 31.6%; ranking number, 6 Reduced income as compared to healthy colleagues: Home dialysis: high or moderate stress, 32.4%; low or no stress, 19.7%; ranking number, 6 In-centre dialysis: high or moderate stress, 30.8%; low or no stress, 22.3%; ranking number, 10 Medical complications and accompanying diseases: Home dialysis: high or moderate stress, 22.7%; low or no stress, 39.4%; ranking number, 10 In-centre dialysis: high or moderate stress, 38.5%; low or no stress, 26.1%; ranking number, 7 Vocational problems due to dialysis: Home dialysis: high or moderate stress, 41.7%; low or no stress, 15.9%; ranking number, 8 In-centre dialysis: high or moderate stress, 21.5%; low or no stress, 25.3%; ranking number, 11 Blood leakages during dialysis: Home dialysis: high or moderate stress, 16.6%; low or no stress, 44.1%; ranking number, 12 In-centre dialysis: high or moderate stress, 28.5%; low or no stress, 33.9%; ranking number, 9 Technical problems with the dialysis machine: Home dialysis: high or moderate stress, 15.1%; low or no stress, 66%; ranking number, 11 In-centre dialysis: high or moderate stress, 10.7%; low or no stress, 42.3%; ranking number, 12	

continued

Quality of life *contd*

Study	Results	Notes
Schreiber & Huber, 1985[29]	• Scale values of home and in-centre dialysis patients' significant others: Denial: Home dialysis: 9.7 [126] In-centre dialysis: 8.5 [109] ($p \leq 0.001$) Communication: Home dialysis: 25.0 [125] In-centre dialysis: 24.0 [109] (not significant) Self-esteem as a handicapped person: Home dialysis: 15.3 [126] In-centre dialysis: 16.6 [112] ($p \leq 0.001$) Depression: Home dialysis: 18.3 [124] In-centre dialysis: 21.3 [107] ($p \leq 0.001$) Problem load: Home dialysis: 10.1 [122] In-centre dialysis: 11.7 [107] ($p \leq 0.01$) Fear of new situations: Home dialysis: 5.2 [125] In-centre dialysis: 5.9 [110] ($p \leq 0.05$)	Mean [number of cases]
Soskolne & De Nour, 1987[30]	• Interview information – percentage of patients (n = 29 pairs) and spouses (n = 24 pairs) very satisfied with treatment: Home dialysis patients: 87% Home dialysis spouses: 75% Hospital dialysis patients: 67% Hospital dialysis spouses: 55%	
	• Comparison of PAIS domain scores for home and hospital dialysis patients (29 pairs) and spouses: 1. Healthcare orientation: Home dialysis patients: 7.2 (2.65) Hospital dialysis patients: 7.9 (4.44) Home dialysis spouses (n = 30): 6.1 (3.72) Hospital dialysis spouses (n = 27): 6.0 (3.15) 3. Domestic environment: Home dialysis patients: 7.1 (3.95) Hospital dialysis patients: 7.1 (5.49) Home dialysis spouses (n = 30): 4.0 (4.44) Hospital dialysis spouses (n = 27): 5.6 (5.28) 4. Sexual relations: Home dialysis patients: 5.9 (4.31) Hospital dialysis patients: 7.0 (5.93) Home dialysis spouses (n = 28): 5.1 (3.92) Hospital dialysis spouses (n = 25): 5.8 (4.95) 5. Extended family: Home dialysis patients: 1.1 (2.37) Hospital dialysis patients: 0.6 (1.63) Home dialysis spouses (n = 30): 0.7 (1.32) Hospital dialysis spouses (n = 28): 1.7 (2.09), $p < 0.05$	PAIS: 45-item questionnaire providing information along seven domains of adjustment, with each item scored from 0 to 3 (higher numbers indicate more problems). Section 2 (vocational environment) was omitted due to the limited number of pairs and spouses Mean (SD)

continued

Quality of life *contd*

Study	Results	Notes
Soskolne & De Nour, 1987[30]	• Comparison of PAIS domain scores for home and hospital dialysis patients (29 pairs) and spouses *contd*: 6. Social environment: Home dialysis patients: 4.6 (4.45) Hospital dialysis patients: 5.5 (4.55) Home dialysis spouses (n = 30): 4.5 (4.17) Hospital dialysis spouses (n = 28): 6.8 (5.36), $p < 0.05$ 7. Psychological distress: Home dialysis patients: 5.4 (5.32) Hospital dialysis patients: 6.3 (5.16) Home dialysis spouses (n = 30): 5.7 (3.91) Hospital dialysis spouses (n = 28): 6.5 (4.35) Total score: Home dialysis patients: 32.6 (17.88) Hospital dialysis patients: 34.9 (22.38) Home dialysis spouses (n = 28): 26.9 (17.78) Hospital dialysis spouses (n = 23): 34.9 (19.29) • BSI scores, male patients: Somatisation: Home dialysis: 0.92 Hospital dialysis: 1.34 ($p < 0.05$) Obsessive–compulsive: Home dialysis: 0.55 Hospital dialysis: 0.75 Interpersonal sensitivity: Home dialysis: 0.59 Hospital dialysis: 0.73 Depression: Home dialysis: 0.55 Hospital dialysis: 1.00 ($p < 0.05$) Anxiety: Home dialysis: 0.56 Hospital dialysis: 0.91 Hostility: Home dialysis: 0.64 Hospital dialysis: 0.90 ($p < 0.05$) Phobic anxiety: Home dialysis: 0.27 Hospital dialysis: 0.56 Paranoid ideation: Home dialysis: 0.45 Hospital dialysis: 0.71 ($p < 0.05$) Psychotism: Home dialysis: 0.30 Hospital dialysis: 0.49 Grand Symptom Index: Home dialysis: 0.56 Hospital dialysis: 0.85 ($p < 0.05$)	

continued

Quality of life *contd*

Study	Results	Notes
Westlie *et al.*, 1984[31]	Satisfied with social contact at home when off dialysis: Home dialysis: satisfied with social contact with family, 25 (100%); with friends, 24 (92.3%) In-centre dialysis: satisfied with social contact with family, 35 (85.4%); with friends, 44 (83%) Desire for other treatment: Transplantation: Home dialysis: 8 (30.8%) In-centre dialysis: 27 (50.9%) Desire for home dialysis: In-centre dialysis: 11 (20.7%) Considered stopping all treatment: Home dialysis: 1 (3.9%) In-centre dialysis: 3 (5.7%) Activity when off dialysis: Outdoors when off dialysis: Home dialysis: 24 (92.3%) In-centre dialysis: 43 (83%) (not significant) Participate in church activities: Home dialysis: 20 (76.9%) In-centre dialysis: 21 (39.6%) ($p < 0.01$) Active hobbies: Home dialysis: 19 (73.1%) In-centre dialysis: 30 (56.6%) (not significant) Cook own meals: Home dialysis: 15 (57.7%) In-centre dialysis: 22 (41.5%) (not significant) Enjoyment of life (scale, 0 = definitely not, 6 = very much): Home dialysis average score: 5.38 In-centre dialysis average score: 5.09 (not significant) Perceived health (compared to others your age, how would you rate your health? – scale, 1 = much worse, 5 = much better): Home dialysis average score: 3.73 In-centre dialysis average score: 3.09 (not significant)	Number of patients (% of total)

continued

Quality of life *contd*

Study	Results	Notes
Westlie *et al.*, 1984[31]	**Physical performance, modified Karnofsky Scale** • Patients' opinion: Scale 90–100: Home dialysis: 12 (46.1%) In-centre dialysis: 16 (30.2%) Scale 80–89: Home dialysis: 8 (30.8%) In-centre dialysis: 21 (39.6%) Scale 70–79: Home dialysis: 4 (15.4%) In-centre dialysis: 13 (24.5%) Scale 40–69: Home dialysis: 2 (7.7%) In-centre dialysis: 3 (5.7%) Scale 1–39: Home dialysis: 0 In-centre dialysis: 0	Modified Karnofsky Scale: 90–100, no complaints, almost normal activity; 80–89, able to carry out normal physical activity at least part of the time; 70–79, only able to carry out physical activities involving self-care; 40–69, requires at least some assistance for care of bodily needs, may require special care, often debilitated; 1–39, requires institutionalisation or hospitalisation, may be moribund
	Home dialysis average score: 84.3 ± 2.9 In-centre dialysis average score: 82.5 ± 1.6 (not significant)	Mean ± SEM
	• Nurse practitioners' opinion: Scale 90–100: Home dialysis: 13 (50.0%) In-centre dialysis: 14 (26.4%) Scale 80–89: Home dialysis: 7 (27.0%) In-centre dialysis: 23 (43.4%) Scale 70–79: Home dialysis: 3 (11.5%) In-centre dialysis: 9 (17.0%) Scale 40–69: Home dialysis: 3 (11.5%) In-centre dialysis: 5 (9.4%) Scale 1–39: Home dialysis: 0 In-centre dialysis: 2 (3.8%)	
	Home dialysis average score: 82.8 ± 3.0 In-centre dialysis average score: 80.0 ± 1.8 (not significant)	Mean ± SEM
Woods *et al.*, 1996[33]	Percentage unable to eat independently: Home dialysis: 2.9% In-centre dialysis: 2.3% Percentage unable to transfer independently: Home dialysis: 8.6% In-centre dialysis: 9.2% Percentage unable to walk independently: Home dialysis: 4.3% In-centre dialysis: 9.3%	

Hospitalisation rate (days per patient per year)

Study	Results	Notes
Bremer *et al.*, 1989[17]	Home dialysis: 13.4 (30.5) In-centre dialysis, self-care: 11.5 (16.8) In-centre dialysis, staff-assisted: 15.1 (19.0)	Mean (SD)
Mohr *et al.*, 2001[12]	Reduction in hospital days associated with daily dialysis (3 studies, 23 patients): weighted average, 43% reduction (weighted CI, 23% to 63%)	

Employment/school status

Study	Results	Notes
Bremer *et al.*, 1989[17]	Percentage employed (age 18–55 years): Home dialysis: full time, 42%; part time, 4% In-centre dialysis, self-care: full time, 6%; part time, 0% In-centre dialysis, staff-assisted: full time, 9%; part time, 23%	
Courts & Boyette, 1998[19]	Home dialysis: 1 of 5 patients worked full time; 4 of 5 patients' wives worked full time In-centre dialysis patients: 2 of 5 patients worked part time	
Hart & Evans, 1987[21] (Evans *et al.*, 1985[38])	Employed: Home group: 39.6% In-centre group: 23.7%	
Parsons & Harris, 1997[14]	• Employment rates (%) among Australian dialysis recipients and reasons for not working in those patients aged 15–65 years: Employed full-time: Home group: 48% Satellite unit group: 26% In-centre group: 22% Employed part-time: Home group: 19% Satellite unit group: 20% In-centre group: 18% Not employed because: Unable to find work: Home group: 4% Satellite unit group: 6% In-centre group: 5% Disinclination: Home group: 4% Satellite unit group: 12% In-centre group: 5% Medically unfit: Home group: 13% Satellite unit group: 25% In-centre group: 39% Dialysis schedule: Home group: 2% Satellite group: 4% In-centre group: 3% Retired: Home group: 9% Satellite group: 6% In-centre group: 8% • Percentage of patients employed: **Study: Evans, 1985** Home group: 40% In-centre group: 24% **Study: Morris and Jones, 1988** Home group: 35% In-centre group: 30% **Study: Bremer, 1989** Home group: 43% In-centre group: 24%	

continued

Employment/school status *contd*

Study	Results	Notes
Piltz-Kirkby & Fox, 1982[37]	Employed: Home group: 9 (38%) In-centre group: 3 (12%)	Number of patients (%)
Reichwald-Klugger *et al.*, 1984[27]	Missing regular school activity due to renal dialysis therapy: Home dialysis: average of 22% of school activity missed (range, 9–31%) Hospital dialysis: average of 37% of school activity missed (range, 8–47%) Class repetitions: Home dialysis: class repetitions occurred in 3 out of 8 children Hospital dialysis: class repetitions occurred in 5 out of 10 children Educational guidance after initiation of dialysis more difficult than before: Home dialysis: 7 out of 10 children Hospital dialysis: 4 out of 10 children Apathy and sadness contribute to difficult education: Home dialysis: 3 out of 10 children Hospital dialysis: 2 out of 10 children Had an additional tutor at home: Home dialysis: 2 out of 10 children Hospital dialysis: 5 out of 10 children	
Soskolne & De Nour, 1987[30]	Interview information – percentage of patients working (n = 29 pairs): Home dialysis: 65% Hospital dialysis: 52%	

Technique failure

Study	Results	Notes
Rubin *et al.*, 1989[28]	Technique survival: Home dialysis: median, 7.5 years Free-standing facility: median, 9.7 years	Any transfer from one dialysis therapy to another that lasted longer than 4 months was considered a dialysis technique failure

Measures of anaemia (haemoglobin, haematocrit)

Study	Results	Notes
Covic, 1998[20]	Haemoglobin (g/L): 8-hour home dialysis: 11.3 ± 2.1 4-hour standard dialysis: 8.3 ± 2.9 ($p < 0.05$)	
McGregor *et al.,* 2001[15]	Haematocrit: Long home dialysis: 33% ± 2.5% Short in-centre dialysis: 31% ± 2.8% ($p = 0.35$)	Mean ± SEM
Westlie *et al.*, 1984[31]	Haematocrit: Home dialysis: 28.40% ± 1.15% In-centre dialysis: 26.36% ± 0.70% (not significant)	Mean ± SEM

Erythropoietin

Study	Results	Notes
McGregor *et al.*, 2001[15]	5 out of 9 patients were receiving EPO at a dose (6000 units/week) that was held constant throughout the study period	
Mohr *et al.*, 2001[12]	Average weekly EPO dose requirement (5 studies, 116 patients): weighted average percentage reduction with daily dialysis, 41% (weighted CI, 32% to 50%) 4 of the 5 studies documented reduced EPO doses	

Biochemical indices of renal disease (serum potassium, calcium, phosphate, albumin, alkaline phosphatase, parathyroid hormone, renal bone disease)

Study	Results	Notes
Freeman & Richards, 1979[35]	Alkaline phosphatase (IU/l): Home haemodialysis (*n* = 20): 212 ± 34 Satellite haemodialysis (*n* = 17): 121 ± 13	Mean ± SEM Samples from the home dialysis group (sorbent cartridge dialysis) were obtained at the time of normally scheduled clinic visits and compared with those of the satellite unit group (single pass dialysis), also seen at the clinic during the same time interval. Patients known to have active renal osteo-dystrophy before the initiation of dialysis therapy were excluded from the analysis
McGregor *et al*., 2001[15]	Calcium (mmol/l): Long home dialysis: 2.64 ± 0.06 Short in-centre dialysis: 2.55 ± 0.05 (*p* = 0.09) Phosphate (mmol/l): Long home dialysis: 2.2 ± 0.6 Short in-centre dialysis: 2.4 ± 0.6 (*p* = 0.67) Albumin (g/l): Long home dialysis: 38.4 ± 1.0 Short in-centre dialysis: 37.1 ± 1.1 (*p* = 0.29)	Mean ± SEM Venous blood was taken before the first dialysis of the week at baseline, 4 and 8 weeks for biochemistry and haematology
Westlie *et al*., 1984[31]	Potassium (mEq/l): Home dialysis: 5.04 ± 0.12 In-centre dialysis: 4.84 ± 0.11 (not significant) Calcium (mg/dl): Home dialysis: 9.53 ± 0.08 In-centre dialysis: 9.45 ± 0.10 (not significant) Albumin (gm/dl): Home dialysis: 3.52 ± 0.07 In-centre dialysis: 3.48 ± 0.04 (not significant) Sodium (mEq/l): Home dialysis: 140.08 ± 0.61 In-centre dialysis: 140.15 ± 0.42 (not significant) Blood urea nitrogen (mg/dl): Home dialysis: 67.80 (4.04) In-centre dialysis: 66.23 (2.71) (not significant)	Predialysis values Mean ± SEM

continued

Biochemical indices of renal disease (serum potassium, calcium, phosphate, albumin, alkaline phosphatase, parathyroid hormone, renal bone disease) *contd*

Study	Results	Notes
Westlie *et al.*, 1984[31]	Creatinine (mg/dl): Home dialysis: 11.74 ± 0.58 In-centre dialysis: 10.05 ± 0.38 ($p < 0.05$) Uric acid (mg/dl): Home dialysis: 7.12 ± 0.28 In-centre dialysis: 6.77 ± 0.14 (not significant) Phosphorus (mg/dl): Home dialysis: 5.13 ± 0.22 In-centre dialysis: 5.09 ± 0.20 (not significant)	Mean ± SEM
Woods *et al.*, 1996[33]	Serum albumin (g/dl): Home dialysis: 3.5 (0.5) In-centre dialysis: 3.6 (0.6) ($p < 0.05$)	Mean (SD) Levels at the beginning of treatment for ESRD

Dialysis adequacy (Kt/V, URR, PCR)

Study	Results	Notes
Covic, 1998[20]	Kt/V: 8-hour home dialysis: 1.72 4-hour standard dialysis: 1.23 ($p < 0.05$)	
McGregor et al., 2001[15]	Kt/V achieved: Long home dialysis: 1.19 ± 0.05 Short in-centre dialysis: 1.17 ± 0.04	Mean ± SEM Before commencing the study, each patient had a trial run of short haemodialysis to ensure an eKt/V_{urea} value similar to their value while on dialysis at home. The eKt/V_{urea} was estimated from a single pool Kt/V_{urea} derived from a postdialysis sample taken after slowing the blood pump to 80 ml/minutes for 20 seconds. Throughout the study, eKt/V_{urea} was measured for a midweek dialysis every 2 weeks
Woods *et al.*, 1996[33]	Kt/V (prescribed): Home dialysis: 1.02 (0.43) In-centre dialysis: 1.00 (0.44)	Mean (SD) Measured at the start of ESRD treatment

Blood pressure

Study	Results	Notes
McGregor *et al.*, 2001[15]	• Predialysis blood pressure (mmHg): Systolic: Long home dialysis: 155 ± 6 Short in-centre dialysis: 169 ± 8 ($p < 0.05$) Diastolic: Long home dialysis: 89 ± 2 Short in-centre dialysis: 93 ± 3 ($p = 0.08$) • Postdialysis blood pressure (mmHg): Systolic: Long home dialysis: 131 ± 6 Short in-centre dialysis: 148 ± 7 ($p < 0.05$) Diastolic: Long home dialysis: 78 ± 2 Short in-centre dialysis: 82 ± 4 ($p = 0.18$)	Mean ± SEM
Mohr *et al.*, 2001[12]	Reduction in average number of anti-hypertensive medications (4 studies, 48 patients): weighted average reduction with daily dialysis, 47% (weighted CI, 33% to 61%)	
Westlie *et al.*, 1984[31]	• Standing blood pressure (mmHg): Predialysis: Home dialysis: 136 ± 4/65 ± 2 In-centre dialysis: 140 ± 2/76 ± 1 (not significant/$p < 0.001$) Postdialysis: Home dialysis: 111 ± 4/56 ± 3 In-centre dialysis: 124 ± 2/69 ± 1 ($p < 0.01$/$p < 0.01$) • Supine blood pressure (mmHg): Predialysis: Home dialysis: 142 ± 4/65 ± 2 In-centre dialysis: 146 ± 2/75 ± 1 (not significant/$p < 0.001$) Postdialysis: Home dialysis: 122 ± 3/58 ± 3 In-centre dialysis: 138 ± 2/73 ± 1 ($p < 0.001$/$p < 0.01$)	Systolic/diastolic (average of last 14 dialyses) Mean ± SEM

Adverse events

Study	Results	Notes
McGregor *et al.*, 2001[15]	• Intradialytic complications – hypotension: Long home dialysis: 16 episodes in 216 treatments; 5 out of these 16 episodes required saline to restore blood pressure Short in-centre dialysis: 31 episodes in 216 treatments; 8 of these 31 episodes required saline to restore blood pressure	
	• Weight (kg): Predialysis: Long home dialysis: 70.6 ± 5.2 Short in-centre dialysis: 70.6 ± 5.2 (p = 0.95)	Mean ± SEM
	Postdialysis: Long home dialysis: 67.9 ± 5.1 Short in-centre dialysis: 68.1 ± 5.1 (p = 0.62)	
	Interdialytic weight gain: Long home dialysis: 2.6 ± 0.3 Short in-centre dialysis: 2.5 ± 0.2 (p = 0.88)	
Westlie *et al.*, 1984[31]	• Weight loss during dialysis (kg): Home dialysis: 1.27 ± 0.17 In-centre dialysis: 1.86 ± 0.11 (p < 0.01)	Mean ± SEM
	• Number of episodes (% of runs) during the last 14 dialyses (home dialysis, 367 dialyses; in-centre dialysis, 714 dialyses): Vomiting: Home dialysis: 3 (0.8%) In-centre dialysis: 27 (3.8%)	
	Hypotension: Home dialysis: 34 (9.3%) In-centre dialysis: 113 (15.8%)	
	Cramps: Home dialysis: 6 (1.6%) In-centre dialysis: 45 (6.3%)	
	Arrhythmia: Home dialysis: 4 (1.1%) In-centre dialysis: 105 (14.7%)	
	Headaches: Home dialysis: 0 In-centre dialysis: 22 (3.1%)	
	• Mean number of complications per dialysis: Home dialysis: 0.13 In-centre dialysis: 0.44 (p < 0.001)	

Mortality/survival

Study	Results	Notes
Arkouche *et al.*, 1999[16]	• All patients: Mortality: 17% Gross mortality rate: mean (SD), 2.74% (2.94%); range, 0–10%; median, 1.85% Causes of death: 50% cardiovascular, 12% infections, 10% cancer, 4% cerebrovascular diseases, 24% miscellaneous Overall cumulative survival: 5 years, 90%; 10 years, 77%; 15 years, 62%; 20 years, 45% • Results of Cox hazard analyses: Sex: Women: hazard risk, 1 Men: hazard risk, 1.398 (95% CI, 0.717 to 2.727; $p = 0.326$) Cause of ESRD: Chronic glomerulonephritis: hazard risk, 1 Other: hazard risk, 1.205 (95% CI, 0.619 to 2.345; $p = 0.5838$) Unknown: hazard risk, 1.364 (95% CI, 0.289 to 6.432; $p = 0.6948$) Vascular: hazard risk, 2.558 (95% CI, 1.187 to 5.513; $p = 0.0165$) Diabetes: hazard risk, 7.009 (95% CI, 2.801 to 17.542, $p < 0.0001$) Age at start of haemodialysis: ≤ 34 years: hazard risk, 1 35–44 years: hazard risk, 2.884 (95% CI, 1.121 to 7.418; $p = 0.0280$) 45–54 years: hazard risk, 2.744 (95% CI, 1.037 to 7.259; $p = 0.0420$) 55–64 years: hazard risk, 5.462 (95% CI, 2.029 to 14.707; $p = 0.0008$) ≥ 65 years: hazard risk, 7.715 (95% CI, 2.435 to 24.437; $p = 0.0005$) Period of start of haemodialysis: 1974–80: hazard risk, 1.040 (95% CI, 0.395 to 2.740; $p = 0.9365$) 1981–85: hazard risk, 1.325 (95% CI, 0.593 to 2.961; $p = 0.4927$) 1986–90: hazard risk, 1 1991–97: hazard risk, 1.700 (95% CI, 0.653 to 4.424; $p = 0.2770$) Modality of dialysis: Self-care: hazard risk, 1 Home: hazard risk, 1.535 (95% CI, 0.718 to 3.282; $p = 0.2694$)	
Capelli *et al.*, 1985[18]	• Survival: Median survival times: Home dialysis: 48.3 months In-centre dialysis: 30.1 months After 1.5 years of treatment, median lifetime remaining: Home dialysis: 37.0 (7.0) months In-centre dialysis: 32.1 (4.3) months Smoothed median quantile survival times for home dialysis patients: 47.21 (6.18) months Adjusted median quantile survival times for in-centre dialysis patients: 34.5 (3.3) months Smoothed survival rates for home dialysis cohort: 1 year, 92.7%; 2 years, 80.9%; 3 years, 67.7%; 5 years, 36.2% Adjusted survival rates for in-centre dialysis cohort: 1 year, 79.9%; 2 years, 65.5%; 3 years, 54.2%; 5 years, 32.5%	Median (SD) Adjusted median quantile: time at which 50% of the patient population is surviving

continued

Mortality/survival *contd*

Study	Results	Notes
Capelli *et al.*, 1985[18]	• Results of Cox hazard analyses: In-centre haemodialysis: parameter estimate, 0 Home haemodialysis: parameter estimate, –0.33; standard error, 0.22 Age (months): parameter estimate, 0.0018; standard error, 0.0004 ($p < 0.001$) Diabetic: parameter estimate, 0.74; standard error, 0.19 ($p < 0.001$)	
Hellerstedt *et al.*, 1984[22]	• Cumulative survival rates: Patients without diabetes: Home dialysis (number alive at 0 years, 148): 1 year, 94%; 2 years, 86%; 3 years, 75%; 4 years, 64%; 5 years, 64% In-centre dialysis (number alive at 0 years, 1259): 1 year, 87%; 2 years, 74%; 3 years, 64%; 4 years, 57%; 5 years, 55% Patients with diabetes: Home dialysis (number alive at 0 years, 40): 1 year, 90%; 2 years, 63%; 3 years, 56%; 4 years, 56%; 5 years, 56% In-centre dialysis (number alive at 0 years, 540) 1 year, 83%; 2 years, 64%; 3 years, 55%; 4 years, 49%; 5 years, 41%	
Jacobs & Selwood, 1995[11]	• Survival rates: Patients aged 15–34 years at start of RRT: At 5 years: home group, 93.4%; in-centre group, 96% At 10 years: home group, 90.3%; in-centre group, 86% Patients aged 55–64 years at start of RRT: At 5 years: home group, 78%; in-centre group, 59% At 10 years: home group, 56%; in-centre group, 32%	
Mailloux *et al.*, 1996[24]	• Mortality/survival Mortality: Home dialysis: of 74 patients, 28% died In-centre dialysis: of 687 patients, 53% died Survival estimates by dialysis modality at start of therapy: Home dialysis ($n = 74$): median months, 147; 1 year, 99%; 5 years, 87%; 10 years, 60%; 15 years, 47%; 20 years, 35% In-centre dialysis ($n = 687$): median months, 47; 1 year, 87%; 5 years, 38%; 10 years, 18%; 15 years, 7%; 20 years, 5% Survival of home dialysis patients compared with 'attempted match' in-centre dialysis population: Home dialysis ($n = 74$): median months, 147; 5 years, 87%; 20 years, 35% In-centre matched ($n = 74$): median months, 110; 5 years, 66%; 20 years, 18% • Results of Cox hazard analyses with time-dependent co-variates: Diagnoses: Diabetes mellitus: risk ratio, 2.12 ($p = 0.0001$) Renal vascular disease: risk ratio, 1.9 ($p = 0.0001$) Other: risk ratio, 1.9 ($p = 0.0001$) Hypertension/tubulointerstitial disease, chronic glomerulonephritis/adult polycystic kidney disease: risk ratio, 1.0 Age groups: ≤ 40 years: risk ratio, 0.31 ($p = 0.0001$) 41–60 years: risk ratio, 0.64 ($p = 0.0002$) ≥ 61 years: risk ratio, 1.0	

continued

Mortality/survival *contd*

Study	Results	Notes
Mailloux *et al*., 1996[24]	• Results of Cox hazard analyses with time-dependent co-variates *contd*: Race: White: risk ratio, 1.38 (p = 0.0365) Black/other: risk ratio, 1.0 Dialysis modality: Ever on home dialysis: risk ratio, 0.49 (p = 0.0071) Ever on in-centre peritoneal dialysis: risk ratio, 3.18 (p = 0.0001) Ever switching: risk ratio, 1.549 (p = 0.0345) Never switching: risk ratio, 1.0 Ever on in-centre haemodialysis/CAPD: risk ratio, 1.0 Risk factors present at the initiation of maintenance dialysis: Hypertension: risk ratio, 1.465 (p = 0.0017) Pre-existing cardiac disease: risk ratio, 1.461 (p = 0.0031) Low serum albumin: risk ratio, 1.64 (p = 0.0001)	
Price *et al*., 1978[26]	50% survival time: Home dialysis (n = 93): 5 years, 8 months In-centre dialysis (n = 166): 7 years, 1 month	
Rubin *et al*., 1989[28]	• Mortality/survival Dialysis-related deaths: Home dialysis: early, n = 10; late, n = 10 Free-standing facility: n = 26 Non-dialysis-related deaths: Home dialysis: early, n = 1; late, n = 0 Free-standing facility: n = 0 Percentage died: Home dialysis: early, 14%; late, 18% Free-standing facility: 23% Length of treatment: Home dialysis (n = 150): median length of treatment, 4030 days Free-standing facility (n = 954): median length of treatment, 3600 days • Results of Cox hazard analyses: Age by 20-year difference: relative risk, 117% (p = 0.001) Race (white versus black): relative risk, 98% (p not significant) Sex (women versus men): relative risk, 97% (p not significant) Marital status (single versus married): relative risk, 100% (p not significant) Joint effects of treatment: Dialysis in a free-standing facility versus home haemodialysis: relative risk, 139% (p = 0.003) Joint effects of aetiology: Chronic glomerulonephritis versus hypertension: relative risk, 76% (p = 0.002) Chronic interstitial nephritis versus hypertension: relative risk, 59% (p = 0.0003) Chronic interstitial nephritis versus diabetes mellitus type 2: relative risk, 62% (p = 0.009)	Early/late: started into home therapy within 180 days or > 180 days after initiation of dialysis, respectively

continued

Mortality/survival *contd*

Study	Results	Notes
Williams *et al.*, 1983[32]	• Results of survival analyses: Treatment modality home dialysis: Variable, age: mean (SD), 51.31 (15.31); coefficient, 0.0121; standard error, 0.0026; coefficient/standard error, 4.72; correlation matrix (age 1.000) Variable, treatment: coefficient, –0.4615; standard error, 0.1176; coefficient/standard error, –3.92; correlation matrix (age, 0.054; treatment, 1.000) Variable, age x treatment: coefficient, 0.0068; standard error, 0.0087; coefficient/standard error, 0.78; correlation matrix (age, –0.293; treatment, 0.216; age x treatment, 1.000)	
Woods *et al.*, 1996[33]	• Mortality By 1500 days: Home dialysis: 16 patients (23%) had died In-centre: 1644 patients (53%) had died • Results of Cox hazard analyses: Home haemodialysis training at Day 30: relative risk, 0.58* ($p = 0.03$) Age (for each additional 10 years): relative risk, 1.40 ($p < 0.001$) Arrhythmia: relative risk, 1.10† ($p = 0.1$) Active insulin therapy: relative risk, 1.30† ($p < 0.001$) COPD: relative risk, 1.18† ($p = 0.03$) Congestive heart failure: relative risk, 1.20† ($p = 0.001$) Myocardial infarction: relative risk, 1.42† ($p < 0.001$) Peripheral vascular disease: relative risk, 1.14† ($p = 0.03$) Active smoker: relative risk, 1.21† ($p < 0.01$) Less than 12 years of education: relative risk, 0.96† ($p = 0.49$) Obese: relative risk, 0.81† ($p < 0.01$) Prescribed Kt/V (per 0.4 increase): relative risk, 1.00 ($p = 0.92$) Missing prescribed Kt/V: relative risk, 1.01 ($p = 0.80$) Serum albumin (per 0.2 g/dl increase): relative risk, 0.92 ($p < 0.001$) Stroke: relative risk, 1.27† ($p < 0.01$) Unable to eat independently: relative risk, 1.22† ($p = 0.19$) Unable to transfer independently: relative risk, 1.15† ($p = 0.21$) Unable to walk independently: relative risk, 1.15† ($p = 0.22$)	* Relative to reference group of in-centre haemodialysis patients † Relative to reference group of all patients without this factor

Appendix 13

Characteristics of included economic evaluations published since 1990

This appendix includes information taken directly from the included studies, therefore the term 'in-centre haemodialysis' has been retained, whereas in the main text of the report, 'in-centre' was changed to 'hospital'.

Study	Study characteristics	Treatment groups	Other characteristics and follow-up	Results	Authors' conclusions
Arkouche *et al.*, 1999[16]	Retrospective but highly controlled patient level analysis of survival benefits of out-centre (home or self-care/ satellite) haemodialysis versus hospital dialysis. Cost data cited from another study	Out-centre (home and self-care/satellite) versus hospital dialysis 471 patients were followed for the survival analysis	Survival analysis controlled for age, cause of ESRD, age at start of haemodialysis, time of start of haemodialysis and modality of haemodialysis. The survival analysis followed patients for up to 20 years, but the cost information was on a per-treatment-year basis for 1994	• Survival benefits were found for out-centre versus hospital haemodialysis. No survival differences for home versus self-care haemodialysis were found. Cost per treatment year was estimated at US$80,000 for hospital, US$50,000 for self-care, and US$42,000 for home and CAPD	• Lower cost of out-centre haemodialysis and greater survival benefits lead to dominance. Despite lack of survival benefit and greater cost of self-care versus home dialysis, authors were highly enthusiastic about self-care haemodialysis
de Wit *et al.*, 1998[42]	Cost-effectiveness and cost–utility analysis of various treatments using a Markov model over 5 years	Satellite (including home dialysis patients), hospital, CAPD, and continuous cycling peritoneal dialysis	Data are provided on the patients' age, sex, number of co-morbidities, months on dialysis and QoL scores by treatment modality. Cost-effectiveness data were gathered from 1993 to 1996. Cost data are in 1996 Dutch guilders	• Hospital haemodialysis was the least cost-effective, with higher costs and lower QoL. Home dialysis was most cost-effective, and satellite was next	• Home or satellite dialysis both offer substantial advantages over hospital dialysis in terms of costs and outcomes
Goeree *et al.*, 1995[44]	Cost-minimisation study in Canada. Results are in 1993 Canadian dollars	Hospital haemodialysis, self-care haemodialysis (satellite facility with 16 stations), CAPD and home haemodialysis	Assumes no differences in survival and does not consider QoL. Provides a detailed description of the sites and breaks out costs by various components	• Hospital haemodialysis: Can$88,585 • Self-care haemodialysis: Can$55,593 • CAPD: Can$44,790 • Home haemodialysis: Can$32,570 • Age, sex, renal disease, heart disease and diabetes had no effect on the variable cost of modality treatment. • Nutritional status was the only predictor of variable costs of treatment	• Concern that allocation to treatment is non-random, despite lack of statistical findings of differences. • Breakout of costs by various components to enable calculation of costs for similar programmes and identification of target areas for cost reductions

continued

Study	Study characteristics	Treatment groups	Other characteristics and follow-up	Results	Authors' conclusions
Kooistra *et al.*, 1998,[51] and Kooistra & Vos, 1999[50]	Uncontrolled observational study to assess benefits and costs of home haemodialysis daily versus 3 times per week	Home haemodialysis daily versus 3 times per week. The weekly dose was held constant	The focus was on clinical outcomes and QoL measured by the Nottingham Health Profile and SF-36. Cost implications of possible reductions in hospitalisations were not considered	• Clincal outcomes and QoL were better under daily dialysis • Treatment costs were no greater than in-hospital haemodialysis	• Short daily home haemodialysis leads to improvements in health outcomes, with no increase in cost relative to conventional hospital haemodialysis
Lim *et al.*, 1999[52]	Cost-effectiveness study of the Malaysian dialysis programme	Home and hospital haemodialysis, and CAPD and intermittent peritoneal dialysis	Costs in 1996 ringgit Malaysia	• Hospital dialysis had the lowest average cost per life-year saved	• Use of hospital (in-centre) haemodialysis is justified, given the results
Mackenzie & Mactier, 1998[54]	Assessment of costs and outcomes for dialysis patients at UK hospital	Primarily home and hospital dialysis, though survival and transition probabilities for transplant and death were also provided	Cites various evidence showing greater survival for home dialysis versus hospital dialysis, controlling for a number of patient characteristics. Also provided data on hospital admissions for home dialysis patients. Used facility data from 1994 to 1995 to look at annual cost of home versus hospital haemodialysis (but did not include costs of patient admissions for complications or other related treatments)	• Annual cost of home dialysis was less than hospital dialysis (£13,577 versus £15,470) • Initially higher costs of home dialysis were offset within 14.2-month payback period (which may be less than the waiting period for a transplant)	• Decline in use of home dialysis was largely attributable to increasing case complexity and increasing availability of CAPD and hospital haemodialysis • Adequacy of CAPD and high cost of hospital dialysis increase attractiveness of home dialysis for suitable patients
Mohr *et al.*, 2001[12]	Systematic review of the literature on daily haemodialysis and economic model of the impact of daily dialysis on costs	Short daily home haemodialysis, short daily in-centre haemodialysis, nocturnal slow haemo-dialysis, and thrice-weekly in-centre dialysis	The focus was on direct healthcare costs from the societal perspective	• Review of the literature showed substantial evidence of improvements in clinical measures and QoL • Three forms of daily dialysis were all less costly than conventional thrice-weekly dialysis, though there was considerable uncertainty about the estimates • Most of the cost reductions came from reductions in hospital use due to improve-ments in clinical outcomes	• The authors recommended changes in reimbursement provisions under the Medicare programme to increase the use of daily dialysis or a demonstration to more fully document benefits and cost reductions

continued

Study	Study characteristics	Treatment groups	Other characteristics and follow-up	Results	Authors' conclusions
Peeters *et al.*, 2000[43]	Systematic review of 25 economic evaluations in western European countries since 1990	Hospital, self-care (satellite facility), CAPD, automated peritoneal dialysis and home haemodialysis. Also considered frequency of dialysis. If costs per session were given, they considered 3 sessions per week for in-centre dialysis and daily sessions for home haemodialysis	The focus was on service costs and costs of morbidity associated with treatment (i.e. complications). The authors did not consider production losses or cost of illness, and did not assess discounting because most studies pertained to costs in 1 year	• Only 4 out of 25 studies met the criteria for high-quality costing • Some of the variation in cost may be due to different perspectives • Home haemodialysis was uniformly less costly than hospital dialysis • When assessed, self-care or satellite centre cost was between the costs of home and hospital haemodialysis	• Reimbursement provisions play a substantial role in the degree of use of the various forms of dialysis
Pierratos *et al.*, 2000[55]	Assessment of costs and outcomes of daily haemodialysis	Hospital haemodialysis, short daily in-centre haemodialysis, short daily home haemodialysis and slow nocturnal home haemodialysis	Provides a non-systematic review of the literature	• Outcomes better from daily haemodialysis • Cost of daily dialysis is obviously higher than less frequent treatment, but overall costs may be lower	• Advantages from short daily or nocturnal haemodialysis could lead to a resurgence of home treatment
Ting *et al.*, 1999[45]	Prospective controlled pre–post study to assess benefits and costs of home haemodialysis daily versus 3 times per week	Daily versus 3 times per week haemodialysis	Selection criteria included medical needs, general well-being and desire to improve dialysis schedule 22 patients were selected; 7 patients ultimately died, 2 were transplanted, and 2 discontinued for other medical reasons	• Improvements were found in clinical measures and QoL measured by the KDQOL questionnaire • Annual costs were reduced, though the difference was not statistically significant	• Daily haemodialysis improved clinical outcomes and QoL • Some indications of potential for reductions in costs • Daily treatment is not likely to be widely used until financial disincentives are removed
Traeger *et al.*, 2001[56]	Observational study of 15 patients switched from standard haemodialysis to short daily haemodialysis	Standard versus short daily haemodialysis, but keeping the weekly dose constant and allowing an increase in the weekly dose	A number of clinical measures were observed regarding the patients both before and after the initiation of short daily haemodialysis, and under different levels of weekly dose. The analysis did not consider the implications of changes in treatment-associated costs (e.g. hospitalisations)	• Short daily haemodialysis led to improvements in clinical outcomes and QoL • Treatment costs of short daily haemodialysis were observed to be greater than those of conventional home dialysis but less than hospital haemodialysis	• Daily haemodialysis improves outcomes and reduces costs • The gains appear to be due to frequency rather than increases in weekly dose

Appendix 14

Quality assessment of included economic evaluations published since 1990*

Study	Checklist items (listed below)													
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Arkouche *et al.*, 1999[16]	Yes	Yes	Yes	Yes	Yes	NC	Yes	Yes	Yes	NA	Yes	NA	NA	Yes
Croxson & Ashton, 1990[47]	Yes	Yes	Yes	Yes	NC	Yes	Yes	Yes	No	No	Yes	NA	NA	Yes
de Wit, 1998[42]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NA	Yes	Yes	Yes	NA
Goeree *et al.*, 1995[44]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NA	NC	Yes	NA	NA	Yes
Kooistra *et al.*, 1998[51] Kooistra & Vos, 1999[50]	Yes	Yes	No	Yes	Yes	No	No	Yes	Yes	NA	No	Yes	Yes	NA
Lim *et al.*, 1999[52]	Yes	Yes	Yes	Yes	NC	Yes	NC	Yes	Yes	NA	Yes	NA	NA	NA
Mackenzie & Mactier, 1998[54]	Yes	Yes	No	Yes	Yes	No	NA	Yes	NA	Yes	No	NA	NA	NA
Mohr *et al.*, 2001[12]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NA	Yes	NC	Yes	Yes	NA
Peeters *et al.*, 2000[43]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NA	NA	NA	NA	NA	NA	Yes
Pierratos, 2000[55]	NC	Yes	No	Yes	Yes	No	No	Yes	No	Yes	No	No	NA	NA
Ting *et al.*, 1999[45]	Yes	Yes	No	Yes	Yes	No	No	Yes	Yes	NA	No	Yes	Yes	NA
Traeger *et al.*, 2001[56]	Yes	Yes	No	Yes	Yes	No	NA	Yes	Yes	NA	No	Yes	Yes	No
	15	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**
Arkouche *et al.*, 1999[16]	Yes	No	No	Yes	No	No	No	Yes	No	NA	No	No	No	NA
Croxson & Ashton, 1990[47]	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NA	NA	NA	NA
de Wit, 1998[42]	NA	No	No	Yes	Yes	Yes	Yes	Yes	No	NA	No	No	Yes	Yes
Goeree *et al.*, 1995[44]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	NA	No	NA	NA	NA
Kooistra *et al.*, 1998[51] Kooistra & Vos, 1999[50]	NA	No	No	No	No	NA	No	No	No	No	No	No	NA	NA
Lim *et al.*, 1999[52]	No	No	No	No	No	No	NA	No	Yes	Yes	NA	No	Yes	Yes
Mackenzie & Mactier, 1998[54]	NA	Yes	No	No	NA	No	NA	No	No	No	NA	No	NA	NA
Mohr *et al.*, 2001[12]	Yes	Yes	No	No	Yes	Yes	Yes	No	No	No	NA	Yes	Yes	Yes
Peeters *et al.*, 2000[43]	Yes	No	No	Yes	Yes	NA	NA	Yes	NC	NC	NC	No	NA	NA
Pierratos, 2000[55]	NA	No	No	No	No	No	No	No	No	No	No	No	No	No
Ting *et al.*, 1999[45]	NA	Yes	NC	Yes	No	NA	NA	Yes	No	No	No	Yes	No	No
Traeger *et al.*, 2001[56]	NA	No	No	No	No	NA	NA	No	No	No	No	No	No	No

continued

Study	Checklist items (listed below)						
	29	30	31	32	33	34	35
Arkouche *et al.*, 1999[16]	NA	Yes	NA	NA	Yes	Yes	Yes
Croxson & Ashton, 1990[47]	NA	Yes	NA	Yes	Yes	Yes	Yes
de Wit, 1998[42]	Yes	Yes	NA	Yes	Yes	Yes	Yes
Goeree *et al.*, 1995[44]	NA	Yes	NA	Yes	Yes	Yes	Yes
Kooistra *et al.*, 1998[51] Kooistra & Vos, 1999[50]	NA	Yes	NA	No	Yes	NC	Yes
Lim *et al.*, 1999[52]	No	Yes	NA	Yes	Yes	NC	Yes
Mackenzie & Mactier, 1998[54]	NA	Yes	NA	Yes	Yes	Yes	Yes
Mohr *et al.*, 2001[12]	Yes	Yes	No	Yes	Yes	Yes	Yes
Peeters *et al.*, 2000[43]	NA	Yes	NA	No	Yes	Yes	Yes
Pierratos, 2000[55]	No	Yes	No	No	Yes	Yes	Yes
Ting *et al.*, 1999[45]	NA	Yes	No	No	Yes	Yes	Yes
Traeger *et al.*, 2001[56]	No	Yes	No	No	Yes	NC	Yes

* *Based on the 35 points from the* BMJ *guidelines. Responses to each question can be yes, no, not clear (NC) or not applicable (NA)*

BMJ *checklist*

1. *Research question stated*
2. *Importance of question stated*
3. *Viewpoint of analysis stated and defined*
4. *Rationale for choosing alternative programmes or interventions compared stated*
5. *Alternatives being compared clearly defined*
6. *Form of economic evaluation used stated*
7. *Choice of form of economic evaluation justified in relation to question addressed*
8. *Source(s) of effectiveness estimates stated*
9. *Details of design and results of effectiveness study given (if based on single study)*
10. *Details of methods of synthesis or meta-analysis of estimates given (if based on overview of a number of effectiveness studies)*
11. *Primary outcome measure(s) for economic evaluation clearly stated*
12. *Methods to value health states and other benefits stated*
13. *Details of subjects from whom valuations were obtained given*
14. *Productivity changes (if included) reported separately*
15. *Relevance of productivity changes to study question discussed*
16. *Quantities of resources reported separately from their unit costs*
17. *Methods for estimation of quantities and unit costs described*
18. *Currency and price data recorded*
19. *Details of currency and price adjustments for inflation or currency conversion given*
20. *Details of any model used*
21. *Choice of model used and key parameters on which it is based justified*
22. *Time horizon of costs and benefits stated*
23. *Discount rate(s) stated*
24. *Choice of rate(s) justified*
25. *Explanation given if costs and benefits are not discounted*
26. *Details of statistical tests and CI given for stochastic data*
27. *Approach to sensitivity analysis given*
28. *Choice of variable for sensitivity analysis justified*
29. *Ranges of which variables are varied stated*
30. *Relevant alternatives compared*
31. *Incremental analysis reported*
32. *Major outcomes presented in an aggregated as well as a disaggregated form*
33. *Answer to study question given*
34. *Conclusions follow from data reported*
35. *Conclusions accompanied by appropriate caveats*

Appendix 15

Transition probability matrices for base case analysis (people without diabetes aged under 50 years)

Year	Markov model transition probabilities					
	HspH	**SatH**	**HomH**	**CAPD**	**Transplant**	**Death**
Year 1						
HspH	0.78*	0	0	0.06	0.03	0.13†
SatH	0	0.78*	0	0.06	0.03	0.13†
HomH	0	0	0.85*	0.06	0.03	0.06†
CAPD	0	0	0	1	0	0
Transplant	0	0	0	0	1	0
Death	0	0	0	0	0	1
Year 2						
HspH	0.78*	0	0	0.06	0.03	0.13†
SatH	0	0.78*	0	0.06	0.03	0.13†
HomH	0	0	0.83*	0.06	0.03	0.08†
CAPD	0	0	0	1	0	0
Transplant	0	0	0	0	1	0
Death	0	0	0	0	0	1
Year 3						
HspH	0.81*	0	0	0.06	0.03	0.10†
SatH	0	0.81*	0	0.06	0.03	0.10†
HomH	0	0	0.80*	0.06	0.03	0.11†
CAPD	0	0	0	1	0	0
Transplant	0	0	0	0	1	0
Death	0	0	0	0	0	1
Year 4						
HspH	0.84*	0	0	0.06	0.03	0.07†
SatH	0	0.84*	0	0.06	0.03	0.07†
HomH	0	0	0.80*	0.06	0.03	0.11†
CAPD	0	0	0	1	0	0
Transplant	0	0	0	0	1	0
Death	0	0	0	0	0	1
Year 5						
HspH	0.89*	0	0	0.06	0.03	0.02†
SatH	0	0.89*	0	0.06	0.03	0.02†
HomH	0	0	0.91*	0.06	0.03	0.00†
CAPD	0	0	0	1	0	0
Transplant	0	0	0	0	1	0
Death	0	0	0	0	0	1

* *Calculations based on the requirement that the added probabilities of the row in the matrix must equal 1*
† *Mortality rates obtained from Hellerstedt* et al.[22]

Appendix 16

Estimation of time commitment of carers and patients receiving different modalities of haemodialysis

Data from the EURODICE study were used to estimate the time commitment of both patients and carers. In the EURODICE study, data were collected on the time spent by hospital haemodialysis patients travelling to the dialysis unit, time spent at the unit but not actually on dialysis, and time on dialysis. It was assumed that the time commitment would be the same for a patient receiving satellite haemodialysis and that the carer would not be required to assist with dialysis sessions. For people receiving home haemodialysis, time would not be committed to travelling or waiting, but time would be required to set up and tidy away following a session. Based on advice from local nephrologists, it was assumed that a patient might spend 1.5 hours per session setting up and tidying away. It was further assumed that a carer would also need to spend the same length of time to do this. A carer would also need to be on hand to deal with any problems during the dialysis session and, although they may be able to carry out other activities during the dialysis session, it has been assumed that this time is devoted to providing care. The only exception to this is for nocturnal home haemodialysis – it has been assumed, because the patient is asleep, that the carer's time during the duration of dialysis is not devoted to caring. The data required to estimate the time commitments of patients and carers for a single week are reported in the table below, along with the estimate of total time per week devoted to the provision of dialysis.

	Patient's time commitments for different modalities of haemodialysis					Carer's time commitment for different modalities of haemodialysis				
	Home	**Nocturnal home**	**Short daily home**	**Satellite**	**Hospital**	**Home**	**Nocturnal home**	**Short daily home**	**Satellite**	**Hospital**
Travelling to sessions (hours)	0.00	0.00	0.00	1.20	1.20	0.00	0.00	0.00	0.00	0.00
Waiting in unit (hours)	0.00	0.00	0.00	1.07	1.07	0.00	0.00	0.00	0.00	0.00
On dialysis (hours)	4.50	7.00	2.00	4.50	4.50	4.50	0.00	2.00	0.00	0.00
Cleaning (hours)	1.50	1.50	1.50	0.00	0.00	1.50	1.50	1.50	0.00	0.00
Number of sessions per week	3.00	6.00	6.00	3.00	3.00	3.00	6.00	6.00	3.00	3.00
Estimated time per week (hours)	**18.00**	**51.00**	**21.00**	**20.31**	**20.31**	**18.00**	**9.00**	**21.00**	**0.00**	**0.00**

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