

# Unexpected Increase in In-Hospital Mortality Among Acute Kidney Injury Patients Receiving Continuous Renal Replacement Therapy: Healthcare Cost and Utilization Project – National Inpatient Sample (HCUP NIS) 2018–2021

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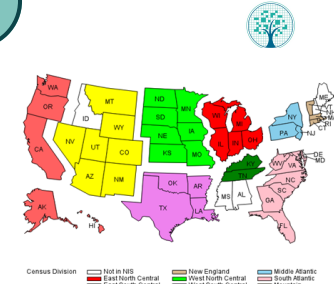
## INTRODUCTION

Acute kidney injury (AKI) requiring continuous renal replacement therapy (CRRT) signals severe critical illness. Contemporary national trends in outcomes remain uncertain.

## METHODOLOGY

We analyzed adult hospitalizations with AKI treated with CRRT in the 2018–2021 HCUP-NIS, excluding end-stage renal disease on maintenance dialysis. Survey weights generated national estimates. Baseline characteristics, complications, and resource use were summarized.

Temporal trends were tested using the Cochran–Armitage test and survey-weighted regression. Mortality predictors were identified via multivariable survey-weighted logistic regression adjusting for demographics, comorbidities (Deyo–Charlson), and hospital factors.



## RESULT

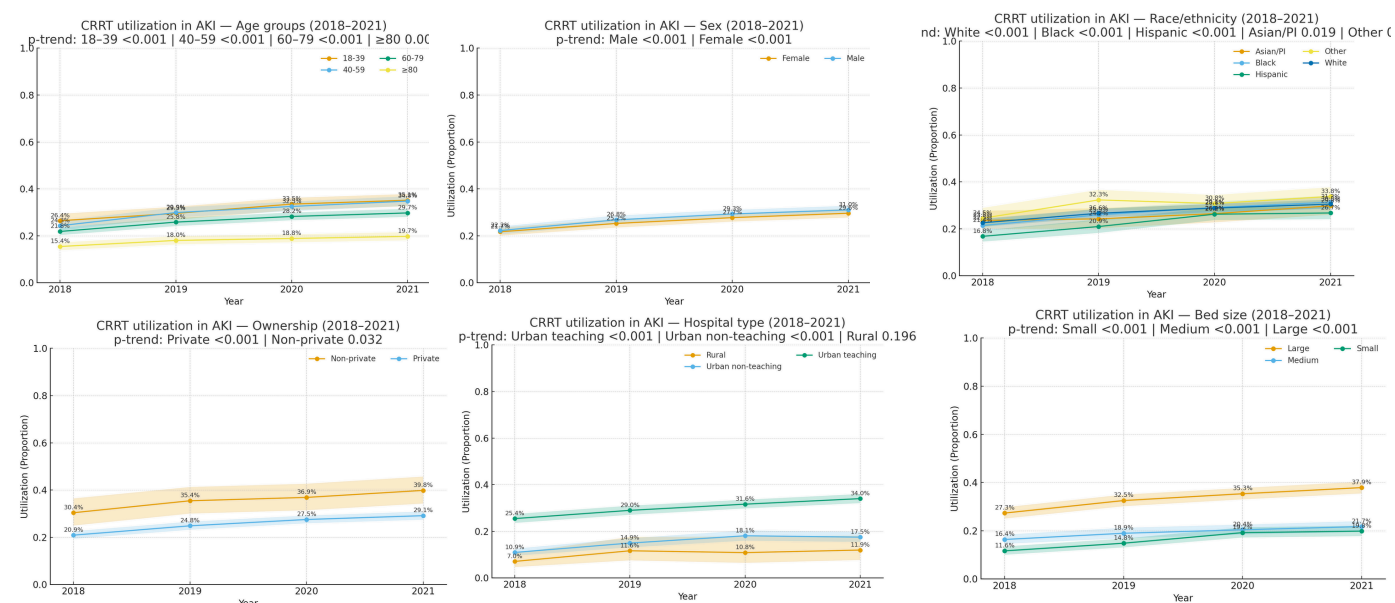
We identified 31,576 unweighted admissions. Weighted demographics: 62% male; age distribution 18–39 (9.6%), 40–59 (30.5%), 60–79 (51.7%),  $\geq 80$  (8.2%); race White (63.6%), Black (19.3%), Hispanic (10.0%), Asian/Pacific Islander (2.7%).

Frequent complications included sepsis (69.4%), metabolic acidosis (60.6%), and hyperkalemia (37.2%).

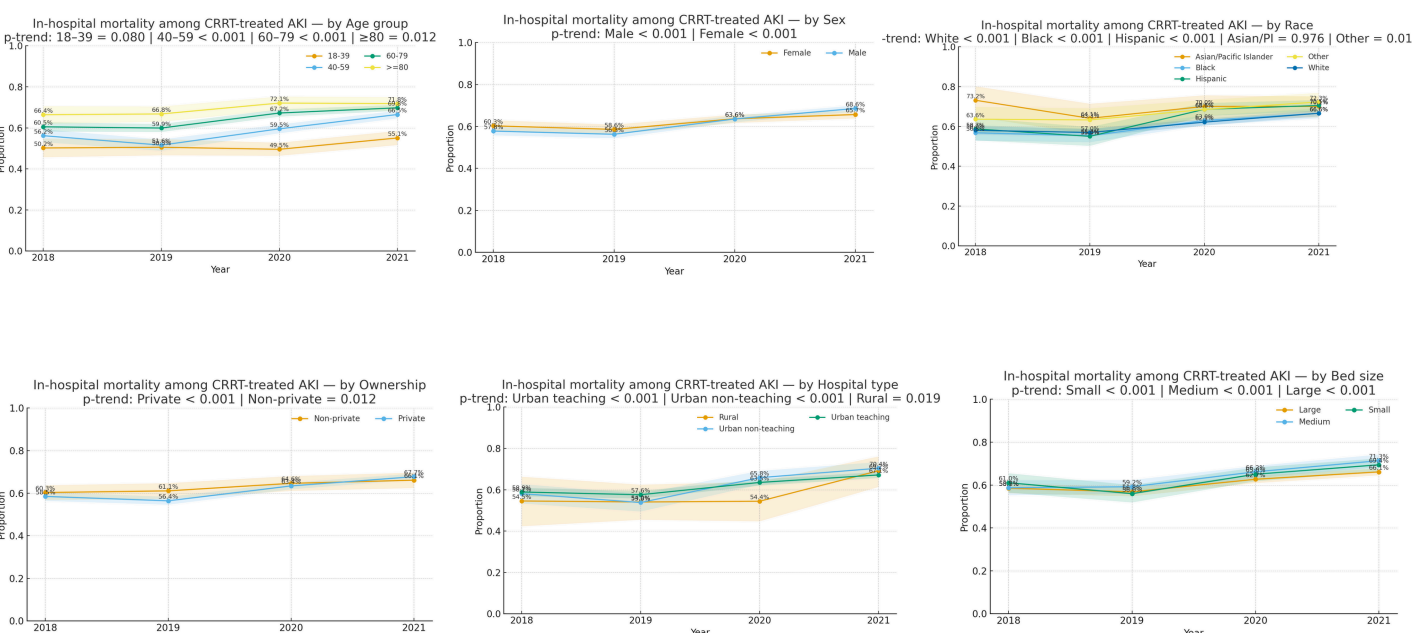
Overall in-hospital mortality was 62.7% (95%CI 61.9–63.5), rising from 58.8% (2018) to 67.5% (2021) ( $P < 0.001$ ), with increases across most age, sex, and race strata. Independent mortality associations (adjusted OR, 95%CI) included older age ( $\geq 80$ : 2.52, 2.22–2.86), Hispanic race (1.22, 1.12–1.33), coronary artery disease (1.33, 1.24–1.42), arrhythmia (1.17, 1.11–1.23), COPD (1.14, 1.08–1.22), cirrhosis (1.46, 1.34–1.59), cancer (1.40, 1.28–1.53); elective admission was protective (0.71, 0.64–0.78).

Charlson score showed an inverse association with mortality (per-point OR 0.96, 0.95–0.97). Median length of stay was 14 days (IQR 6–24). Mean hospitalization cost increased from \$392,331 (2018) to \$461,320 (2021) ( $P = 0.006$ ).

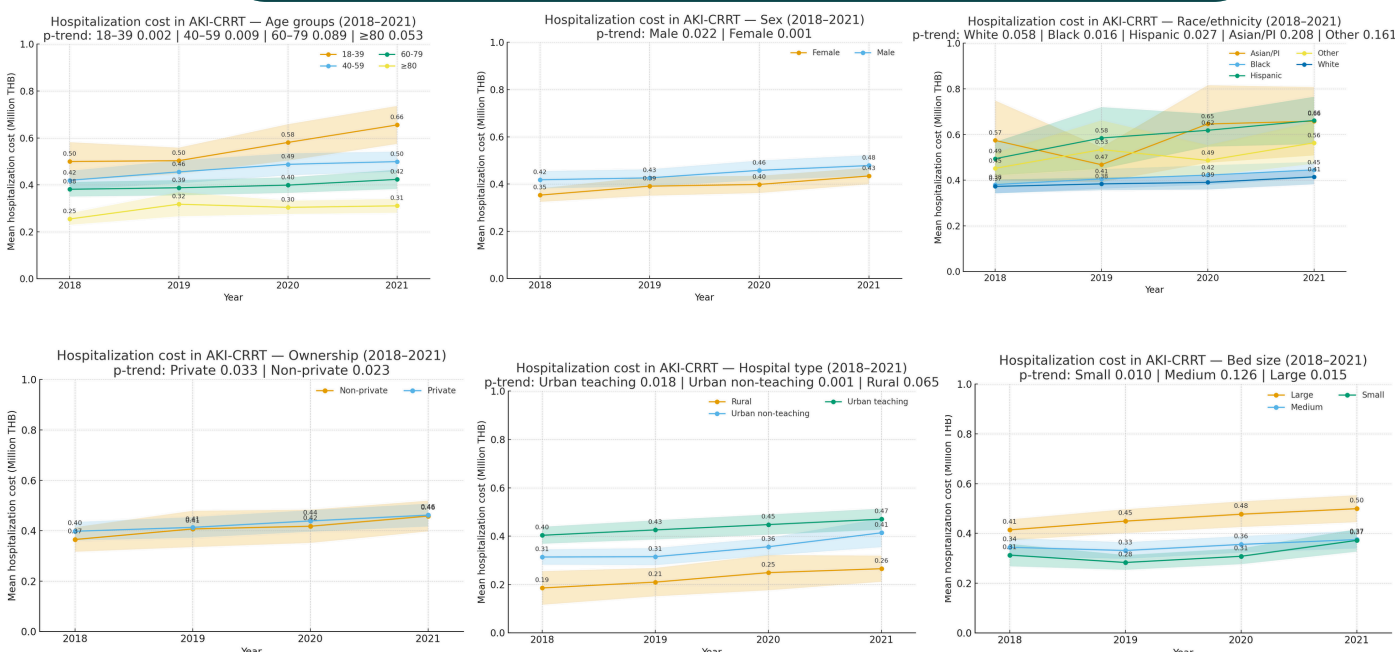
### Trend of continuous renal replacement therapy utilization in acute kidney injury from 2018 to 2021



### In-hospital mortality of acute kidney injury patients requiring continuous renal replacement therapy from 2018 to 2021



### Mean hospitalization cost of acute kidney injury patients requiring continuous renal replacement therapy from 2018 to 2021



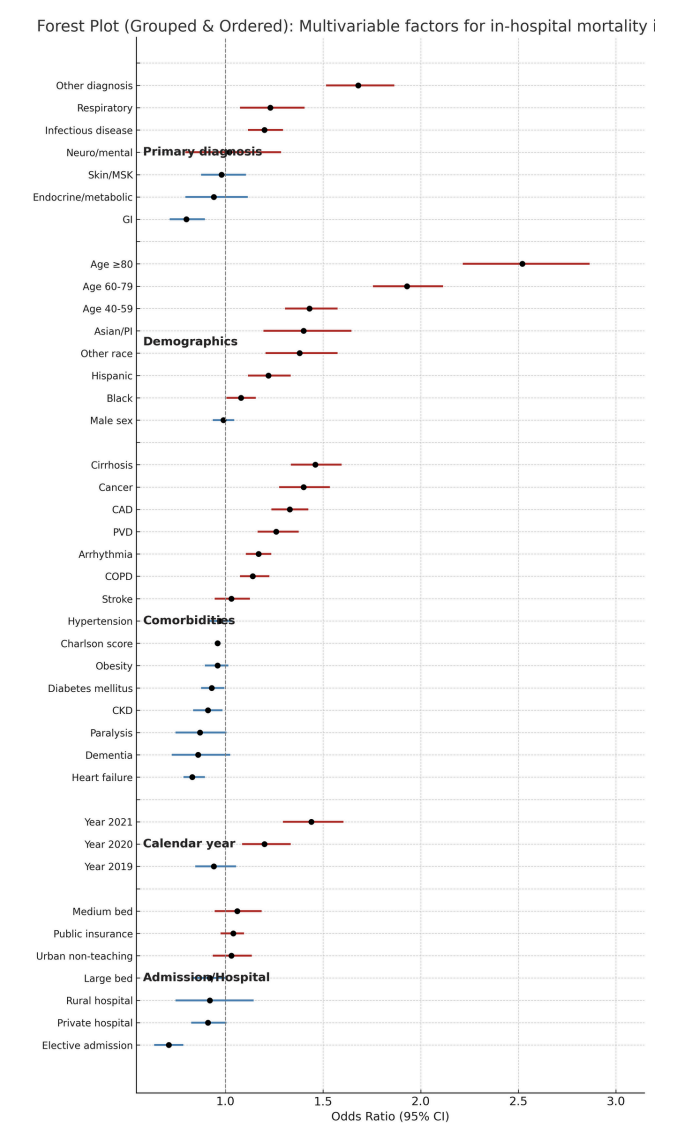
### Baseline characteristics of acute kidney injury patients requiring continuous renal replacement therapy from 2018 to 2021

Characteristics	Unweighted N	Weighted % (95%CI)
Age (years)		
- 18–39	3,045	9.64 (9.29–10.00)
- 40–59	9,631	30.50 (29.93–31.08)
- 60–79	16,318	51.68 (51.08–52.28)
- $\geq 80$	2,581	8.17 (7.83–8.53)
Male sex	19,464	61.65 (61.09–62.20)
Race		
- White	19,325	63.62 (62.46–64.76)
- Black	5,876	19.34 (18.45–20.28)
- Hispanic	3,051	10.04 (9.41–10.72)
- Asian/Pacific Islander	817	2.69 (2.44–2.97)
- Other	1,307	4.30 (3.97–4.66)
Year of hospitalization		
- 2018	5,360	16.97 (15.18–18.94)
- 2019	6,573	20.82 (18.77–23.02)
- 2020	9,152	28.98 (26.57–31.52)
- 2021	10,491	33.22 (30.62–35.94)
Comorbidity		
- Diabetes mellitus	12,010	38.04 (37.35–38.73)
- Hypertension	19,581	62.01 (61.22–62.80)
- Chronic kidney disease	4,064	12.87 (12.36–13.40)
- Heart failure	13,716	43.44 (42.77–44.10)
- Coronary artery disease	6,663	21.10 (20.56–21.65)
- Cardiac arrhythmia	16,264	51.51 (50.81–52.20)
- Stroke	3,358	10.63 (10.28–11.00)
- Peripheral vascular disease	4,089	12.95 (12.50–13.42)
- COPD	7,116	22.54 (21.97–23.11)
- Cirrhosis	4,550	14.41 (13.82–15.02)
- Cancer	4,005	12.68 (12.17–13.22)
- Dementia/cognitive impairment	693	2.19 (2.03–2.37)
- Paralysis	922	2.92 (2.73–3.12)
- Obesity	7,788	24.66 (23.98–25.37)
Primary diagnoses for admission		
- Cardiovascular	752	2.38 (2.22–2.55)
- Endocrine/metabolic	2,465	7.81 (7.42–8.21)
- Gastrointestinal	13,923	44.09 (43.35–44.84)
- Infectious disease	1,287	4.08 (3.86–4.30)
- Respiratory	1,068	3.38 (3.18–3.59)
- Genitourinary	385	1.22 (1.11–1.34)
- Neurological/mental	271	0.86 (0.76–0.97)
- Skin/soft tissue/musculoskeletal	1,819	5.76 (5.49–6.05)
- Trauma/injury	3,568	11.30 (10.84–11.78)
- Other	2,044	6.48 (6.15–6.83)
Elective admission	21,153	66.99 (66.28–67.70)
Public insurance		
- Hospital type		
- Urban teaching	28,185	89.26 (88.51–89.97)
- Urban non-teaching	2,882	9.13 (8.52–9.77)
- Rural	509	1.61 (1.29–2.00)
Hospital bed size		
- Small	3,316	10.50 (9.83–11.22)
- Medium	5,910	18.72 (17.62–19.87)
- Large	22,350	70.78 (69.37–72.16)
Private hospital	26,413	83.65 (81.98–85.19)
Charlson comorbidity score		
- median (IQR) min-max		
- 4 (2–7) 0–21		
- 5 (5–5)		

### Outcomes and resource utilization of acute kidney injury patients requiring continuous renal replacement therapy from 2018 to 2021

Outcomes and resource utilization	Unweighted N	Weighted % (95%CI)
Volume overload	3,229	10.23 (9.68–10.80)
Hyperkalemia	11,759	37.24 (36.34–38.15)
Metabolic acidosis	19,124	60.56 (59.83–61.29)
Sepsis	21,925	69.44 (68.74–70.12)
Hemodialysis	695	2.20 (2.00–2.42)
Blood transfusion	9,265	29.34 (27.77–30.96)
Parenteral nutrition	1,501	4.75 (4.40–5.13)
Vasopressor	10,960	34.71 (32.75–36.72)
Mechanical ventilation	4,809	15.23 (14.50–15.99)
Cardiac arrest	4,385	13.89 (13.45–14.34)
Palliative care	10,470	33.16 (32.30–34.02)
In-hospital mortality	19,804	62.73 (61.95–63.50)
Resource utilization		
- median (IQR) min-max		
- Length of hospital stay (day)	14 (6–24) 0–354	18 (18–19)
- Hospitalization cost (\$)	271,393 (141,270–512,195)	431,765 (412,986–450,543)

### Factors associated with in-hospital mortality in acute kidney injury patients requiring continuous renal replacement therapy from 2018 to 2021



## CONCLUSION

In-hospital mortality among AKI patients receiving CRRT increased substantially from 2018 to 2021, alongside rising costs. Targeted prevention and risk-stratified care—particularly for elderly patients and those with high-risk comorbid profiles—are urgently needed.

## KEYWORDS

acute kidney injury; continuous renal replacement therapy; in-hospital mortality; temporal trends

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