Dialysis dependence at 90 days post discharge for patients treated with continuous renal replacement therapy (CRRT) vs. intermittent hemodialysis (IHD)

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Introduction

Acute kidney injury (AKI) requiring dialysis in ICU patients is associated with a high mortality rate, but a substantial proportion of patients who survive remain dialysis dependent. Prior studies suggest that the risk of dialysis dependence post discharge is lower for patients treated with continuous renal replacement therapy (CRRT) than for patients treated with intermittent hemodialysis (IHD). We tested this hypothesis in a multicenter retrospective observational cohort study using claims data linked to US hospital discharge data from the Premier PINC AI Healthcare Database (PHD).

Methods and Materials

- Inclusions: Adults aged 18+ with first inpatient CRRT or IHD in the ICU of a PHD hospital and discharged alive from January 1, 2018 to June 30, 2021, with linked claims data.
- Exclusions: End-stage renal disease, renal transplant, or more than one dialysis in the past 12 months, no AKI ICD-10 diagnosis code, or non-continuous hospital data submission.
- Outcomes: Dialysis dependence at discharge and 90 days post discharge, defined as 2+ days of dialysis in the 7 days prior to discharge or prior to day 90 post discharge, respectively.
- Statistical analyses: Potential confounders were balanced using inverse probability treatment weighting (IPTW). Propensity scores were calculated using gradient boosted modeling including all variables in Table below, plus peptic ulcer and peripheral vascular disease, dementia, and cardiopulmonary bypass surgery. The odds ratio (95%CI) for dialysis dependence at hospital discharge and 90 days post discharge for CRRT vs. IHD patients were calculated using weighted logistic regression, weighting by the inverse of the propensity score, and additionally adjusted for teaching hospital, shock, mechanical ventilation (MV), and use of vasopressors.

Results

Characteristics	Unweighted cohort CRRT	Unweighted cohort IHD	Unweighted cohort Std. diff.	After IPTW (Weighted) CRRT	After IPTW (Weighted) IHD	After IPTW (Weighted) Std. diff.
Age, years	52.4	55.4	-0.20	54.4	54.7	-0.02
Men	59.1%	58.5%	0.01	59.4%	58.9%	0.01
White	65.3%	68.9%	-0.08	65.2%	68.3%	-0.07
Black	20.1%	19.2%	0.02	21.1%	19.3%	0.05
Hispanic	9.1%	12.2%	-0.10	10.3%	11.5%	-0.04
Hospital size (# Beds)						
1-299	11.6%	31.0%	-0.44	21.8%	26.1%	-0.10
300-499	29.5%	31.4%	-0.04	31.9%	30.9%	0.02
500+	58.7%	37.4%	0.43	45.9%	42.8%	0.06
Urban Hospital	92.7%	90.0%	0.10	90.6%	90.7%	-0.02
Teaching Hospital	74.9%	51.8%	0.47	63.7%	57.6%	-0.10
Geographic Region						0.02
Northeast	10.2%	12.2%	-0.06	11.6%	11.8%	0.06
Midwest	29.8%	25.1%	0.10	27.7%	26.6%	
South	48.4%	45.1%	0.07	47.1%	45.5%	
West	11.7%	17.5%	-0.16	13.5%	16.1%	
Health Insurance						
Medicare	23.3%	32.2%	-0.20	27.4%	29.9%	-0.06
Medicaid	36.5%	33.8%	0.06	34.7%	34.3%	0.01
Private Insurance	36.9%	30.2%	0.15	34.4%	32.1%	0.05
Uninsured	1.5%	1.5%	0.00	1.7%	1.4%	0.02
Surgical patient	60.7%	41.9%	0.38	49.2%	46.6%	0.05
Sepsis	65.2%	52.3%	0.26	59.3%	55.7%	0.07
Shock	76.6%	47.9%	0.58	61.2%	55.1%	0.12
Any vasopressor use	90.1%	59.4%	0.66	73.0%	67.1%	0.13
Mechanical Ventilation	77.2%	53.1%	0.49	65.5%	59.3%	0.13
ECMO	7.4%	1.0%	0.39	3.3%	2.5%	0.05
COVID-19	7.5%	5.1%	0.10	6.7%	5.6%	0.05
Comorbidities						
Charlson Comorbidity Index	3.89	4.03	-0.05	4.01	3.99	0.01
Myocardial infarction	23.6%	21.6%	0.05	22.0%	21.9%	0.00
Hypertension	48.8%	56.8%	-0.16	54.2%	55.3%	-0.02
Diabetes	46.9%	52.1%	-0.10	50.8%	50.8%	0.00
Chronic Kidney Disease	39.0%	50.5%	-0.23	45.9%	48.2%	-0.05
Mod./Severe Liver Disease	13.1%	7.5%	0.20	10.2%	8.8%	0.05

Results

- Among patients whose first RRT modality (CRRT or IHD) occurred in the ICU and were discharged alive (n=40,564), 3,790 patients from 380 hospitals were included in the linked claims dataset with claims coverage in days 83-90 post discharge (Figure 1).
- CRRT (n=1042) vs. IHD (n=2,748) patients were younger, with more surgical patients, sepsis, shock, MV, and any vasopressor use, but lower prevalence of comorbidities (Table).
- The weighted cohort had good balance (Table, Figure 2), with std. diffs <0.10 for most variables and <0.15 for teaching hospital, shock, MV and vasopressors, which remained slightly higher among CRRT patients and were additionally adjusted for in adjusted weighted models.
- Dialysis dependence at hospital discharge occurred less often with CRRT vs. IHD (25% vs. 28.5%, p=0.036), with weighted adjusted OR(95%CI): 0.88 (0.71-1.08), p=0.22.
- **Dialysis dependence at 90 days post discharge occurred less often with CRRT vs. IHD (4.9% vs. 8.0% p=0.001), with weighted adjusted OR (95%CI): 0.63 (0.44-0.93), p= 0.014.**
- Results were unchanged in sensitivity analyses (Figure 3) that excluded patients with stage 5 CKD at admission (n=86), discharged to hospice (n=105), or who switched from IHD to CRRT (n=59).

Figure 1. Patient selection

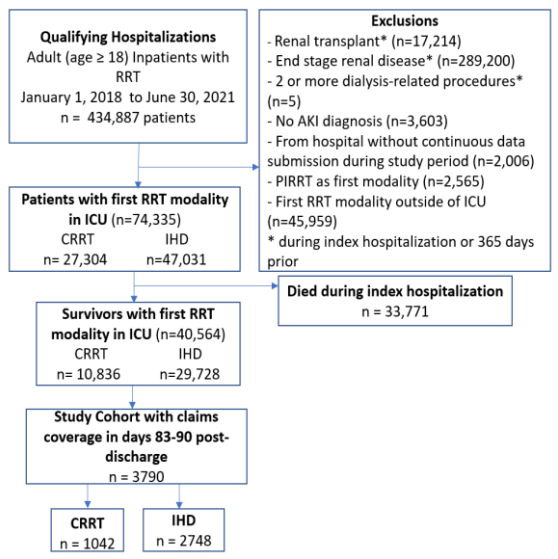


Figure 2. IPTW-achieved confounder balance (reduction in standardized differences).

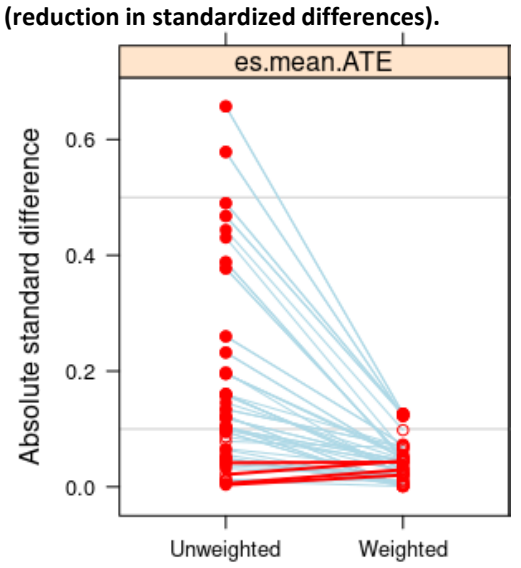
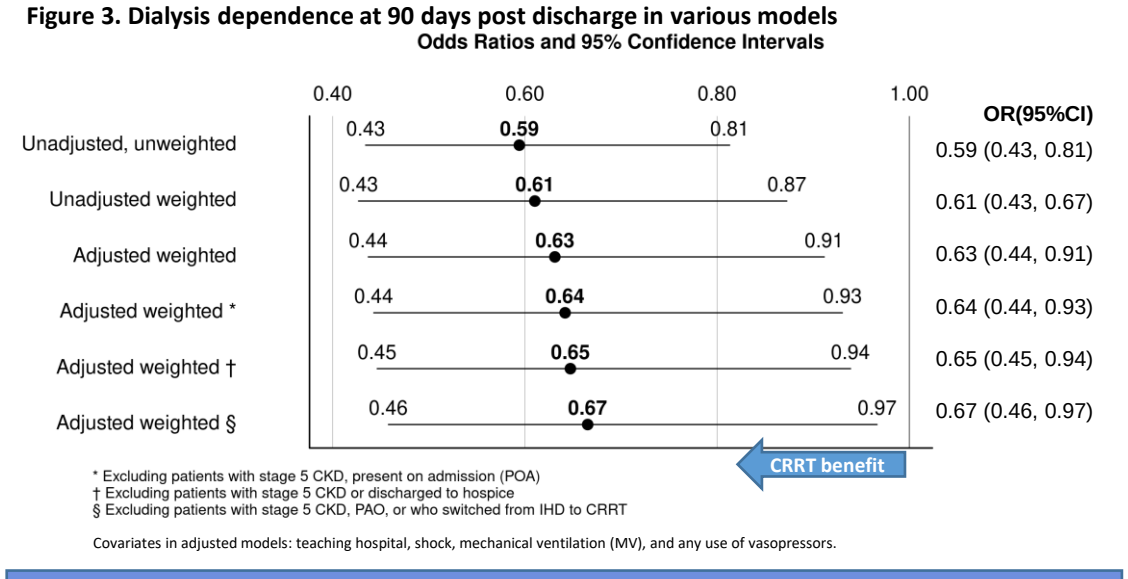


Figure 3. Dialysis dependence at 90 days post discharge in various models



* Excluding patients with stage 5 CKD, present on admission (POA)
† Excluding patients with stage 5 CKD or discharged to hospice
§ Excluding patients with stage 5 CKD, PAO, or who switched from IHD to CRRT

Covariates in adjusted models: teaching hospital, shock, mechanical ventilation (MV), and any use of vasopressors.

Discussion

- Study strengths include the large sample of dialysis requiring AKI (n=3790) and linked claims data to allow follow-up over 90 days post discharge.
- Study limitations include potential for confounding by unmeasured variables including biomarkers needed to calculate SOFA or APACHE-II scores or other indices of acute disease severity. However, patients with CRRT had higher levels of shock, sepsis and mechanical ventilation, indicating more severe acute illness, variables that were balanced in the weighted, adjusted analyses.

Conclusions

Patients treated with CRRT vs. IHD as first modality in the ICU had 37% lower adjusted odds of dialysis dependence at 90 days post discharge, with OR(95%CI): 0.63 (0.44-0.93), p=0.014.