

The risk of hospitalization and modality failure with home dialysis

Rita S. Suri^{1,2}, Lihua Li² and Gihad E. Nesrallah^{3,4}

¹Department of Medicine, Section of Nephrology, Centre de Recherche, Centre Hospitalier de l'Université de Montréal (CHUM), Montréal, Québec, Canada; ²Division of Nephrology, Western University, London, Ontario, Canada; ³Department of Nephrology, Humber River Regional Hospital, Toronto, Ontario, Canada and ⁴The Li Ka Shing Knowledge Institute, Keenan Research Centre, St. Michael's Hospital, Toronto, Ontario, Canada

While home dialysis is being promoted, there are few comparative effectiveness studies of home-based modalities to guide patient decisions. To address this, we matched 1116 daily home hemodialysis (DHD) patients by propensity scores to 2784 contemporaneous USRDS patients receiving home peritoneal dialysis (PD), and compared hospitalization rates from cardiovascular, infectious, access-related or bleeding causes (prespecified composite), and modality failure risk. We performed similar analyses for 1187 DHD patients matched to 3173 USRDS patients receiving in-center conventional hemodialysis (CHD). The composite hospitalization rate was significantly lower with DHD than with PD (0.93 vs. 1.35/patient-year, hazard ratio = 0.73 (95% CI = 0.67–0.79)). DHD patients spent significantly fewer days in hospital than PD patients (5.2 vs. 9.2 days/patient-year), and significantly more DHD patients remained admission-free (52% DHD vs. 32% PD). In contrast, there was no significant difference in hospitalizations between DHD and CHD (DHD vs. CHD: 0.93 vs. 1.10/patient-year, hazard ratio 0.92 (0.85–1.00)). Cardiovascular hospitalizations were lower with DHD than with CHD (0.68 (0.61–0.77)), while infectious and access hospitalizations were higher (1.15 (1.04–1.29) and 1.25 (1.08–1.43), respectively). Significantly more PD than DHD patients switched back to in-center HD (44% vs. 15%; 3.4 (2.9–4.0)). In this prevalent cohort, home DHD was associated with fewer admissions and hospital days than PD, and a substantially lower risk of modality failure.

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Home-based dialysis modalities are being increasingly promoted internationally as preferred renal replacement therapy options when transplantation is not immediately feasible.^{1–6} Both home peritoneal dialysis (PD) and home hemodialysis (HD) are associated with similar or better survival than in-center HD,⁷ while offering better patient autonomy and quality of life,^{8,9} at lower cost.^{10,11} PD remains the dominant home dialysis therapy, comprising 15% of dialysis in developed countries.¹² In contrast, <2% of patients with end-stage renal disease receive home HD.¹³ Yet, although the use of PD has been steadily decreasing in developed countries,¹² the prevalence of home HD is increasing.^{13,14}

Many advocate home HD in order to facilitate the delivery of more intensive dialysis, delivered as more frequent (at least 5 days per week) and/or longer (at least 6 h per treatment) sessions. However, whether such intensive HD therapies improve hard outcomes over conventional three times per week HD or PD is as yet unknown. Prior observational studies suggested that home frequent HD was associated with better survival than in-center three times per week HD.^{15–19} Despite rigorous methods used in some of these studies to match groups on known prognostic variables,^{15–17} these studies are difficult to interpret, as they compared home patients with in-center patients. Compared with patients receiving in-center HD, patients performing their own treatments at home may have better health literacy, social support, financial resources, cognitive function, and motivation. It is thus unclear whether the observed improvements in survival in these studies were related to greater HD frequency and duration, or to these other unmeasured factors. A recent observational study comparing home intensive with home CHD found no difference in survival between groups,²⁰ and the Frequent Hemodialysis Network Nocturnal Randomized Trial surprisingly noted significantly increased mortality with six nights per week home HD compared with three days per week home HD.²¹

Nevertheless, the recent growth in home HD has likely been facilitated by options for more frequent and/or longer treatments, the possibility of night-time treatments, the recent development of easier-to-use machines, and better funding models.^{13,22} As home HD becomes more widely available,

Correspondence: Rita S. Suri, Department of Medicine, Section of Nephrology, Centre de Recherche, Centre Hospitalier de l'Université de Montréal (CHUM), Room 3148, Hôpital Saint-Luc, 1058 St Denis St, Montreal, Quebec H2X 3J4, Canada. E-mail: rsuri.kidney@gmail.com

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Table 1 | Patient flow

	Home DHD	Home PD	Home DHD	In-center CHD
No of patients aged ≥ 18 years	2501	195,465	2501	1,519,609
Exclusions				
Not in the time window ^a	0	133,908	0	109,623
Not Medicare before index	922	41,280	922	—
Nonindependent living	50	828	50	65,282
Missing race	0	1	0	573
Missing comorbidity	0	1	0	59
BMI > 50 or < 16 or missing	87	634	87	116,201
Albumin < 1.0 g/dl or hemoglobin < 5 g/dl	10	81	10	6057
Prior transplants > 2	2	5	2	30
Follow-up < 30 days	44	618	44	41,537
Total no excluded	1115	177,356	1115	339,362
No eligible	1386	18,109	1386	1,180,247
No matched	1116	2784	1187	3173
Follow-up time (years)	1506	4923	1614	6885
(25/50/75th percentile)	(0.6/1.2/2.0)	(0.7/1.4/2.6)	0.6/1.2/2.0)	(0.9/1.9/3.2)
Range	0.1–4.8	0.1–5.4	0.1–4.8	0.1–7.9

Abbreviations: BMI, body mass index; CHD, conventional hemodialysis; DHD, daily home hemodialysis; HD, home hemodialysis; No, number; PD, peritoneal dialysis; USRDS, United States Renal Data System.

^aThe time window was defined as having started renal replacement therapy after 1995, as end-stage renal disease patients were more completely captured in the USRDS after this date. In addition, only patients who started PD between 2004 and 2009 were eligible to be selected as PD controls, as DHD subjects also began HD during this period.

patients needing dialysis are now faced with a multitude of choices: hospital or home-based therapy; if home-based, PD or home HD; if HD, what frequency and duration? Few comparative effectiveness studies of these options exist to help guide these choices. Given that patients opting for home daily HD often also have the choice of doing PD instead, studies comparing the effects of these two therapies on clinically important, patient-centered outcomes are highly relevant. Acknowledging differences in technique, training time, and available home care support between home daily HD and PD, appropriately matched comparisons of home daily HD with PD would have the added advantage of being less subject to selection bias introduced by self-care ability, as both therapies are performed at home. This may be particularly true of home HD with newer devices that have improved the ease of training for home daily HD.²³

With these considerations, we performed an observational matched retrospective cohort study to compare dialysis-related hospitalization risk associated with DHD versus PD. We hypothesized that DHD would result in less cardiovascular, infectious, and bleeding admissions, but similar access-related hospitalizations compared with PD. This hypothesis was based on the theoretical benefits of DHD over PD, including higher daily ultrafiltration capacity, greater small solute clearance with potentially improved hemostasis and immune function, but an equal tendency to vascular access or PD catheter-related complications. Notwithstanding the limitations of home versus in-center analyses discussed above, we also compared hospitalization risk between home DHD and in-center three times per week CHD to serve as a reference point in the context of previous studies.

RESULTS

Study sample, baseline characteristics, and dialysis prescription

Of 1386 potentially eligible DHD subjects, 1116 (81%) were matched to 2784 PD controls, and 1187 (86%) were matched to 3173 in-center CHD controls (Table 1). Distribution of baseline variables was similar between DHD and comparator groups with standardized differences of $< 10\%$ for all variables (Table 2). The mean treatment time received by DHD subjects was 2.7 h (s.d. = 0.6, interquartile range = 2.4–2.9 h) during month 1 and 2.9 h (s.d. = 0.6, interquartile range = 2.5–3.4 h) by 24 months (Figure 1). Eighty-nine percent of DHD patients used low dialysate flow rates of 300 ml/min; the remaining received ≥ 900 ml/min. Mean percent reduction in urea was 40% per treatment (s.d. = 10, interquartile range = 35–43). Of PD controls, 68% received continuous ambulatory PD, whereas 32% used a cyclor.

DHD versus PD

There were 2443/3900 patients who had 8103 hospitalizations during 6429 patient-years (mean follow-up 1.6 years, s.d. = 1.3). The composite hospitalization rate was significantly lower for DHD compared with PD (DHD: 0.94/patient-year, PD: 1.36/patient-year; hazard ratio (HR) = 0.73 (95% confidence interval (CI) = 0.67–0.79); $P < 0.001$).

Results were similar when we included only up to three hospitalizations per patient, excluded recurrent hospitalizations occurring within 14 days of a previous one, and restricted the analysis to the subgroup whose index date was < 1 year after start of end-stage renal disease. The subdistribution HR of time to first hospitalization with DHD versus PD, accounting for the competing events of death and transplantation, was similar

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