

Prognosis of Severe Acute Kidney Injury Requiring Renal Replacement Therapy: A Systematic Review

Meysam Ghanbari Saray,¹ Mohammad Mahdi Heidari²

¹Scientific Research Center of Azerbaijan Medical University, Baku, Azerbaijan

²Department of Pediatrics, School of Medicine, Iran University of Medical Sciences, Tehran, Iran

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Introduction. Acute kidney injury (AKI) requiring renal replacement therapy (RRT) represents the most severe spectrum of AKI in critically ill patients and is associated with high mortality and long-term morbidity. To systematically review short- and long-term outcomes and prognostic factors in adult patients with severe AKI requiring RRT in intensive care settings.

Methods. A systematic search of PubMed, Embase, and the Cochrane Library was conducted from January 2000 to June 2024 in accordance with PRISMA 2020 guidelines. Adult studies reporting mortality and/or renal outcomes in AKI requiring RRT were included. Data were synthesized narratively.

Results. Thirty-two studies involving over 80,000 patients were included. Short-term mortality ranged from 40% to 70%, with hospital mortality frequently exceeding 50%. Long-term mortality remained high, approaching 70 to 80% at 5 to 10 years. Renal recovery occurred in approximately 30 to 40% of survivors, while 10 to 20% remained dialysis-dependent at discharge. Prognosis was predominantly influenced by sepsis, multi-organ failure, illness severity scores, advanced age, and fluid overload.

Conclusions. Severe AKI requiring RRT is associated with poor short- and long-term outcomes. Prognosis is driven primarily by the severity of critical illness rather than dialysis-related factors, highlighting the need for early risk stratification and structured post-ICU follow-up.

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INTRODUCTION

Acute kidney injury (AKI) is a common complication of critical illness, affecting up to 50% of patients admitted to the intensive care unit (ICU) and contributing substantially to morbidity, mortality, and healthcare costs.^{1,2} While many episodes of AKI are mild and reversible, a significant subset progresses to severe AKI requiring renal replacement therapy (RRT), representing the most advanced stage of renal dysfunction in critically ill patients.³

The requirement for RRT in AKI reflects profound systemic derangement and is frequently accompanied by sepsis, hemodynamic instability, and multi-organ failure.⁴ Epidemiological studies have consistently demonstrated that AKI requiring RRT is associated with markedly higher mortality compared with AKI not requiring dialysis and



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with critically ill patients without AKI.⁵ Despite advances in critical care management and dialysis technology, mortality rates among patients with AKI requiring RRT have remained persistently high over the past two decades.⁶

Beyond short-term outcomes, AKI requiring RRT has emerged as a strong predictor of long-term adverse events. Survivors are at increased risk of chronic kidney disease (CKD), end-stage kidney disease (ESKD), cardiovascular events, and late mortality.^{7,8} Importantly, renal recovery following AKI requiring RRT is often incomplete, and dialysis dependence at hospital discharge or during follow-up is associated with poor long-term survival.⁹

Accurate prognostication in this population remains challenging. Traditional severity-of-illness scoring systems, such as APACHE II and SOFA, incompletely capture the risk associated with severe AKI and RRT initiation.¹⁰ Furthermore, uncertainty persists regarding the prognostic significance of dialysis-related factors, including modality and timing of RRT initiation, compared with patient-related and illness-related determinants.¹¹

Given the clinical, ethical, and prognostic implications of initiating RRT in critically ill patients, a comprehensive synthesis of available evidence on outcomes and prognostic factors is essential. This systematic review aims to evaluate short- and long-term mortality, renal recovery, and determinants of prognosis in adult patients with severe AKI requiring RRT.

MATERIALS AND METHODS

Study Design and Reporting

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines.

Search Strategy

A comprehensive search of PubMed/MEDLINE, Embase, and the Cochrane Library was performed for studies published between January 2000 and June 2024. Search terms included combinations of acute kidney injury, renal replacement therapy, dialysis, critical illness, intensive care, mortality, outcome, and prognosis.

Eligibility Criteria

Inclusion criteria.

- Adult patients (≥ 18 years)
- AKI requiring RRT in ICU or critical care settings
- Reported mortality and/or renal recovery outcomes
- Observational studies or randomized controlled trials

Exclusion criteria.

- Pediatric studies
- Chronic dialysis or ESKD populations
- Case reports, editorials, conference abstracts
- Studies without extractable outcome data

Data Extraction and Quality Assessment

Two reviewers independently screened studies and extracted data. Risk of bias was assessed using the Newcastle–Ottawa Scale for observational studies and the Cochrane Risk of Bias Tool for randomized trials.

RESULTS

Study Selection and Characteristics

A total of 4,126 records were identified, and 32 studies were included in the final qualitative synthesis. Most were retrospective cohort studies conducted in mixed ICUs. Continuous renal replacement therapy (CRRT) was the predominant modality (Figure).

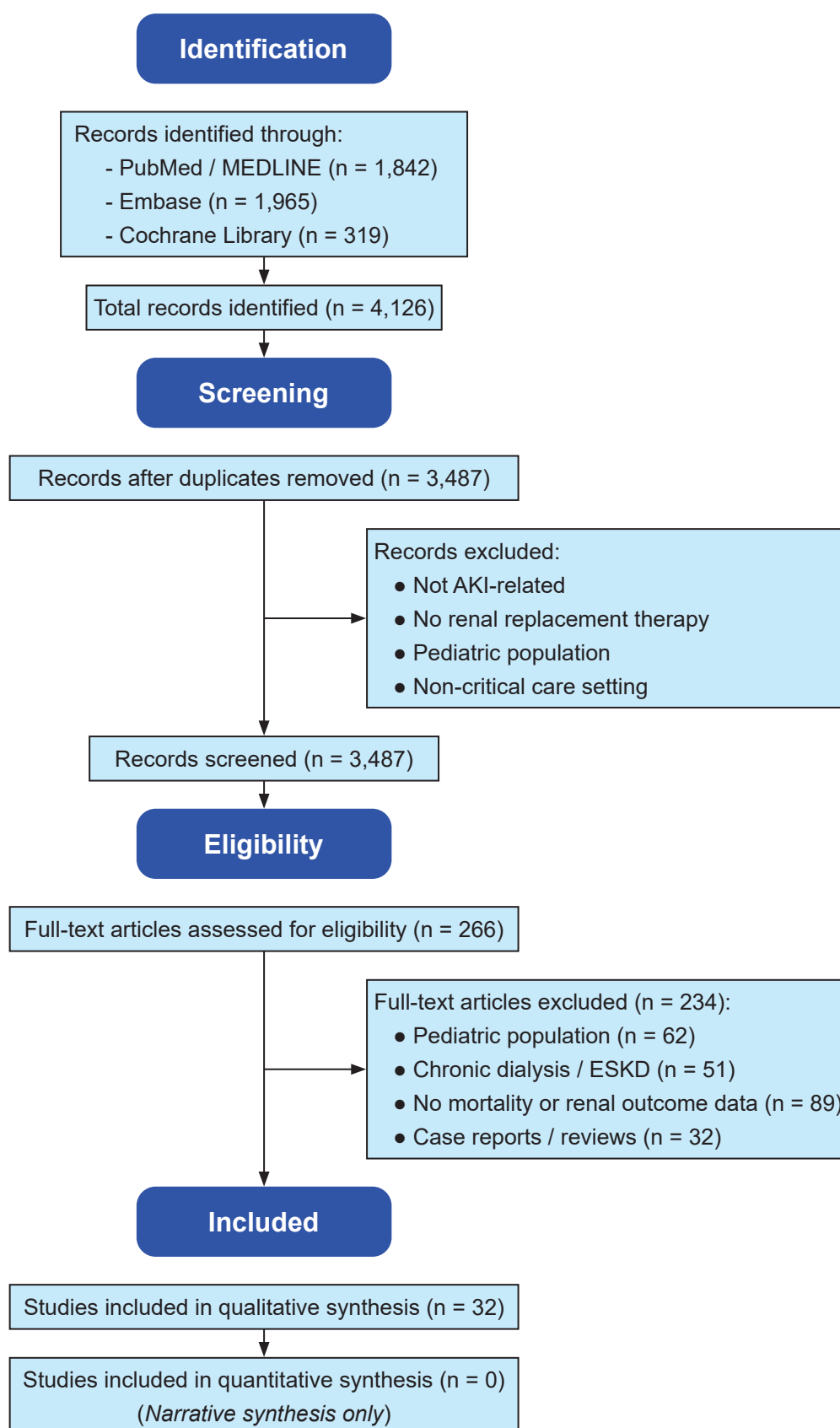
Short-Term Mortality

Short-term mortality was consistently high across studies. In a large cohort of 573 critically ill patients with AKI requiring RRT, in-hospital mortality was 52%, with early deaths occurring predominantly within the first week of RRT initiation.¹² Similarly, a UK ICU cohort of 821 patients reported ICU mortality of 55% and hospital mortality of 66%.¹³

A single-center study reported 30-day survival of 54.4% and 90-day survival of 47.2%, highlighting substantial early attrition.¹⁴ Mortality was strongly associated with the presence of multi-organ failure and septic shock.

Long-Term Mortality

Long-term outcomes remained poor even among



PRISMA Flowchart. A total of 4,126 records were identified, and 32 studies were included in the final qualitative synthesis.

hospital survivors. A prospective cohort with five-year follow-up demonstrated that only 25% of patients were alive at five years following AKI requiring RRT.¹⁵ Other long-term studies reported progressively increasing mortality over time, with AKI requiring RRT emerging as an independent predictor of late death.^{7,8}

Renal Recovery

Renal recovery was incomplete in a substantial proportion of survivors. In one cohort, only 32.5% recovered sufficient kidney function to discontinue RRT before discharge, while 15.9% remained dialysis-dependent.¹² At one year, approximately 25 to 30% of patients were RRT-independent, although many had persistent CKD.^{14,16} Late recovery after hospital discharge was uncommon.

Prognostic Factors

Consistent predictors of poor prognosis included:

- Sepsis and septic shock^{12,14}
- High SOFA and APACHE II scores^{10,12}
- Advanced age^{13,16}
- Oliguria and fluid overload^{12,17}
- Mechanical ventilation and vasopressor requirement¹³

Dialysis modality and timing of RRT initiation were not consistently associated with improved survival, suggesting that prognosis is driven primarily by systemic illness severity rather than dialysis-specific variables.^{11,18}

DISCUSSION

This systematic review demonstrates that severe AKI requiring RRT remains a condition with devastating short- and long-term outcomes. Across diverse ICU populations, hospital mortality exceeds 50%, and long-term mortality approaches 70 to 80% in extended follow-up studies.¹²⁻⁵ These findings confirm that the need for RRT represents a marker of advanced critical illness rather than isolated renal failure.

Renal recovery occurs in only a minority of patients and is frequently incomplete. Survivors with persistent renal dysfunction face an increased risk of CKD progression, cardiovascular disease, and late mortality.^{7,9} Importantly, renal recovery typically occurs early, emphasizing the prognostic

importance of kidney function status at hospital discharge.

Prognosis is consistently determined by non-renal factors, particularly sepsis, multi-organ failure, and overall illness severity.^{4,12,14} The lack of consistent survival benefit associated with RRT modality or timing supports the concept that dialysis serves as supportive therapy rather than a disease-modifying intervention.¹¹

These findings have important implications for clinical practice. Early recognition of patients with a poor prognostic profile may facilitate shared decision-making, realistic goal setting, and timely integration of palliative care. Furthermore, survivors of AKI requiring RRT should be considered a high-risk population requiring structured post-ICU nephrology follow-up.

CONCLUSIONS

Severe AKI requiring RRT in critically ill adults is associated with high mortality and frequent incomplete renal recovery. Prognosis is driven predominantly by the severity of systemic illness rather than dialysis-related factors. Improved prognostic tools, early risk stratification, and long-term survivorship care are essential to improve outcomes in this vulnerable population.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this article.

AI USAGE STATEMENT

The authors used artificial intelligence (AI)-assisted tools for language editing and grammar improvement during the preparation of this manuscript. All scientific content, interpretations, and conclusions were reviewed and approved by the authors.

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Correspondence to:

Meysam Ghanbari Saray
Scientific Research Center of Azerbaijan Medical University,
Baku, Azerbaijan
ORCID ID: 0009-0003-4568-117X
E-mail: meysamghanbari2202@gmail.com

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