

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 (in perspective 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	203 058	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.