Online Supplement

Association of Hospital-level Continuous Kidney Replacement Therapy Use and Mortality in Critically Ill Patients with Acute Kidney Injury

Intensive Care Medicine

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eMethods 1: The PINC AI Healthcare Database

The Premier Incorporated Healthcare (PINC-AI) Database is a privately maintained registry that provides hospital discharge files detailing billable items associated with patient encounters, including demographic information, disease states, service costs, and hospital characteristics [1]. The PINC-AI uses hospital statistics from member hospitals, gathered through self-reports and the American Hospital Association Annual Survey Database,™ and serves as a resource for assessing hospital quality of care, particularly where metrics are based on inpatient data.

The PINC AI Healthcare Database, formerly the Premier Healthcare Database, originated from the merger of Premier with American Healthcare Systems and SunHealth in 1997 [2, 3]. More than 1,400 hospitals/healthcare systems contribute data to the PINC-AI. The PINC-AI comprises U.S. hospital-based, service-level, all-payer information on inpatient discharges, primarily from geographically diverse non-profit, non-governmental, and community and teaching hospitals and health systems from rural and urban areas. Hospitals and healthcare systems submit administrative, healthcare utilization, and financial data from patient encounters. Inpatient admissions include more than 170 million visits, with more than 9 million per year since 2012, representing approximately 25% of annual United States inpatient admissions [4]. The PINC-AI contains information from more than 347 million unique patients. Using a unique masked identifier, patients can be tracked across the same hospital's inpatient and hospital-based outpatient settings, and their hospital length of stay and readmissions to the same hospital can be assessed. Information in the PINC-AI is de-identified and HIPAA-compliant, as per the HIPAA Privacy Rule [5].

The PINC-AI contains information on hospital and visit characteristics, admitting and attending physician specialties, healthcare payers, and patient data from standard hospital discharge billing files. These data include demographics, including sex, race, and ethnicity, and disease states; admission and discharge diagnoses; information on billed services, including costs at the departmental level such as medications and devices, laboratory tests performed, diagnostic and therapeutic services, microbiology test results (for a subset of hospitals), and patient disposition and discharge health status. For most data elements, fewer than 1% of patient records are missing; for key components, such as demographics and diagnostic information, less than 0.01% of data is missing [4].

The PINC-AI uses member hospital statistics from a combination of self-reports and the American Hospital Association Annual Survey Database [6]. Hospitals in the PINC-AI represent the four geographic regions and their respective divisions, as defined by the United States Census defines them (Northeast: New England, Middle Atlantic; Midwest: East North Central, West North Central; South: South Atlantic, East South Central, West South Central; West: Mountain, Pacific). Hospital characteristics, including bed capacity, urban and rural populations served, and teaching status are recorded for all hospitals contributing data.

The United States Census defines an urban area as a territory in which core census groups or blocks have a population density of at least 1000 people per square mile and surrounding census blocks have an overall density of at least 500 people per square mile. Rural areas are considered territories outside the definition of urban [7]. A teaching facility has either a medical school affiliation reported to the American Medical Association or a documented affiliation

agreement with a medical school accredited by the Liaison Committee on Medical Education (LCME) of the Association of American Medical Colleges. These organizations must sponsor or participate significantly in at least four approved active residency programs. At least two approved residency programs should be in medicine, surgery, obstetrics/gynecology, pediatrics, family practice, or psychiatry.

Comparisons of the member hospital characteristics from the PINC-AI with those from the American Hospital Association (AHA) demonstrate a similar distribution. However, the AHA has a more significant number of smaller member hospitals. Visit-level information in the PINC-AI includes admitting and attending physician specialties, point of origin, type of admission, and discharge status (including mortality). Definitions are based on the elements in hospital claims derived from the Uniform Billing Form (UB-04) and categorized into PINC AI standard definitions and the PINC AI proprietary data dictionary.

Patient demographics include age, sex, race (white, black, other), and ethnicity (Hispanic, non-Hispanic). International Classification of Diseases (ICD) Diagnosis Codes for each hospital encounter (ICD-9 for discharge dates before October 1, 2015, or ICD-10 for discharge dates on or after October 1, 2015) identify disease states and comorbid conditions. ICD procedure codes (versions 9 and 10 as described above), as well as hospital-submitted Current Procedural Terminology (CPT) and Healthcare Common Procedure Coding System (HCPCS) codes, identify diagnostic and therapeutic procedures ordered during hospital encounters. There is no limit on the number of ICD diagnosis codes provided; therefore, all codes a hospital offers are contained in the database.

Detailed pharmacy data, including brand/generic drug names, strength, dosing, route of administration, day of service charge, and quantity charged, are also available in the PINC-AI. Medical devices and supply utilization can also be identified with a day-of-service charge. Additionally, the PINC-AI contains microbiology laboratory results information from more than 516 hospitals, including specimen ID, test name, test day of service and time, specimen source, result, sensitivity data, and observation status (i.e., final, corrected) cumulatively from 2009 forward. Since 2017, more than 404 hospitals have provided in-hospital laboratory results. Patient vitals, including height, weight, blood pressure, heart rate, and temperature, are also available, and a select group of hospitals also provide respiratory function.

The PINC-AI contains the necessary information for generating various clinical algorithms. 3M™ All Patient Refined™ Diagnosis Related Group (APR™-DRG), Severity of Illness (APR-SOI), and Risk of Mortality (APR-ROM) account for age, procedures, and clinical severity of primary diagnosis and all secondary diagnoses assigned during hospitalization and computed for each patient at the time of hospital discharge [8].The Elixhauser Comorbidity Index measures patient comorbidity based on ICD-9 and ICD-10 diagnosis codes and has been found to predict hospital resource use and in-hospital mortality [9].

The PINC-AI maintains data integrity through data collection practices, transformation processes, and ongoing monitoring and validation. However, like other administrative databases, it can face limitations such as coding bias and lack of comprehensive clinical details. In the past 20 years, numerous studies have utilized the PINC-AI to examine the relationship between procedures or conditions and outcomes during hospital stays [10-15].

eTable 1: ICD-10-CM Diagnosis and CPT-4 Procedure Codes Used for Exclusion Criteria

End stage renal disease (ESRD) present on admission or during 12 months prior to index hospitalization		
	ICD-10 Diagnosis Codes	**CPT-4 codes***
ESRD	N18.6	90957-90962,90995, 90998
ESRD-related dialysis		90965, 90966,90969, 90970, 90976-90985
Renal transplant during or 12 months prior to index hospitalization		
	ICD-10 Diagnosis Codes	**CPT-4 codes***
Renal transplant	Z94.0	00868, 01990, 50300, 50320, 50323, 50325, 50327-50329, 50340, 50360, 50365, 50370, 50380
Complications of kidney transplant	T86.10, T86.11, T86.12, T86.13, T86.19	
	ICD-10 Procedure Codes	
CT scan of kidney transplant	BT2900Z, BT290ZZ, BT2910Z, BT291ZZ, BT29Y0Z, BT29YZZ, BT29ZZZ	
MRI of kidney transplant	BT39Y0Z, BT39YZZ, BT39ZZZ	
Ultrasonography of kidney transplant	BT49ZZ	
Transplantation, Kidney, right, kidney, left	0TY0, 0TY1	
KRT-related diagnosis or procedures, two or more discharges during 12 months prior to index hospitalization		
	ICD-10 Diagnosis Codes	**CPT-4 codes***
Care for renal KRT	R88.0, Z49.01, Z49.02, Z49.31, Z49.32	90935, 90937, 90939-90945, 90947, 90988-90994, 90996, 90997, 90999
Patient non-compliance with renal dialysis	Z91.15	
Dependence on renal dialysis	Z99.2	
Complication following kidney dialysis	T81.502A, T81.502D, T81.502S, T81.512A, T81.512D, T81.512S, T81.522A, T81.522D, T81.522S, T81.532A, T81.532D, T81.532S, T81.592A, T81.592D, T81.592S	
Mechanical complication of vascular dialysis catheter	T82.41XA, T82.41XD, T82.41XS T82.42XA, T82.42XD, T82.42XS T82.43XA, T82.43XD, T82.43XS	

	T82.49XA, T82.49XD, T82.49XS	
Mechanical complication of intraperitoneal dialysis catheter	T85.611A, T85.611D, T85.611S, T85.621A, T85.621D, T85.621S T85.631A, T85.631D, T85.631S T85.691A, T85.691D, T85.691S	
Infection/inflammatory reaction due to peritoneal dialysis catheter	T85.71XA, T85.71XD, T85.71XS	
Failure of sterile procedures during kidney dialysis or other perfusion	Y62.2	
Kidney dialysis as cause of abnormal reaction of patient or later complication	Y84.1	
Cloudy dialysis effluent	R88.0	
	ICD-10 Procedure Codes	
Radiography of dialysis shunt/fistula Fluoroscopy of dialysis shunt/fistula	B50W0ZZ, B50W1ZZ, B50WYZZ B51W0ZA, B51W0ZZ, B51W1ZA, B51W1ZZ, B51WYZA, B51WYZZ, B51WZZA, B51WZZZ	
Performance of urinary filtration Irrigation of peritoneal cavity using dialysate	5A1D70Z, 5A1D80Z, 5A1D90Z, 3E1M39Z	

eTable 2: ICD-10 Diagnosis Codes for Clinical Conditions, Procedures, and Comorbidities

Condition	ICD-10 codes
Shock	R57.0, R57.1, R57.8, R57.9, R65.21
Mechanical ventilation (MV)	5A1935Z, 5A1945Z, 5A1955Z
Sepsis	
Salmonella Sepsis	A02.1
Septicemic plague	A20.7
Anthrax sepsis	A22.7
Melliodosis sepsis	A24.1
Erysipelothrix sepsis	A26.7
Sepsis due to listeria monocytogenes	A32.7
Meningococcemia, unspecified (includes sepsis)	A39.4
Sepsis due to Streptococcus	A40.x
Other Sepsis	A41.x
Actinomycotic sepsis	A42.7
Gonococcal sepsis	A54.86
Herpesviral sepsis or disseminated herpesviral disease	B00.7
Candidal sepsis	B37.7
Septic arterial embolism	I76
Sepsis following incomplete spontaneous abortion	O03.37
Sepsis following complete spontaneous abortion	O03.87
Sepsis following pregnancy termination	O04.87
Sepsis following failed pregnancy termination	O07.37
Sepsis following ectopic and molar pregnancy	O08.82
Sepsis during labor	O75.3
Puerperal sepsis	O85
Sepsis following obstetrical procedure	O86.04
Severe sepsis	R65.20
Septic shock	R65.21
Bloodstream infection due to central venous catheter (includes sepsis)	T80.211x
Sepsis following a procedure	T81.44x
Sepsis following immunization	T88.0
Chronic kidney disease (CKD)	D63.1, I12.x, I13.x, N18.x
Hypertension	I10, I11.x, I12.x, I13.x, I15.x, I16.x
Extracorporeal membrane oxygenation (ECMO) procedure during index hospitalization	
ICD-10 Procedure Codes	5A15223, 5A1522F, 5A1522G, 5A1522H

Condition	ICD-10 codes
CPT-4 codes	33946-33949, 33952, 33954, 33956, 33958, 33962, 33964, 33966, 33984, 33986-33989
Cardiopulmonary bypass surgery (CPB)	
Description	**MS-DRG codes**
Cardiac Valve & Oth Maj Cardiothoracic Proc W Card Cathw MCC	216
Cardiac Valve & Oth Maj Cardiothoracic Proc W Card Cathw CC	217
Cardiac Valve & Oth Maj Cardiothoracic Proc W Card Cath w/o CC/MCC	218
Cardiac Valve & Oth Maj Cardiothoracic Proc W/O Card Cathw MCC	219
Cardiac Valve & Oth Maj Cardiothoracic Proc W/O Card Cathw CC	220
Cardiac Valve & Oth Maj Cardiothoracic Proc W/O Card Cath w/o CC/MCC	221
Coronary Bypass W Cardiac Cath w MCC	233
Coronary Bypass W Cardiac Cath w/o MCC	234
Coronary Bypass W/O Cardiac Cath w MCC	235
Coronary Bypass W/O Cardiac Cath w/o MCC	236

eTable 3: Model Incorporating Chronic Kidney Disease, Charlson Comorbidity Index Score, Hypertension, and Diabetes

	Original Model			Original Model + Comorbidities		
	CKRT Utilization by Facility (n = 49,685)			CKRT Utilization by Facility (n = 49,685)		
	Hazard Ratio	95% CI	p-value	Hazard Ratio	95% CI	p-value
Facility ICU CKRT Utilization, Yearly						
Q1	—	—		—	—	
Q2	1.00	0.95, 1.05	>0.9	1.00	0.95, 1.05	>0.9
Q3	0.94	0.89, 0.98	0.009	0.93	0.89, 0.98	0.008
Q4	0.85	0.81, 0.90	<0.001	0.85	0.81, 0.89	<0.001
Hypertension	—			1.00	0.96, 1.04	>0.9
Diabetes	—			0.80	0.77, 0.83	<0.001
CKD	—			0.89	0.85, 0.93	<0.001
CCI Category	—					
0				—	—	
1-2				1.03	0.96, 1.10	0.400
3-4				1.14	1.07, 1.23	<0.001
5+				1.21	1.12, 1.31	<0.001

Incorporating chronic kidney disease, Charlson Comorbidity Index score category, hypertension, and diabetes into the original cox regression model did not alter the relationship between the quartiles of CKRT utilization and risk-adjusted mortality. The model was adjusted for all other covariates in the original model.

eTable 4: Monthly ICU KRT Volume by Quartiles

Quartile	Mean no. of patients with ICU KRT / Month	Total no. of patients in the study population
1	0.1 - 4.6	3,598
2	4.7 - 7.6	7,018
3	7.7 - 13.6	12,000
4	13.7 – 56	27,068

Additional sensitivity analysis was performed to explore the effect modification of ICU KRT volume on the existing results. The average ICU KRT per month was calculated for each hospital in the dataset, with adult inpatients receiving KRT in the ICU between January 2018 and June 2021. This was the average per month of data reported, as not all facilities reported all months. Quartile thresholds for ICU KRT volume were then determined using these averages, and each facility was assigned to a specific quartile based on the monthly KRT use in the ICU. Patients were then assigned a quartile based on their hospital allocation (eTable 4 and eTable 5).

eTable 5: Cross Table of Number of Patients Stratified by Annual ICU CKRT utilization and Monthly ICU KRT Volume by Quartiles

	Facility ICU KRT Volume per Month				
Facility ICU CKRT Utilization, Yearly	**First Quartile**	**Second Quartile**	**Third Quartile**	**Fourth Quartile**	**Total**
Q1	914	2728	2979	3939	10560
Q2	758	1232	3032	3673	8695
Q3	702	1690	3179	6338	11909
Q4	1224	1369	2810	13118	18521
Total	3598	7019	12000	27068	49685

eTable 6: Cox Regression Model Hazard Ratios Original vs. New Model after Adding ICU KRT Volume per Month Quartiles

	Original Model		Original Model + ICU KRT Volume per Month Quartiles	
	CKRT Utilization by Facility (n = 49,685)		CKRT Utilization by Facility (n = 49,685)	
	Adjusted Hazard Ratio (95% CI)	p-value	Adjusted Hazard Ratio (95% CI)	p-value
Facility ICU CKRT Utilization, Yearly				
Q1	—		—	
Q2	1.00 (0.95, 1.05)	>0.9	1.00 (0.95, 1.06)	0.900
Q3	0.94 (0.89, 0.98)	0.009	0.94 (0.89, 0.99)	0.013
Q4	0.85 (0.81, 0.90)	<0.001	0.86 (0.82, 0.90)	<0.001
ICU KRT per Month				
Q1	—		—	
Q2	—		1.09 (1.01, 1.17)	0.030
Q3	—		1.07 (0.99, 1.15)	0.074
Q4	—		1.07 (0.99, 1.15	0.082

Adding ICU KRT Volume per Month Quartiles to the original model did not change the association of ICU CKRT utilization quartiles and mortality. The model shown in eTable 6 have also been adjusted for all other variables of the original model.

eTable 7. Cox Regression Model Hazard Ratios Stratified by ICU KRT Volume per Month Quartiles

Facility ICU CKRT Utilization, Yearly	Original Analysis		Stratified by ICU KRT per Month Quartile							
			First Quartile (0.1 to 4.6 per month)		Second Quartile (4.7 to 7.6 per month)		Third Quartile (7.7 to 13.6 per month)		Fourth Quartile (13.7 to 56 per month)	
	CKRT Utilization by Facility (n = 49,685)		CKRT Utilization by Facility (n = 3,598)		CKRT Utilization by Facility (n = 7,019)		CKRT Utilization by Facility (n = 12,000)		CKRT Utilization by Facility (n =27,068)	
	Adjusted Hazard Ratio (95% CI)	p-value	Adjusted Hazard Ratio (95% CI)	p-value	Adjusted Hazard Ratio (95% CI)	p-value	Adjusted Hazard Ratio (95% CI)	p-value	Adjusted Hazard Ratio (95% CI)	p-value
Q1	—		—		—		—		—	
Q2	1.00 (0.95, 1.05)	>0.9	1.14 (0.94, 1.39)	0.200	0.99 (0.86, 1.13)	0.800	0.95 (0.87, 1.05)	0.300	1.03 (0.95, 1.12)	0.500
Q3	0.94 (0.89, 0.98)	0.009	1.18 (0.97, 1.43)	0.089	1.03 (0.91, 1.16)	0.600	0.89 (0.81, 0.98)	0.019	0.92 (0.85, 0.99)	0.034
Q4	0.85 (0.81, 0.90)	<0.001	0.91(0.75, 1.10)	0.300	0.97 (0.85, 1.11)	0.700	0.93 (0.84, 1.03)	0.140	0.82 (0.76, 0.88)	<0.001

There was a statistically significant interaction (p<0.001) between ICU CKRT Utilization and ICU KRT Volume per Month.
When stratifying by ICU KRT Volume per Month quartiles, a dose-response pattern of decreasing mortality with increasing CKRT utilization was observed only in the highest ICU KRT Volume per Month quartile. Model was adjusted for all covariates of the original model.

eTable 8: Heatmap of Adjusted Hazard Ratios for CKRT Utilization Quartiles from the Original Model, Stratified by ICU KRT Volume per Month Quartiles

CKRT Utilization	ICU KRT per Month			
	First Quartile	Second Quartile	Third Quartile	Fourth Quartile
Q1	1	1	1	1
Q2	1.14 (0.94, 1.39)	0.99 (0.86, 1.13)	0.95 (0.87, 1.05)	1.03 (0.95, 1.12)
Q3	1.18 (0.97, 1.43)	1.03 (0.91, 1.16)	0.89 (0.81, 0.98)	0.92 (0.85, 0.99)
Q4	0.91 (0.75, 1.10)	0.97 (0.85, 1.11)	0.93 (0.84, 1.03)	0.82 (0.76, 0.88)

The data shown in the heat map have also been adjusted for all other elements of the original model. Similar results were observed in the cubic spline models. (eFigure 5)

eTable 9: ICU CKRT Volume per Month Quartiles

Quartile	ICU CKRT Volume per Month	Number of Patients	Mortality Rate
1	0 - 0.4	6,084	1,921 (32%)
2	0.5 - 1.2	6,897	2,224 (32%)
3	1.3 - 2.7	10,549	3,341 (32%)
4	2.8 - 33.9	26,155	9,313 (36%)

Additional sensitivity analysis was performed to explore the effect modification of ICU CKRT volume on the existing results. The average ICU CKRT volume per month was calculated for each facility in the Premier dataset, with adult inpatients receiving CKRT in the ICU between January 2018 and June 2021. This was the average per month of data reported, as not all facilities reported all months. Quartile thresholds for ICU CKRT volume were then determined using these averages, and each facility was assigned to a specific quartile based on the monthly CKRT use.

eTable 10: Cox Regression Model Hazard Ratios Original vs. New Model after Adding ICU CKRT Volume per Month Quartiles

	Original Model		Original Model + ICU CKRT Volume per Month Quartiles	
	CKRT Utilization by Facility (n = 49,685)		CKRT Utilization by Facility (n = 49,685)	
	Adjusted Hazard Ratio (95% CI)	p-value	Adjusted Hazard Ratio (95% CI)	p-value
Facility ICU CKRT Utilization, Yearly				
Q1	—		—	
Q2	1.00 (0.95, 1.05)	>0.9	1.01 (0.95, 1.07)	0.800
Q3	0.94 (0.89, 0.98)	0.009	0.95 (0.89, 1.02)	0.200
Q4	0.85 (0.81, 0.90)	<0.001	0.88 (0.82, 0.94)	<0.001
ICU CKRT per Month				
Q1	—		—	
Q2	—		1.04 (0.97, 1.11)	0.300
Q3	—		0.98 (0.91, 1.06)	0.600
Q4	—		0.97 (0.89, 1.06)	0.500

Adding ICU CKRT volume per month quartiles to the new model slightly impacted the effect of ICU CKRT utilization quartiles on risk-adjusted mortality. The data shown in eTable 10 have also been adjusted for all other covariates of the original model. There was no statistically significant interaction between ICU CKRT utilization and ICU CKRT volume per month (p=0.054).

eTable 11: Cox Regression Model Hazard Ratios Original vs. New Model Replacing Facility ICU CKRT Utilization with ICU CKRT Volume per Month Quartiles

	Original Model		Replace Facility ICU CKRT Utilization with ICU CKRT Volume per Month	
	CKRT Utilization by Facility (n = 49,685)		ICU CKRT Volume per Month (n = 49,685)	
	Adjusted Hazard Ratio (95% CI)	p-value	Adjusted Hazard Ratio (95% CI)	p-value
Facility ICU CKRT Utilization, Yearly				
Q1	—		—	
Q2	1.00 (0.95, 1.05)	>0.9	—	
Q3	0.94 (0.89, 0.98)	0.009	—	
Q4	0.85 (0.81, 0.90)	<0.001	—	
ICU CKRT Volume per Month				
Q1	—		—	
Q2	—		1.03 (0.97, 1.10)	0.400
Q3	—		0.95 (0.90, 1.01)	0.087
Q4	—		0.89 (0.84, 0.95)	<0.001

When ICU CKRT volume per month quartiles are used in the model instead of ICU CKRT utilization, a similar dose-response pattern is seen. The data shown in eTable 11 have also been adjusted for all other elements of the original model.

eTable 12: Number of Patients by KRT Modality According to CKRT Utilization and ICU KRT Volume Quartiles

	ICU KRT per Month Quartiles									
	First Quartile		Second Quartile		Third Quartile		Fourth Quartile		Total	
Facility ICU CKRT Utilization, Yearly	CKRT	IHD	CKRT	IHD	CKRT	IHD	CKRT	IHD	CKRT	IHD
Q1	54	860	123	2605	181	2798	281	3658	639	9921
Q2	157	601	280	952	615	2417	753	2920	1805	6890
Q3	228	474	646	1044	1086	2093	2454	3884	4414	7495
Q4	721	503	769	600	1551	1259	8221	4897	11262	7259
Total	1160	2438	1818	5201	3433	8567	11709	15359	18120	31565

eTable 13: Number of Patients in each CKRT Utilization Quartile Stratified by KRT Modality

Facility ICU CKRT Utilization, Yearly	CKRT Only	IHD Only	Both modalities	Total
Q1	483	9793	284	10560
Q2	1332	6684	679	8695
Q3	3286	7103	1520	11909
Q4	8398	6534	3589	18521
Total	13499	30114	6072	49685

eTable 14: Cox Regression Model Hazard Ratios of Mortality at 90 vs. 28 days

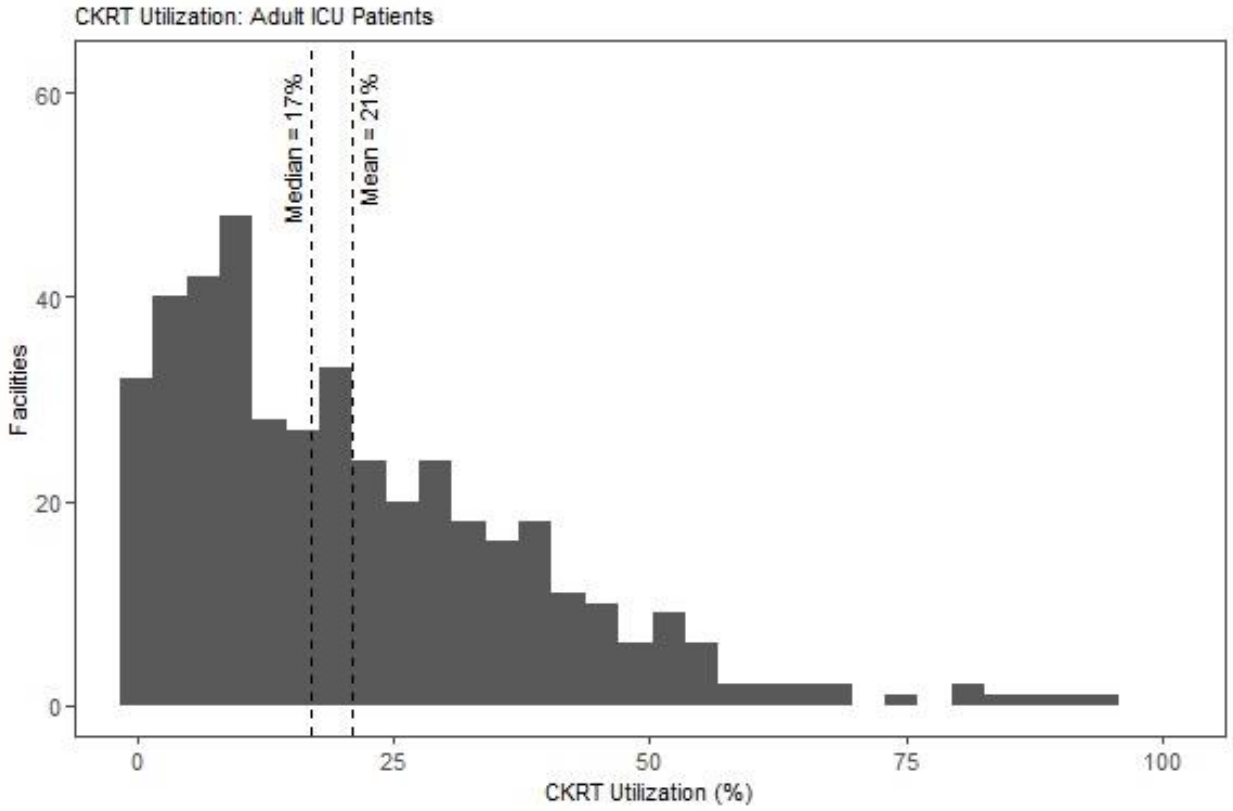
Facility ICU CKRT Utilization, Yearly	Original Analysis, 90-day Mortality		Sensitivity analysis, 28-day Mortality	
	CKRT Utilization by Facility (n = 49,685)		CKRT Utilization by Facility (n = 49,685)	
	Adjusted Hazard Ratio (95% CI)	p-value	Adjusted Hazard Ratio (95% CI)	p-value
Q1	—		—	
Q2	1.00 (0.95, 1.05)	>0.9	1.00 (0.94, 1.05)	0.900
Q3	0.94 (0.89, 0.98)	0.009	0.94 (0.89, 0.98)	0.011
Q4	0.85 (0.81, 0.90)	<0.001	0.86 (0.82, 0.90)	<0.001

eTable 15. Cox Regression Model Hazard Ratios Original vs. New Model accounting for Hospital Clustering Effects

	Original Analysis		Mixed Effects Model: Hospital	
Variable	**Adjusted Hazard Ratio (95% CI)**	**p-value**	**Adjusted Hazard Ratio (95% CI)**	**p-value**
Hospital-level CKRT utilization				
First Quartile (reference)	—		—	
Second Quartile	1.00 (0.95, 1.05)	>0.9	0.98 (0.92, 1.04)	0.500
Third Quartile	0.94 (0.89, 0.98)	0.009	0.97 (0.91, 1.03)	0.300
Fourth Quartile	0.85 (0.81, 0.90)	<0.001	0.91 (0.85, 0.97)	0.006
Age	1.02 (1.02, 1.02)	<0.001	1.02 (1.02, 1.02)	<0.001
Male vs. female	1.10 (1.07, 1.14)	<0.001	1.10 (1.07, 1.14)	<0.001
White, Non-Hispanic	0.96 (0.93, 0.99)	0.009	0.96 (0.92, 0.99)	0.014
MS-DRG Category: Medical vs. Surgical	2.19 (2.11, 2.26)	<0.001	2.20 (2.12, 2.27)	<0.001
Extreme APR-DRG Severity of Illness	2.25 (1.98, 2.56)	<0.001	2.24 (1.97, 2.54)	<0.001
COVID-19	1.51 (1.46, 1.57)	<0.001	1.51 (1.45, 1.57)	<0.001
Septic Shock	1.22 (1.18, 1.26)	<0.001	1.22 (1.18, 1.26)	<0.001
ECMO	1.59 (1.47, 1.72)	<0.001	1.59 (1.47, 1.73)	<0.001
Mechanical Ventilation	1.72 (1.64, 1.81)	<0.001	1.73 (1.65, 1.82)	<0.001
Days in ICU before KRT Initiation				
0-1 vs 2-3	0.87 (0.83, 0.91)	<0.001	0.88 (0.84, 0.92)	<0.001
0-1 vs 4-7	1.05 (1.01, 1.10)	0.024	1.06 (1.01, 1.11)	0.013
0-1 vs ≥ 8	1.18 (1.13, 1.24)	<0.001	1.19 (1.14, 1.25)	<0.001
Number of Vasopressors, post-KRT				
1 vs. 0	1.46 (1.40, 1.52)	<0.001	1.46 (1.40, 1.52)	<0.001
2+ vs. 0	1.90 (1.81, 1.98)	<0.001	1.93 (1.84, 2.01)	<0.001
First KRT modality				
IHD vs. CKRT	0.73 (0.70, 0.76)	<0.001	0.72 (0.70, 0.75)	<0.001
Teaching Status				
Non-Teaching vs. Teaching hospital	0.99 (0.96, 1.03)	0.700	0.99 (0.93, 1.06)	0.800
Population Served				
Rural vs. urban	0.95 (0.89, 1.00)	0.065	0.97 (0.88, 1.06)	0.500
Hospital no. of beds				
1-299 vs. 300-499	1.00 (0.96, 1.05)	>0.9	1.00 (0.94, 1.07	>0.9
1-299 vs 500+	1.00 (0.96, 1.05)	>0.9	1.01 (0.94, 1.08)	0.900
Geographic region				
Northeast (reference)	—		—	
Midwest	0.85 (0.80, 0.89)	<0.001	0.89 (0.81, 0.97)	0.008
South	0.91 (0.87, 0.95)	<0.001	0.95 (0.88, 1.03)	0.200
West	0.91 (0.86, 0.97)	0.001	0.96 (0.87, 1.06)	0.400

To address the residual risk associated with potential clustering effects and correlation within the data among hospitals, we performed a mixed-effects Cox model, maintaining the same set of variables as in our initial analysis. The overall findings were consistent across both models, but only the fourth CKRT utilization quartile exhibited a statistically significant association with risk-adjusted mortality. The data shown in eTable 14 have also been adjusted for all other elements of the original model.

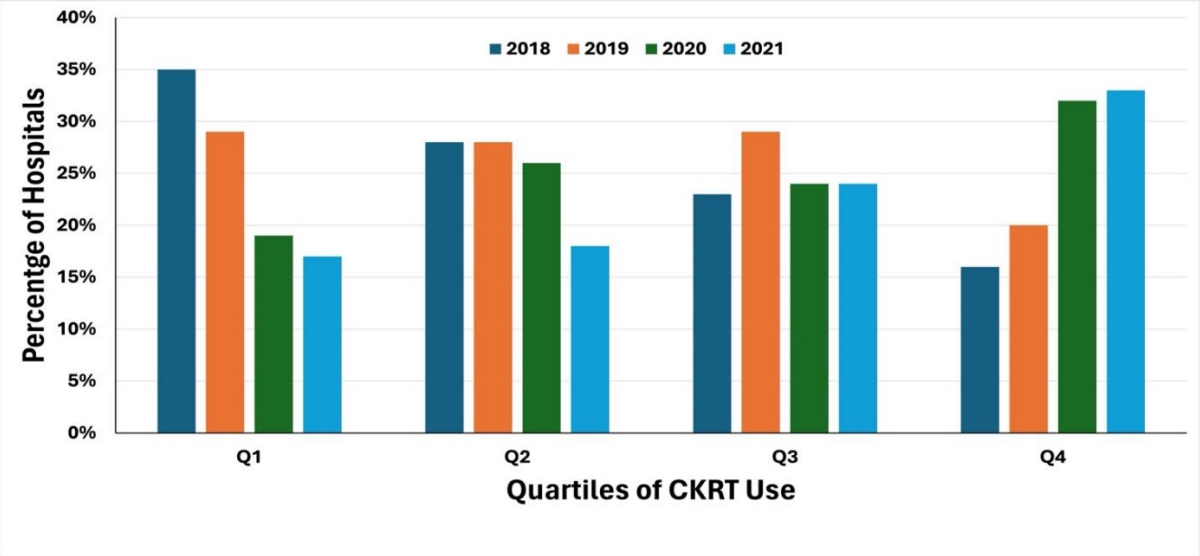
eFigure 1: Distribution of Facility CKRT utilization



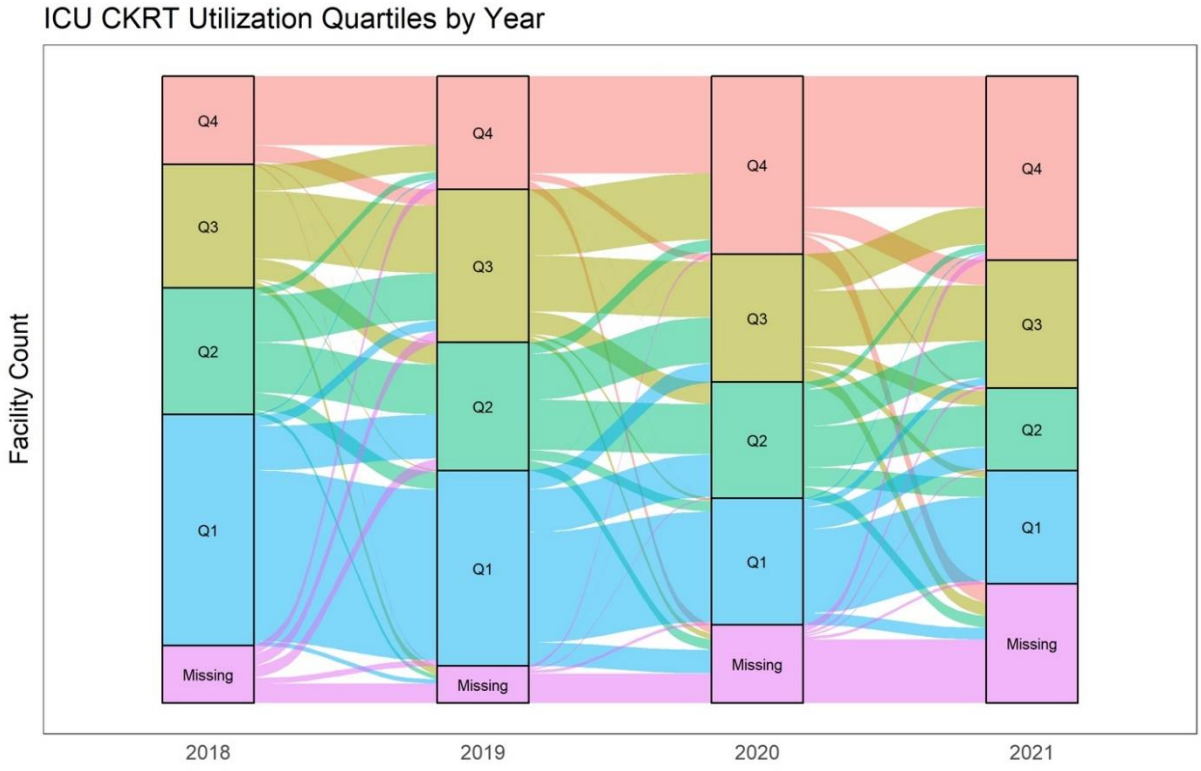
					Tertiles		Quartiles			Quintiles			
Population	**Mean**	**Median**	**Min**	**Max**	**33%**	**66%**	**25%**	**50%**	**75%**	**20%**	**40%**	**60%**	**80%**
All Years	21	17	0	94	10	26	8	17	31.5	6	13	22	35

eFigure 2. Hospital-level CKRT Utilization by Year and Quartiles of CKRT use

A



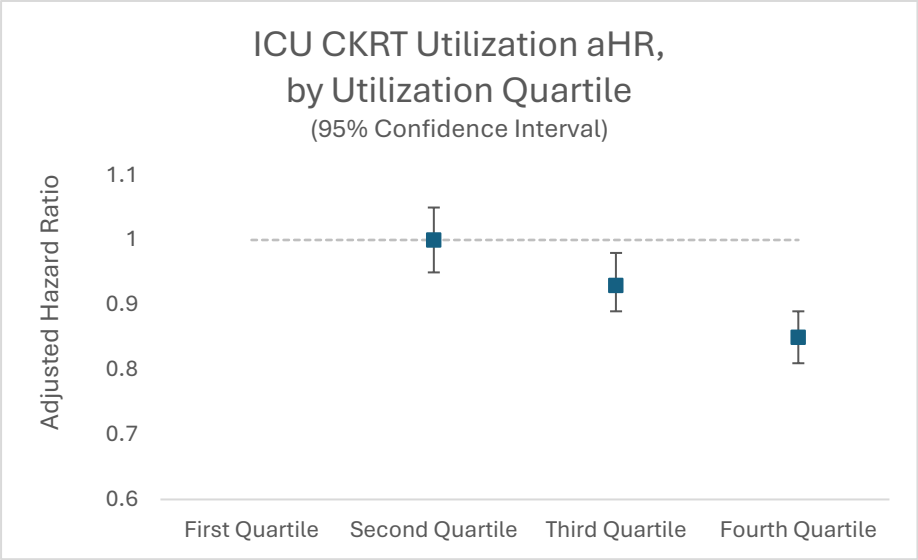
B



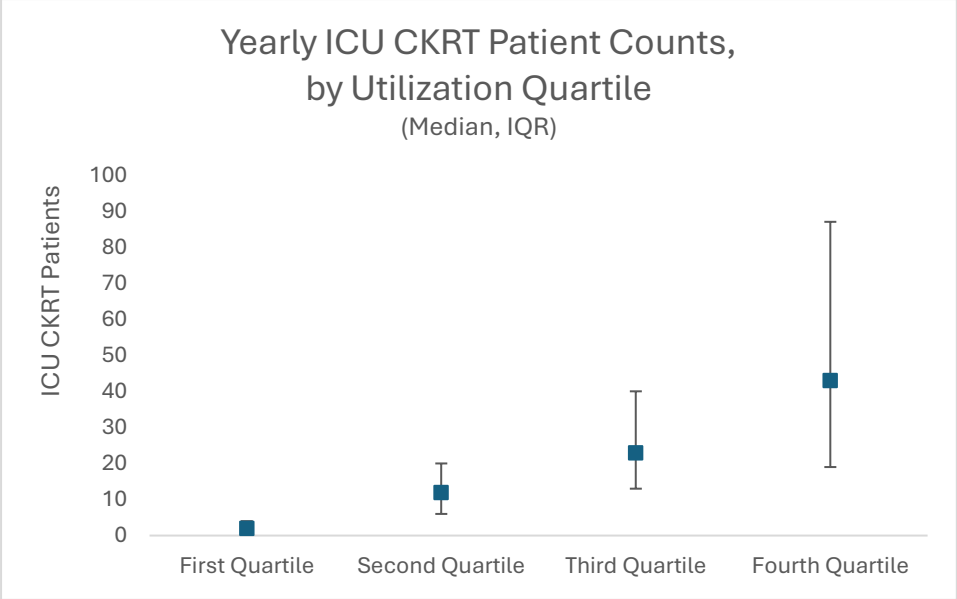
A. The yearly CKRT utilization rates were calculated for each hospital. In 2020 and 2021, a shift to a larger percentage of hospitals with higher CKRT utilization was observed.
B. Alluvial diagram showing transitions in CKRT utilization rates over time. Hospitals that did not report data to the Premier Healthcare Dataset during the year were designated as missing for that year.

eFigure 3. Association of CKRT Utilization Quartiles with Risk-Adjusted Mortality

A

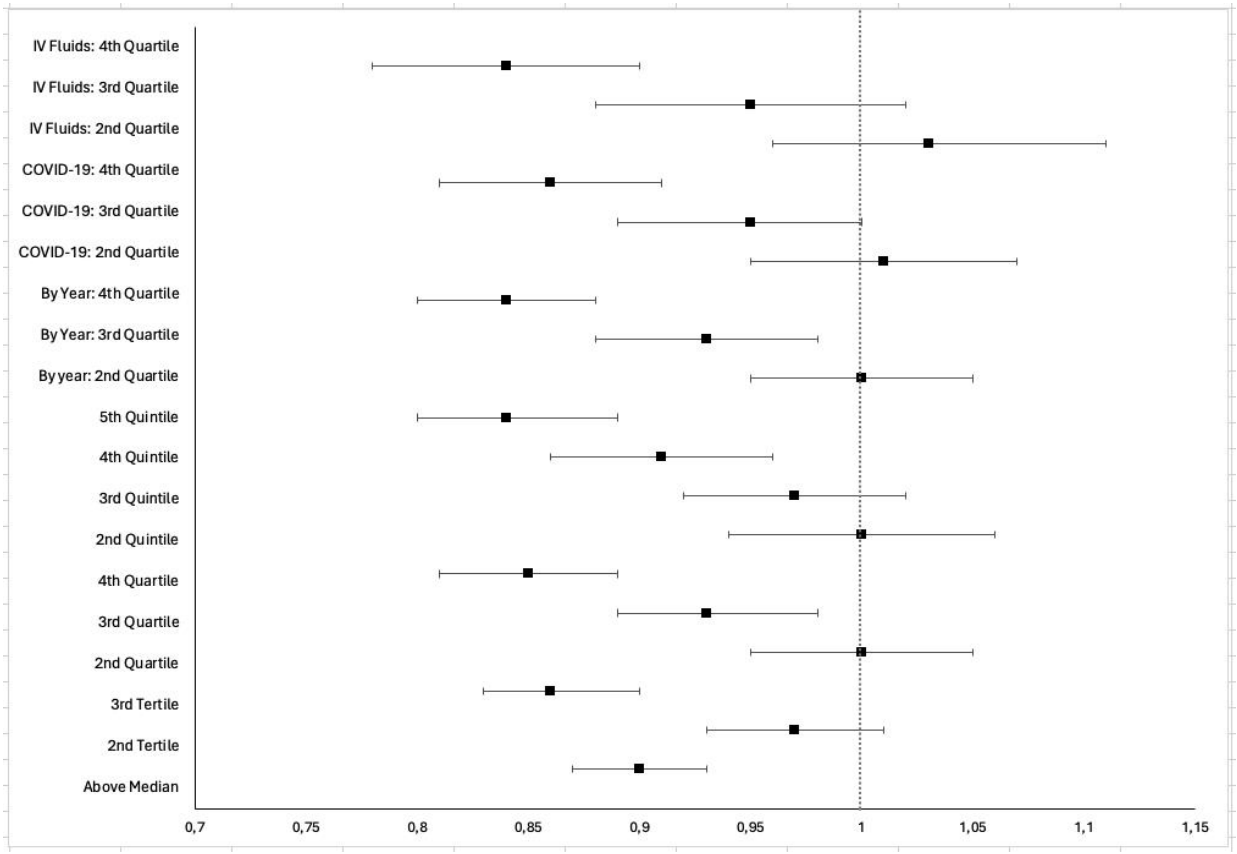


B



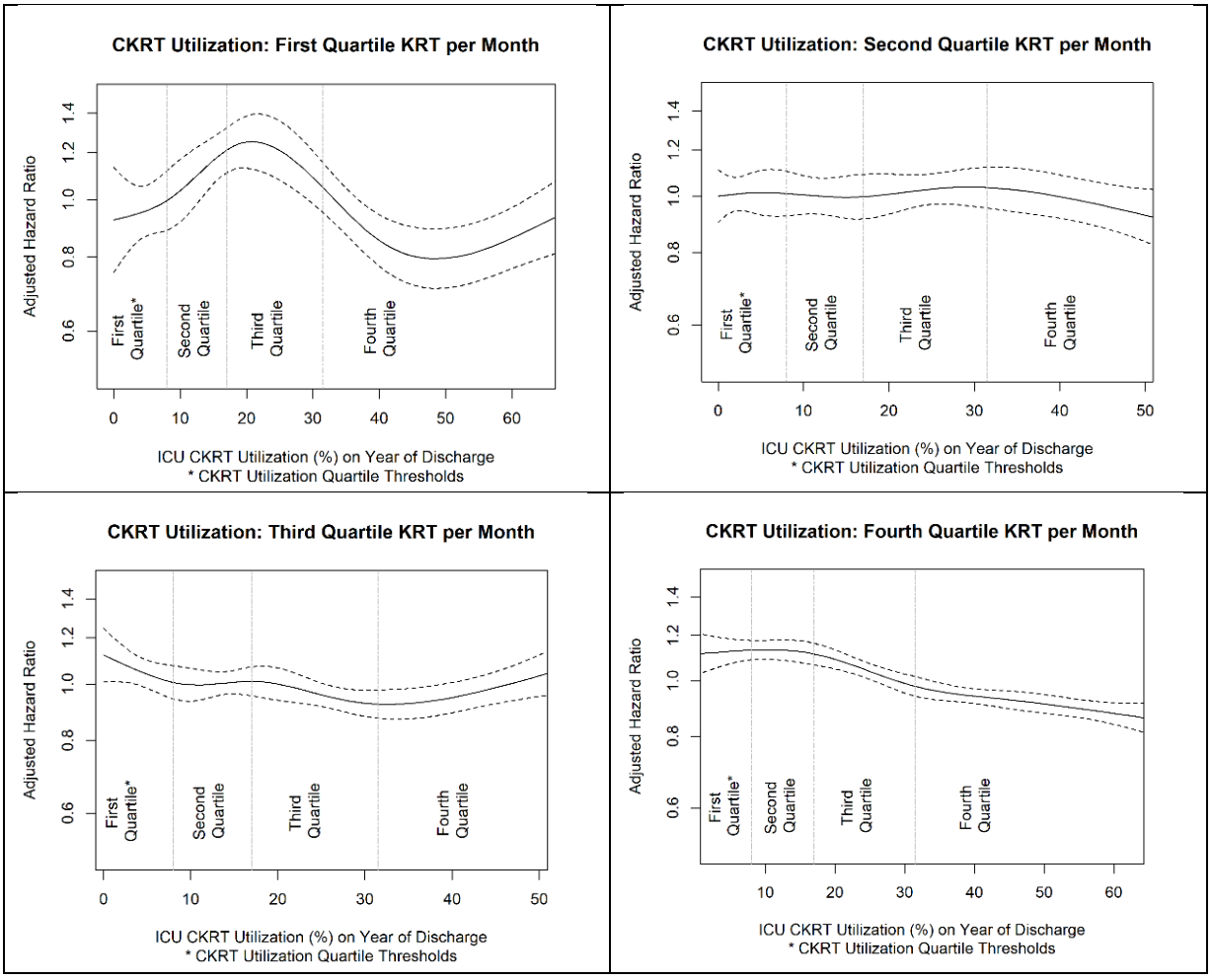
A: Forest plot showing the association of hospital-level CKRT utilization with risk-adjusted mortality.
B: Yearly ICU CKRT patient counts, by CKRT utilization quartile.
Models were adjusted for differences in age, sex, race, medical diagnosis, extreme APR-DRG severity illness category, COVID-19 infection, septic shock, ECMO use, mechanical ventilation use, days in the ICU before KRT, no. of vasopressors used after KRT initiation, initial KRT modality, hospital teaching status, geographic region, urban population, and no. of hospital beds.

eFigure 4. Sensitivity Analyses of CKRT Utilization Rates with Mortality



Models were adjusted for differences in age, sex, race, medical diagnosis, extreme APR-DRG severity illness category, COVID-19 infection, septic shock, ECMO use, mechanical ventilation use, days in the ICU before KRT, no. of vasopressors used after KRT initiation, initial KRT modality, hospital teaching status, geographic region, urban population, and no. of hospital beds.

eFigure 5. Cubic Spline Models stratified by ICU KRT Volume per Month Quartiles



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