

# Short daily-, nocturnal- and conventional-home hemodialysis have similar patient and treatment survival



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Home hemodialysis (HHD) has many benefits, but less is known about relative outcomes when comparing different home-based hemodialysis modalities. Here, we compare patient and treatment survival for patients receiving short daily HHD (2-3 hours/5 plus sessions per week), nocturnal HHD (6-8 hours/5 plus sessions per week) and conventional HHD (3-6 hours/2-4 sessions per week). A nationally representative cohort of Canadian HHD patients from 1996-2012 was studied. The primary outcome was death or treatment failure (defined as a permanent return to in-center hemodialysis or peritoneal dialysis) using an intention to treat analysis and death-censored treatment failure as a secondary outcome. The cohort consisted of 600, 508 and 202 patients receiving conventional, nocturnal, and short daily HHD, respectively. Conventional-HHD patients were more likely to use dialysis catheter access (43%) versus nocturnal or short daily HHD (32% and 31%, respectively). Although point estimates were in favor of both therapies, after multivariable adjustment for patient and center factors, there was no statistically significant reduction in the relative hazard for the death/treatment failure composite comparing nocturnal to conventional HHD (hazard ratio 0.83 [95% confidence interval 0.66-1.03]) or short daily to conventional HHD (0.84, 0.63-1.12). Among those with information on vascular access, patients receiving nocturnal HHD had a relative improvement in death-censored treatment survival (0.75, 0.57-0.98). Thus, in this national cohort of HHD patients, those receiving short daily and nocturnal HHD had similar patient/treatment survival compared with patients receiving conventional HHD.

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Observational studies have identified that home hemodialysis (HHD) is associated with improved patient survival compared with conventional in-center hemodialysis.<sup>1–6</sup> Patients receiving short daily HHD (SDHD) (2–3 hours, 5+ sessions/week), nocturnal HHD (NHD) (6–8 hours, 5+ sessions/week), or more hours of conventional HHD have been shown to have a relative survival advantage compared with in-center conventional hemodialysis (CHD) (3–6 hours, 2–4 sessions/week).<sup>1–6</sup> However, comparisons of home versus in-center hemodialysis are limited by patient selection. Those who are able to receive HHD will have better health outcomes by virtue of their demographics, social supports, socioeconomic factors, and underlying health state as opposed to the dialysis modality itself.<sup>2,7,8</sup> Furthermore, these comparisons do not allow one to determine whether the survival advantage is due to the dialysis modality or home location.

Identifying the optimal way to deliver HHD to maximize patient outcomes (including patient and treatment survival) is a more clinically relevant analysis for patients who chose to dialyze at home. However, thus far, direct comparisons of the effect of modality on treatment survival have not been previously examined in detail. In terms of patient survival, most results are limited to inferences from studies comparing HHD with in-center hemodialysis.<sup>1,4</sup> In the one home versus primarily home comparison (a *post hoc* analysis of the frequent hemodialysis network nocturnal trial), the risk of mortality was relatively higher for NHD than for home CHD.<sup>9</sup> However, this follow-up study was relatively small, and the lack of events prevented the ability to draw definitive conclusions about the relative effects of both therapies.<sup>9</sup>

Therefore, the objective of this study was to examine the association between the home hemodialysis modality and patient and treatment survival in a large nationally representative cohort of Canadian HHD patients. We hypothesized that treatment/patient survival would be better with intensive home dialysis modalities (NHD or SDHD) compared with home CHD.

## RESULTS

The eligible cohort consisted of 1310 patients. Overall, 600 (46%), 508 (39%), and 202 (15%) patients were receiving

home CHD, NHD, and SDHD, respectively. Baseline characteristics stratified by modality are noted in Table 1. Distributions of comorbidities were similar for each modality. Home CHD patients were of older age and were more likely to have central venous catheter access before HHD was initiated. A higher proportion of NHD and SDHD patients were from large dialysis centers compared with CHD patients. Finally, there were regional differences in modality distribution such that a higher proportion of SDHD patients were from the Western/Prairie provinces as opposed to Ontario.

**Primary outcome (death and treatment failure)**

There were 450 events (death/treatment failure) for the entire cohort (2889.1 patient-years at risk). Rates of transplantation were similar for each modality (transplantation rates of 4.3/100 patient years, 5.3/100 patient-years, and 5.4/100 patient-years for CHD, SDHD, and NHD, respectively, during the first HHD modality year) (Supplementary Table S1). Rates of treatment failure, death, and the composite of both are noted in Table 2. After multivariable adjustment in the intention-to-treat model, there was no statistically significant difference in the composite of death/treatment failure for either NHD (hazard ratio 0.83, 95% CI 0.66–1.03) or SDHD (hazard ratio 0.84, 95% CI 0.63–1.12) compared with home CHD (Table 3). Patients receiving NHD did have a significantly lower relative risk of death-censored treatment failure (hazard ratio 0.75, 95% CI 0.57–0.98). Other variables associated with death/treatment failure are noted in Supplementary Table S2. In the sensitivity analysis including those with missing vascular access, neither NHD nor SDHD had a statistically significant difference in the composite of death/treatment failure or death-censored treatment failure compared with CHD (Table 4).

**As-treated analysis**

NHD was associated with a significantly lower relative risk of death/treatment failure in the as-treated analysis (HR 0.77, 95% CI 0.61–0.98) compared with home CHD, driven by improvements in treatment survival (Tables 3 and 4). In contrast, patients receiving SDHD did not have a statistically significant different relative risk of mortality, treatment failure, or the composite outcome compared with home CHD. Changes in modality during follow-up were common; 31% and 35% of patients on CHD and SDHD, respectively, changed to at least 1 alternate modality during follow-up. In contrast, 92% of patients who initiated treatment with NHD remained on NHD.

**Subgroup analysis**

Overall, there was no evidence of effect modification by body mass index, dialysis vintage, or dialysis access at the time of HHD initiation (Table 5), acknowledging that statistical inferences were limited by the small sample size.

**Table 1 | Baseline characteristics of cohort, stratified by home hemodialysis modality**

Variable	Conventional N = 600	Short daily N = 202	Nocturnal N = 508	P value
Age, yr (mean ± SD)	53 ± 14	52 ± 14	50 ± 14	0.002
Male sex (%)	66.0	64.0	64.0	0.833
Race (%)				0.242
Caucasian	70.3	74.3	66.5	
Asian	8.0	6.9	6.9	
Black	4.5	4.5	7.9	
Other	11.5	8.4	12.6	
Unknown	5.7	5.9	6.1	
Body mass index (mean kg/m <sup>2</sup> )	29.2	28.7	28.4	0.337
Body mass index categories, kg/m <sup>2</sup> (%)				0.836
<18.5	2.7	3.0	3.9	
18.5–24.9	27.0	30.2	28.5	
24.9–29.9	26.0	22.3	26.4	
>29.9	33.8	32.7	31.1	
Unknown	10.5	11.9	10.0	
Primary end-stage renal disease diagnosis (%)				0.041
Failed transplant	6.0	13.4	7.5	
Glomerulonephritis	18.7	16.3	18.7	
Diabetes	25.8	23.8	22.4	
Vascular disease	11.5	6.4	10.6	
Polycystic kidney disease	11.7	13.4	12.0	
Drug induced	2.8	1.5	1.6	
Pyelonephritis	3.8	3.5	2.0	
Other	9.7	12.4	13.2	
Unknown	10.0	9.4	12.0	
Comorbidity (%)				
Stroke	6.3	5.0	3.9	0.198
Peripheral Vascular Disease	8.0	3.5	6.1	0.069
Hypertension	81.0	76.7	77.6	0.258
Diabetes	8.0	7.9	8.9	0.854
Coronary artery disease	13.7	10.9	11.6	0.451
Smoking at time of dialysis initiation	10.7	10.4	7.7	0.211
Median distance from dialysis center (km)	15.4	13.8	13.7	0.832
Neighborhood income quintile (%)				0.289
1st	15.7	12.4	14.0	
2nd	16.0	17.3	15.0	
3rd	19.7	17.8	21.1	
4th	22.2	29.2	25.8	
5th	25.0	22.3	21.3	
Unknown	1.5	1.0	3.0	
Region (%)				<0.001
Atlantic	4.0	4.0	3.9	
Ontario	76.2	76.7	47.8	
West/Prairie	19.8	19.3	48.2	
Facility size (%)				<0.001
Small	4.0	3.5	4.7	
Medium	24.0	10.4	12.2	
Large	72.0	86.1	83.1	
Modality before HHD (%)				0.063
Incident HHD	13.7	6.9	14.6	
Hemodialysis	81.0	88.6	78.7	
Peritoneal dialysis	4.7	4.5	5.5	
Transplant	0.7	0	1.7	

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