

Peritoneal dialysis versus haemodialysis (adult)

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GUIDELINES

No recommendations possible based on Level I or II evidence

SUGGESTIONS FOR CLINICAL CARE

(Suggestions are based on Level III and IV evidence)

- Treatment starting with peritoneal dialysis (PD) may lead to more favourable survival in the first 1–2 years compared to starting treatment with haemodialysis (HD) (Level II evidence, small RCT).
- Peritoneal dialysis compared with conventional HD is associated with equivalent or better survival in the first few years, especially with respect to residual renal function (RRF) (Level III evidence)
- With loss of RRF, PD may lead to worse outcomes than HD (Level III evidence)
- Haemodialysis is associated with improved long-term survival (Level III evidence)
- A timely transfer from PD to HD may improve patient survival (Level IV evidence)
- Renal programs should include an integrated PD/HD program where therapies are not competitive but rather complementary (Opinion)
- Survival according to modality should be considered in the context of life quality as perceived by the patient when they are choosing HD or PD as initial therapy (Opinion)

IMPLEMENTATION AND AUDIT

Routine reporting and audit through the Australian and New Zealand Dialysis and Transplant Association Registry (ANZDATA).

BACKGROUND

The objective of this guideline is to provide a summary of the evidence surrounding patient mortality according to modality – HD and PD – and to guide clinicians and patients with initial dialysis modality choice.

It is well acknowledged that kidney transplantation is the renal replacement therapy of choice for improved patient survival in kidney disease. However, with growth in the incidence and prevalence of kidney disease and a shortage of donor organs, more patients are remaining on dialysis for a longer term. Thus, there is sustained interest as to which dialytic therapy improves patient survival in the short and

long term. Many early studies have led to conflicting results – most demonstrating that HD results in improved survival compared with PD.^{1,2} But with recent improvements in PD therapy and specifically, better preservation of residual kidney function, studies comparing HD and PD have demonstrated either equivalence, or that PD extends initial survival, especially in particular patient subgroups.^{3–6} Attention to specific subgroups such as those patients who are older and have diabetes are extremely relevant to contemporary populations where diabetes is the leading cause of kidney disease and the mean patient age is increasing.

With issues of feasibility around randomized controlled trials on this subject, the body of evidence studied is mostly generated from registry data analyses from the United States, Canada and the Netherlands, along with a few larger cohort studies from Europe, the United Kingdom, Canada and the United States.

SEARCH STRATEGY

Databases searched: MeSH terms and text words for renal replacement therapy, haemodialysis and peritoneal dialysis were combined with MeSH terms and text words for decision-making. The search was carried out in Medline (1950–January, Week 1, 2008). The Cochrane Central Register of Controlled Trials (CENTRAL) was also searched for clinical trials not indexed in Medline.

Date of search: 16 January 2008.

WHAT IS THE EVIDENCE?

Randomized controlled trial

A randomized controlled trial was performed by multiple centres in the Netherlands with only 38 patients recruited.⁷ Eighteen patients were randomized to receive in-centre HD and 20 to receive continuous ambulatory peritoneal dialysis. The results were adjusted for age, comorbidity and primary kidney disease, with a 5-year follow up. The primary outcome was mean quality-adjusted life-year score (QALY), secondary outcome and survival.

The results suggested that after adjustment for age, comorbidity score and primary kidney disease, despite only a small difference in the QALY score between patients

starting either treatment, that starting with PD leads to more favourable survival in the first 4 years when compared with commencing with HD. The hazard ratio was 3.6 (95% CI: 0.8–15.4). However, when the results were adjusted for modality changes, the PD survival benefit became less apparent.

Limitations: The study was significantly underpowered, had baseline population differences and allowed for modality switching (1 patient meant to have HD started with PD and 3 meant to have PD started with HD). The trial was stopped prematurely due to poor recruitment numbers. At least 100 patients were needed to provide statistical power.

Cohort studies

Single centre

Timely transfer of peritoneal dialysis patients to haemodialysis improves survival rates. Panagoutsos *et al.*⁸ conducted a study that retrospectively analysed data from patients who had started dialysis during the past 10 years in a single Division of Nephrology in Greece. A total of 299 patients were included in the analysis and 5-year survival rates calculated, with adjustment for age, gender, common comorbidities and serum albumin. Three groups of patients were compared – those commencing on HD, those commencing on PD and those transferring from PD to HD. Dialysis dose and serum albumin were compared between groups with no significant differences identified.

The results of this small, single-centre study identified two clear survival curve phases – RRF gives PD an advantage in the first phase and in the second phase a loss of RRF and reduction in Kt/V increases the mortality risk for PD patients. This study also demonstrated that patients commenced on PD with a timely transfer to HD had greater survival rates than those remaining on PD; however, survival was not different from that of the HD group. Reasons for PD to HD transfer included peritonitis, poor ultrafiltration and sclerosis.

Limitations: This study was only a single-centre analysis of retrospective data and could be subject to selection bias.

Clinical outcomes and quality of life in elderly patients on PD versus HD. Harris *et al.*⁹ ran a prospective, cohort study of 174 new dialysis patients from four hospital-based renal units in London, specifically looking at an elderly cohort of 70 years and above and comparing modality outcomes. This ‘new’ patient cohort was compared with a prevalent patient cohort during the study period of 12 months. There were no significant differences in comorbidity between the PD and HD groups in new and prevalent patients. The results demonstrated no effect of modality on 12-month survival after controlling for potential confounding factors such as patient comorbidity and included analysis of dialysis adequacy.

Limitations: This was an observational cohort study of a single centre with small numbers that cannot be interpreted without considering selection bias and generalizability. Thirty per cent of the dialysis population elected not to take part in the study, which could represent a participation bias and there was only a 12-month follow up. Although this

study made adjustments for patient comorbid factors, the analysis did not examine specific diseases or their severity.

Survival on haemodialysis and peritoneal dialysis over 12 years with emphasis on nutritional parameters. Avram *et al.*² performed a study enrolling 959 patients on HD and PD, commencing dialysis at a single centre in the United States from 1987 to 1999, to compare modality survival. This was a retrospective analysis of medical records. The cumulative survival over 12 years was significantly higher in HD patients. This study demonstrated a 44% lower mortality risk for patients on HD compared with PD.

Limitations: There were limited data on dialysis adequacy as PD adequacy was not routinely measured in the United States before 1992. A selection bias, once again, may have influenced the outcomes. There was no data adjustment for comorbid conditions other than diabetes and AIDS.

Multicentre

Comparative mortality of haemodialysis and peritoneal dialysis patients in Canada. Murphy *et al.*¹⁰ performed a prospective cohort study analysing mortality data from 822 consecutive patients commencing dialysis in 11 Canadian centres between March 1993 and November 1994. Extensive comorbidity data were collected prior to patient commencement. Average follow up was 24 months. The PD and HD patient groups differed considerably at baseline with respect to age, haemoglobin (Hb), albumin and comorbidity score (significantly higher in the HD group). Data were also obtained regarding acuity of onset of renal failure (majority in HD cohort) and severity of disease.

When the mortality data for both groups were adjusted for comorbidity, survival for both groups was similar. The study group concluded that the apparent initial survival advantage of PD in other studies could be due to lower comorbidity and lower incidence of acute start in PD cohorts. This study demonstrated that when comorbidity and acute start were adjusted for in the final analysis, a survival advantage for either modality was not apparent.

Limitations: Once again, due to the observational nature of this study, a modality selection bias needs to be considered in the final interpretation of results. The study follow up was only for 24 months and during the years of 1993 and 1994 before any recent advances in PD technology. Dialysis adequacy data were not collected on either group for comparison.

Haemodialysis and peritoneal dialysis: comparison of adjusted mortality rates according to the duration of dialysis (NECOSAD). The NECOSAD study performed by Termorshuizen *et al.*⁶ was a large multicentre, prospective, observational cohort study observing 1222 new patients commencing dialysis over a 4-year period in the Netherlands. Data were collected on RRF, primary renal disease, comorbidities, dialysis efficiency, nutritional status, Hb and albumin at dialysis commencement and stages throughout the study period of 4 years.

Subgroups were analysed according to age, gender, diabetes and cardiovascular disease (CVD). On average, the

HD cohort was older, had more comorbid conditions, lower Hb and poorer RRF. No significant difference in serum albumin was found. Unadjusted mortality rates were significantly greater in the HD group, particularly in the first 12 months after commencing dialysis and stayed relatively stable up until the fourth year of observation. The PD group experienced time-related increase in mortality over the 4 years. There were no substantial differences in the intent-to-treat or as-treated analyses. After adjustment, the relative risk (RR) of death for HD compared with PD patients was not statistically significant up until 12 months, but did show a PD advantage. However, a RR disadvantage with PD was discovered after 2 years of follow up.

Subgroup analysis: For patients aged <60 years without diabetes, there was no difference in survival between PD and HD during the 4-year follow up. For the younger cohort with diabetes, there was a statistically higher mortality rate for HD patients in the first 2 years. Regardless of diabetic status, the 2–4 year analysis presented a survival advantage in favour of HD. This HD survival advantage in the 2- to 4-year analysis was demonstrated for all patients >60 years regardless of gender, diabetic status or CVD status.

Conclusion: Long-term use of PD, especially in the elderly, is associated with an increase in mortality. Further studies are needed to explore the possible survival benefit in those PD patients making a timely switch to HD therapy.

Limitations: Possible selection bias given in the study is observational in nature. The contribution of dialysis adequacy was not analysed in terms of PD or HD survival.

Comparing the risk for death with peritoneal dialysis and haemodialysis in a national cohort of patients with chronic kidney disease (CHOICE). The CHOICE study performed by Jaar *et al.*¹¹ studied 1041 patients on HD and PD from 81 dialysis clinics in the United States. They were prospectively studied for up to 7 years after commencement. Data were gathered on coexisting diseases and disease severity along with age, sex, ethnicity, serum albumin, Hb, C-reactive protein, residual urine output and BMI. After adjustment, the risk of death did not differ between HD and PD patients undergoing treatment for the first 12 months. However, after the second year, the mortality risk was significantly higher in the PD group. This study did not find an increased risk of death with PD for diabetic or elderly patients; however, there was a somewhat greater risk of death for some groups on PD if the patient had a history of CVD (not statistically significant in all subgroups).

Limitations: Measured dialysis adequacy was not available for all patients to make a comparison between modalities and possibly associate with survival. A selection bias could influence results due to the observational nature of this study. This study allowed for modality switching without analysis of the reasons and the survival outcome.

Registry data studies

Registry data analysis from the USA, the Netherlands, Canada, Italy and Denmark is included here.

Haemodialysis versus peritoneal dialysis: comparison of adjusted mortality rates

Canadian Organ Replacement Register data analysis by Fenton *et al.*⁵ studied 11 970 patients with stage 5 kidney disease commencing treatment in Canada from 1990 until 1994 with up to 5 years of follow up. Deaths were allocated to the treatment the patient was receiving at the time of their death. Data were adjusted for age, primary renal disease, centre size and predialysis comorbidities.

Results indicated that the mortality risk for patients commencing treatment with PD was 73% that of those commencing with HD when adjusting for various prognostic factors; however, this became less pronounced when various subgroups were teased out (especially for those with diabetes and over the age of 65 years). The mortality rate for those on PD tended to increase over time while the HD survival was represented by a U shape.

Limitations: This study did not adjust registry data for the impact of dialysis adequacy, nutritional status, patient compliance, comorbidity severity and the effect of late referral on patient mortality.

Mortality in end-stage kidney disease

United States Renal Data System (USRDS) registry data analysis. This registry data study by Vonesh and Moran³ extracted mortality data on nearly 204 000 patients from the USRDS for incident and prevalent patients over a 7-year period from 1987 to 1993.

The results showed significant variations in mortality rates according to specific cohorts studied such as age, diabetes and gender. Importantly, there were no statistically significant differences in the adjusted death rates among non-diabetic PD and HD patients across age, gender or race. However, for patients with diabetes there was a significantly increased mortality risk on PD *versus* HD if the patient was aged over 50 years. This risk was also more pronounced in females compared with males, which appears to be the first significant gender-by-treatment interaction identified. For patients under 50 years, a significantly lower mortality rate was found when treated with PD *versus* HD.

Limitations: This is a large study with significant power, making it quite easy to identify statistically significant population differences. When applied in the clinical context, these statistical differences may not be clinically relevant. The study was not adjusted for differences in comorbidity, disease severity, dialysis adequacy or patient nutritional status.

Initial survival advantage of peritoneal dialysis relative to haemodialysis

This registry data study by Heaf *et al.*¹² retrieved records from 4921 patients commencing dialysis between 1990 and 1999. The authors adjusted for age, sex and primary renal disease. The results described a substantial advantage of PD over HD during the first 1–2 years of dialysis, after which

results are approximately similar. The difference was less marked for older patients and those with diabetes, but this study found no subgroup where treatment with PD had a statistically significant detrimental effect.

Limitations: Due to the use of observational registry data, one cannot exclude a modality selection bias.

Comparison of haemodialysis and peritoneal dialysis survival in the Netherlands

This study was carried out by Liem *et al.*⁴ and looked at registry data from the Dutch End-Stage Renal Disease Registry (RENINE). A total of 16 643 patients were enrolled from 1 January 1987 to 31 December 2002 and adjusted for age, gender, primary renal disease, centre of dialysis and year of start.

The results demonstrated an initial survival advantage for PD therapy compared with HD therapy. However, over time with increasing age and the presence of diabetes as the cause of renal failure, the survival advantage diminished.

Limitations: The RENINE registry does not include data on patient comorbidity. The data were not adjusted for ethnicity, nutritional status or dialysis adequacy.

Registry data studies looking at specific patient subgroups

Survival and development of cardiovascular disease by modality of treatment in patients with end-stage kidney disease

Lombardy Dialysis and Transplant Registry data analysis by Locatelli *et al.*¹³ included 4191 patients commencing dialysis between 1 January 1994 and 31 December 1997. The Italian group wanted to look at both mortality depending on modality choice and the risk of developing *de novo* CVD. Relevant endpoints for this study included death, the development of ischaemic heart disease or chronic heart failure.

CVD was defined by either of the following conditions:

- coronary artery disease
- myocardial infarction, and
- congestive cardiac failure.

The results, when adjusted for age, gender and established CVD, did not show any survival differences between PD and HD. There was also no difference in the number of patients in either modality group who developed *de novo* CVD.

Limitations: This study was only a 3-year follow up, which may be too early to see cardiovascular changes. It is also observational, as all registry data are, meaning that there may be some modality selection bias. The definitions used for presence or absence of CVD in registry data are inconsistent.

Impact of dialysis modality on survival of new end-stage kidney disease patients with congestive heart failure in the United States

This study by Stack *et al.*¹⁴ evaluated national incidence data for 107 922 new patients from the Centre for Medi-

care and Medicaid Services Medical Evidence Form between 1 May 1995 and 31 July 1997 to see whether PD offered improved survival to HD for those patients with congestive heart failure (CHF). CHF was defined according to the medical evidence form and data were merged with the USRDS mortality and transplant data. Data were also adjusted for many comorbidities, including age, gender, cancer, peripheral vascular disease, body mass index and glomerular filtration rate, and were censored when patients switched modalities. Median patient follow up was for 12 months. The adjusted analysis of the total patient cohort demonstrated a lower risk of death for PD compared with HD for up to 12 months of follow up, equal survival for 12–18 months and higher risk of death after 18 months. When subgroup analysis was carried out, a significantly poorer survival for both non-diabetic and diabetic patients with CHF was found after 6 months if they commenced on PD therapy compared with HD. Non-diabetic patients without CHF had a 10% lower mortality risk if they commenced with PD than those commencing on HD.

Limitations: The same limitations apply to this study as all observational cohort studies based on registry data – possible selection bias, survival bias due to using prevalent cohorts and statistical bias that may ignore time-dependent effects of treatment modality on mortality. The cohort of patients was only studied for 2 years. There is also the possibility of errors in reporting of comorbidities when relying on the medical evidence form for patient characteristics. Data were not adjusted for nutritional indices or dialysis adequacy.

Mortality differences by dialysis modality with and without coronary artery disease

A national cohort of 107 922 incident patients were studied by Ganesh *et al.*¹⁵ from the US Medicare and Medicaid Services and linked to mortality data from the USRDS over 2 years. Patients were stratified according to the presence or absence of coronary artery disease (CAD) and presence or absence of diabetes. The results demonstrated that the RR of death comparing HD and PD varied significantly over time. The adjusted data analysis demonstrated a survival advantage for patients commencing with PD; however, this advantage was only noted in the first 6 months of dialysis. Subgroup analysis demonstrated that:

- those patients with diabetes and CAD treated with PD had a 23% higher RR of death compared with similar HD patients
- patients with CAD but not diabetes still had a 20% higher RR of death compared to HD, and
- non-diabetic patients without CAD had an early survival benefit on PD of up to 6 months and a late survival advantage in favour of HD.

To summarize, regardless of diabetic status, patients with CAD on PD had significantly poorer survival than those on HD.

Limitations: Due to the study's observational nature, there may have been selection bias towards one modality over the other. By using the Centre for Medicaid and Medicare Services data for the analysis, there may have been under-reporting of the population's comorbidities. No data was available on dialysis adequacy or patient nutritional status.

Critical review

There has been one critical review by Vonesh *et al.*¹⁶ of nine major mortality studies comparing PD and HD to investigate any trends in outcomes within selected subgroups of patients. Six large-scale registry studies and three prospective cohort studies were included in the analysis. The studies included originated from the USA, Canada, the Netherlands and Denmark. The differences in study results were attributed to the amount of case-mix adjustment made and the subgroup investigated. When these differences were accounted for, the critical review cited a remarkable degree of synergism in results.

Peritoneal dialysis was generally found to have equal, if not better, survival in younger diabetic and non-diabetic patients regardless of study origin; however, there were variations in results with the older diabetic population. Only in the United States was there shown to be a survival advantage for the older diabetic patient to choose HD therapy over PD. All studies demonstrated a time-dependent trend in the RR of death.

All studies associated PD with equivalent or better survival during the 2 years of dialysis.

SUMMARY OF THE EVIDENCE

Survival outcomes based on dialysis modality have been heavily researched internationally with the larger registry data-based studies dominating publications, most of which are from the United States and the Netherlands. It is important to review the more recent publications when assisting with patient modality choice as the survival trends of American patients on PD have shown double the improvement in survival rates when compared with HD survival improvement in the past few years. When analysing more recent patient populations with clearer dialysis adequacy targets, we are able to identify that PD therapy is at least equivalent to HD therapy overall, but when considering subgroups such as age, diabetes and CVD, survival differences do become apparent.

There has been one randomized controlled trial by Korevaar *et al.*⁷ in the Netherlands, which needs to be interpreted with caution. Only 38 patients were recruited to this trial, which ceased early due to a lack of participants. At least 100 patients were needed to provide statistical power. There was some modality switching given the ethical and logistical difficulties of running a randomized controlled trial in this area. However, there was a significant survival benefit to those commencing on PD at least in the 4-year follow up, which was consistent, although less prominent, even after adjustment for the modality switching.

The majority of the studies investigating mortality associated with modality are cohort or registry data studies. These publications do differ according to their criteria for inclusion; incident *versus* prevalent patient populations; intention-to-treat *versus* as-treated models; duration of follow up; varying adjustments for comorbidity number and severity; and subgroup analysis.

Despite these major study differences, a critical review of mortality studies comparing PD and HD has been performed by Vonesh *et al.*¹⁶ They adjusted for differences in case-mix population data between the studies and subgroups used and were able to identify some key conclusions:

- when comparing HD and PD as initial dialysis therapies, PD is associated with equal or improved survival among younger patients without diabetes
- the RR of death varied depending on the patient's time on the therapy – PD had an equal or lower mortality rate during the first 2 years but after this time it depended on subgroup analysis (diabetes, age and comorbidity), and
- a survival advantage for HD patients over 45 years with diabetes was observed in the United States but not in Canada or the Netherlands.

In the absence of properly conducted randomized controlled trials, Vonesh *et al.*¹⁶ suggests that a clearer picture of survival benefit according to modality is demonstrated when examining the large registry studies with extensive subgroup analyses.

Registry data studies such as that of Liem *et al.*⁴ analysed nearly 17 000 patients in the Netherlands, stratified for age and diabetic status. The survival advantage with PD was confined to those patients <50 years and without diabetes as the cause of their renal disease and disappeared with time (>15 months). In patients 50 years and older with diabetes, PD was associated with worse survival after 15 months, but there was no particular difference in survival between modalities in the first 14 months. Heaf *et al.*¹² also found that the survival advantage disappeared for those in older cohorts and with diabetes.

These results are also supported by Fenton *et al.*⁵ and Vonesh and Moran.³ The Fenton *et al.*⁵ Canadian group studied nearly 12 000 patients from their national database. A decreased mortality in the PD group was less pronounced among those with diabetes and over 65 years of age. The survival advantage in the PD group was also limited to the first 2 years after initiation. Vonesh and Moran also found PD patients under the age of 50 years to have a significantly lower risk of death than those treated with HD, whether or not they had diabetes.³

When observing patient cohorts with CHF, Stack *et al.*¹⁴ found that patients treated initially with PD had significantly higher adjusted mortality compared with HD after 6–24 months of follow up (RR 1.47 at 24 months). Similar to the previously mentioned studies, the patient cohort without CHF experienced lower mortality on PD for the first 6–12 months regardless of whether or not they had diabetes. Stack *et al.*¹⁴ did not stratify for age. Ganesh *et al.*¹⁵ also found those cohorts with CAD had worse survival on PD than HD, but an initial survival advantage if they did not have CAD. The patients with diabetes had significantly

poorer survival on PD compared with HD, regardless of coronary artery status. The results were not interpreted for age-related differences. The report by Locatelli *et al.*¹³ from Italy was the only registry data study of more than 4000 new patients that after stratifying for age, gender, established CVD and diabetes, and did not reveal any significant difference in survival comparing modalities at least until the follow-up period of 20 months post initiation.

Of particular interest is a retrospective cohort study performed by Panagoutsos *et al.*⁸ in a single centre with a 10-year follow up, which lends support to the concept of 'integrative care'; optimal outcomes are achieved by an initial 'career' in PD followed by a timely transfer to HD when PD-related morbidity increases. This concept sees PD and HD not as mutually exclusive therapies, but complementary to one another, a concept also supported by Blake¹⁷ and Alloatti *et al.*¹⁸ Panagoutsos *et al.*⁸ found that in their 300 patient cohort, those commencing on PD and then transferring to HD (when RRF deteriorated) had a better survival at 5 years than those who stayed on PD. Patients starting and remaining on HD had a similar 5-year survival to those changing modality.

When interpreting this study in the context of the previous studies, there is a survival benefit to commencing renal replacement therapy with PD, particularly if the patient is younger and has limited comorbidities. The survival benefit does disappear between 2–5 years, during which time the patient is either transplanted or discusses a timely change to HD. For the elderly patients with diabetes, or cardiac comorbidities, the survival benefit of commencing with PD therapy is less pronounced and varies according to country.

WHAT DO THE OTHER GUIDELINES SAY?

Kidney Disease Outcomes Quality Initiative: No recommendation.

UK Renal Association: No recommendation.

Canadian Society of Nephrology: No recommendation.

European Best Practice Guidelines: These guidelines state that the type of dialysis method that should be favoured as first therapy is unsettled at present. There will be debate regarding this issue until the concept of the 'integrative care approach' (starting renal replacement therapy with PD) gains more scientific merit.

International Guidelines: No recommendation.

SUGGESTIONS FOR FUTURE RESEARCH

More prospective cohort studies are required comparing home dialysis therapies (HD or PD) with hospital-based or satellite HD. A body of evidence is yet to emerge comparing mortality rates of home dialysis therapies – HD and PD, including nocturnal therapies.

CONFLICT OF INTEREST

Melissa Stanley has no relevant financial affiliations that would cause a conflict of interest according to the conflict of interest statement set down by CARI.

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APPENDIX

Table 1 Characteristics of included studies

Study ID (author, year)	Study design	No. of subjects	Outcome
Korevaar <i>et al.</i> 2003 ⁷	RCT	38	Modality mortality After 5 years of follow up, significant longer-term survival favouring PD Adjusted for age, comorbidity and primary kidney disease
Termorshuizen <i>et al.</i> 2003 ⁶	Multicentre prospective, observational cohort of incident patients	1222	Modality mortality Follow up until Tx or death (or 5 years) No statistical differences in mortality in first 2 years, then PD > HD. Subgroup analysis: Patients <60 with DM had increased RR on HD than PD in first 2 years RR for patients >60 higher on PD after 2 years (irrespective of DM status)
Liem <i>et al.</i> 2007 ⁴	Dutch End Stage Renal Disease Registry	16 600 from 47 centres	Modality mortality Not able to adjust for comorbidity Initial survival advantage for PD. Over time, with advancing age and in the presence of DM (as PRD) this survival reverses
Vonesh <i>et al.</i> 1999 ³	US registry data of incident & prevalent patients	203 958	Modality mortality Not adjusted to comorbidity RR (PD vs HD) 1.28 – DM > 50 years (sig.) 0.89 – DM < 50 year (sig.) Females and patients >50 had higher risk of death. DM and <50 years – significantly lower risk of death if on PD
Stack <i>et al.</i> 2003 ¹⁴	USRDS Historical prospective cohort of incident patients	107 922	Modality mortality w/o CHF 2 years of follow up Significantly higher mortality risk with patients on PD and CHF (DM & non-DM). Survival advantage if non-DM and non-CHF on PD at least in the first 6 months
Ganesh <i>et al.</i> 2001 ¹⁵	USRDS historical prospective cohort of incident patients	107 922	Modality mortality w/o CAD 2 years of follow up Underreporting of comorbidities with registry data Survival benefit in first 6 months to PD, lose this at 12 months DM with CAD significantly higher mortality on PD Patients w/o CAD 9% lower mortality on PD. Caution exercised in recommending PD as an initial choice in those with proven CAD whereas either modality recommended if no CAD
Locatelli <i>et al.</i> 2001 ¹³	Lombardy Dialysis and Transplant registry	4000 from 44 units, incident patients	Modality mortality and CVD 4 years of follow up Adjusted for age, gender and DM No statistical difference in the probability of developing CVD on either dialysis modality. No difference in mortality up to an average of 20 months follow up

Table 1 Continued

Study ID (author, year)	Study design	No. of subjects	Outcome
Heaf <i>et al.</i> 2002 ¹²	Danish Terminal Uraemia register	7000 incident and prevalent patients	Modality mortality Except for elderly diabetic patients, PD has a survival advantage in the first 2 years
Panagoutsos <i>et al.</i> 2005 ⁸	Single-centre retrospective cohort of incident patients	299 new patients over 10-year period	Modality mortality and timely transfer Follow up to 10 years Adjusted for Dx dose, co morbidities, age 5-year survival rate of PD-HD transfers >PD, but = HD Patients who start on PD and subsequently transfer to HD had a higher survival rate than those remaining on PD
Murphy <i>et al.</i> 2000 ¹⁰	Prospective cohort of incident patients	822	Modality mortality 2 years of follow up No survival advantage of either therapy when adjusted for comorbidity and severity of illness No Dx adequacy collected
Avram <i>et al.</i> 2001 ²	Single-centre retrospective cohort on prevalent patients	959	Modality mortality Follow up to 12 years Not adjusted for Dx dose or comorbidity HD patients had better survival (44% lower mortality risk)
Harris <i>et al.</i> 2002 ⁹	Prospective cohort study of incident and prevalent patients	174	Modality mortality in elderly No significant modality effect on survival of patients >70 years in 12 months follow up QOL similar for elderly people of PD and HD
Jaar <i>et al.</i> 2005 ¹¹	Prospective cohort of incident patients	1041 from 81 clinics	Modality mortality 7 years of follow up Not adjusted for Dx dose/adequacy No significant modality effect in the first year PD RR>HD after the first year Subgroup analysis No difference with DM or age RR death on PD higher if CVD at start of dialysis but not consistent in all models
Vonesh <i>et al.</i> 2006 ¹⁶	Critical review 4 – US Registry 2 – Non-US Registry 3 – Prospective cohort studies	9 studies	Modality mortality 1. Compared to HD, PD is associated with equivalent or better survival among non-DM patients and younger DM patients. 2. PD has an equal or lower mortality rate during the first 1–2 years and thereafter results vary by subgroup. 3. In the US, HD is associated with better survival among DM patients over 45 which is not observed in other countries (Denmark/Canada). 4. DM, age and comorbidity all significantly modify the effect of treatment modality on survival.