Positive Clinical Outcomes for In-Center Nocturnal Patients Observed in Certain Subgroups

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Introduction and Objective

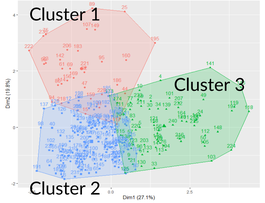
- In-center nocturnal hemodialysis (INHD) allows for a longer treatment time than the usual in-center hemodialysis (ICHD) regimen prescribed in the United States.
- However, there is limited evidence of reduced hospitalization rates with the more intensive nocturnal dialysis treatments.[1]
- In this study, we sought to identify distinct groups within the INHD population and then evaluate the hospitalization rate amongst these groups within the INHD population vs. matched ICHD patients.

Methods

- Electronic health records were used to identify adult (≥18 years) patients starting INHD between Jan 01, 2022 and Jul 31, 2024 at a kidney care organization.
  - To be included, patients needed to dialyze with kidney care organization for 90+ days prior, have 15+ ICHD treatments within those 90 days, no home treatments within prior 30 days, and no prior transplant.
  - Facilities with ≤2 INHD patients were excluded.
- Substantial variability was seen in the type of patient who initiates INHD. To account for confounding, we investigated each of the patient subtype groups.
  - Following k-means clustering, three distinct patient types were identified in the INHD cohort (Figure 1, Table 1).
- INHD patients of each type were then separately matched 1:1 to similar patients undergoing ICHD. Patients were characterized as of the index date and 90-day baseline period. Outcomes period: Until censoring (lost to follow up, death, or modality loss for INHD patients) + 60 days.
- Formal hospitalization comparisons (incidence rate ratios) were estimated using a generalized linear mixed model with a Poisson distribution and adjusted for covariates.

Figure 1: Cluster Grouping of Patients Initiating INHD

Clustering was done using patient age, vintage, BMI, and fluid-related metrics [ultrafiltration rate (UFR), inter-dialytic weight gain, intradialytic hypotension, and post weight > target weight (PW>TW)].



Results

We identified 3 distinct groups of patients:

1. Younger, lower BMI, longer vintage, high-UFR [early-onset kidney failure]
2. Younger, clinically unremarkable, shorter vintage [Nocturnal 'by preference']
3. Oldest with high BMI, frequently diabetic with PW>TW, and hypotension [High-BMI Diabetics]

Table 1: Cluster Characterization

	Early-onset kidney failure N=33	Nocturnal 'by preference' N=141	High-BMI diabetics N=70	P
Female, n (%)	9 (27.3%)	47 (33.3%)	27 (38.6%)	0.51
Race, n (%)				0.001
White	4 (12.1%)	34 (24.1%)	24 (34.3%)	
Black	8 (24.2%)	64 (45.4%)	21 (30.0%)	
Hispanic	15 (45.5%)	25 (17.7%)	15 (21.4%)	
Asian	3 (9.1%)	6 (8.5%)	0 (0.0%)	
Other	3 (9.1%)	12 (8.5%)	10 (14.3%)	
Age (years), mean (SD)	**47.9 (15.5)**	**49.7 (11.7)**	**54.6 (12.4)**	0.10
Insurance, n (%)				0.007
Commercial	7 (22.1%)	41 (29.1%)	8 (11.4%)	
Medicaid/Other/Unknown	11 (33.3%)	23 (16.3%)	12 (17.1%)	
Medicare/Medicare Advantage	15 (45.5%)	77 (54.6%)	50 (71.4%)	
Vintage (months), mean (SD)	**75.8 (59.3)**	**43.3 (40.3)**	**52.6 (43.3)**	0.001
Etiology, n (%)				0.004
Diabetes	4 (12.1%)	61 (43.3%)	36 (51.4%)	
Hypertension	10 (30.3%)	28 (19.9%)	9 (12.9%)	
Other/Unknown	19 (57.6%)	52 (36.9%)	25 (35.7%)	
Diabetes Diagnosis, n (%)	**20 (60.6%)**	**106 (75.2%)**	**59 (84.3%)**	0.03
Charlson Comorbidity Index, mean (SD)	3.9 (1.6)	4.2 (1.4)	4.9 (1.6)	0.001
BMI, mean (SD)	**24.2 (4.2)**	**30.6 (6.9)**	**38.8 (9.7)**	<0.001
UFR>13[a], mean % (SD)	**54.0% (21.0%)**	**4.0% (7.0%)**	**4.0% (7.0%)**	<0.001
Inter-dialytic weight gain[b], mean	**3.4**	**2.4**	**3.7**	<0.001
Intradialytic hypotension[c], mean % (SD)	**13% (19%)**	**11% (15%)**	**32% (27%)**	<0.001
Post weight over target weight[d], mean % (SD)	**34% (23%)**	**22% (19%)**	**74% (22%)**	<0.001
Hospitalization within 90 days before starting nocturnal dialysis, n (%)				0.04
0	22 (66.7%)	119 (84.4%)	52 (74.3%)	
1	9 (27.3%)	17 (12.1%)	10 (14.3%)	
2	2 (6.1%)	5 (3.5%)	8 (11.4%)	
Potassium[e], mean (SD)	5.3 (0.7)	4.8 (0.7)	5.0 (0.7)	0.001

[a]% of treatments with UFR > 13 in 90 days before starting INHD; [b]Average inter-dialytic weight gain over 90 days before starting INHD, broken out by bucket; [c]% of treatments with intradialytic hypotension in 90 days before starting INHD; [d]% of treatments with post weight 1+ kg above target weight in 90 days before starting INHD; [e] Most recent value prior to starting INHD.

Table 2: Crude Outcomes

	N	Total Risk Days	Mean Risk Days	Admits	Admit Rate
Early-onset kidney failure	33	8,026	243	27	1.23
Nocturnal 'by preference'	141	40,370	286	113	1.02
High-BMI diabetics	70	19,384	277	66	1.24

Among the 3 INHD patient phenotypes, samples were matched where possible to similar patients undergoing ICHD in 2 categories. No match pursued for the early-onset kidney failure phenotype group due to low sample size.

Table 3: Matched Outcomes

		N	Total Risk Days	Mean Risk Days	Admits[a]	Admit Rate
Nocturnal 'by preference' cluster	ICHD control patients[b]	119	56,476	475	195	1.26
	INHD patients	119	34,750	292	95	0.99
	Admits IRR (95% CI) *Unadjusted*	0.80 (0.61, 1.03)				
	Admits IRR (95% CI) *Adjusted*[c]	0.79 (0.61, 1.02)				
High-BMI diabetic cluster	ICHD control patients[d]	63	30,127	478	100	1.21
	INHD patients	63	18,368	292	60	1.19
	Admits IRR (95% CI) *Unadjusted*	0.98 (0.71, 1.35)				
	Admits IRR (95% CI) *Adjusted*[e]	0.99 (0.69, 1.40)				

[a]within 60 days of censoring; [b]matched on age, vintage, BMI, race, and state; [c]adjusted for gender; [d]age, vintage, BMI, race, intradialytic hypotension, post-weight>target weight, & region; [e]adjusted for diabetes and post weight>target weight. IRRs generated using generalized linear mixed models with Poisson distribution assumptions.

Conclusions

- Matched comparisons of patient phenotype clusters revealed:
  - A similarity in hospitalization rates amongst patients with frequent diabetes and high BMI;
  - Trending lower hospitalization rates amongst patients that could be described as dialyzing via nocturnal dialysis by preference.
- Importantly, there was no evidence of harm in any of the subgroups.
- This phenotypic clustering strategy should be considered in future modality comparisons to mitigate unmeasured confounding.

Limitations

- Stratification of the sample limited sample size and thus limited power to detect statistically significant effects.
- Characterization of patients was limited to a set of quantitative variables identified a priori.
  - Other approaches may be valid.
- Observational study so residual confounding may occur.

References and Acknowledgments

1. Int J Nephrol Renovasc Dis. 2019; 12: 59–68.

We extend our sincere appreciation to the teammates in more than 2,000 DaVita clinics who work every day to take care of patients and to ensure the extensive data collection on which our work is based. We specifically acknowledge Kathryn Husarek of DaVita, Inc. for editorial contributions in preparing this poster.

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Presented at ASN Annual Meeting 2025 Kidney Week, Houston, TX.