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Vancomycin pharmacokinetics and dosing in critically ill adult patients on continuous renal replacement therapy: A scoping review

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ADMINISTRATIVE INFORMATION

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Review Stage at time of this submission - This scoping review is being registered retrospectively following a recommendation from the journal editor during the peer-review process. The study has been completed, and the manuscript is currently under formal review.

Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 24 April 2026 and was last updated on 24 April 2026.

INTRODUCTION

Review question / Objective What is the current state of evidence regarding vancomycin pharmacokinetics and dosing regimens in critically ill adult patients receiving continuous renal replacement therapy (CRRT)?

Background Acute kidney injury (AKI) represents a sudden decline in renal function affecting up to 25% of intensive care unit (ICU) patients, with associated mortality reaching as high as 60 %. When AKI results in significant metabolic derangements, renal replacement therapy (RRT) is recommended. Between 1996 and 2010, the utilization of RRT in critical care settings quadrupled, with continuous renal replacement therapy (CRRT) emerging as the primary modality for hemodynamically unstable patients.

CRRT facilitates fluid management and solute clearance (Cl) through three primary modalities: continuous veno-venous hemofiltration (CVVH), continuous veno-venous hemodialysis (CVVHD), and continuous veno-venous hemodiafiltration (CVVHDF). These modalities differ by their transport mechanisms; CVVH relies on convection, CVVHD on diffusion, and CVVHDF utilizes both. Operational parameters include blood, dialysate, and replacement fluid flow rates, which collectively determine the total effluent rate. Per the 2012 KDIGO guidelines, an effluent volume of 20–25 mL/kg/hr is the standard recommendation.

The clearance of drugs during CRRT is influenced by different factors including the effluent rate, membrane porosity, and the drug's protein-binding characteristics. Most medications possess a molecular weight under 500 daltons, allowing for easy passage across high-flux membranes; however, only the unbound fraction is available for removal. Vancomycin, a glycopeptide with a molecular weight of roughly 1,450 daltons and 10–50% protein binding. While it typically has a half-

life of 6–12 hours and a volume of distribution of 0.4–1 L/kg, these pharmacokinetic parameters are significantly altered by both critical illness and CRRT. This complicates the achievement of the target AUC24/MIC ratio, which is the primary predictor of vancomycin's efficacy.

Current global guidelines offer varying approaches to vancomycin administration in this population. The 2020 consensus from major US societies (ASHP/IDSA/PIDS/SIDP) suggests a loading dose of 20 – 25 mg/kg and a maintenance dose of 7.5 – 10 mg/kg every 12 hours for standard effluent rates. The 2013 Japanese guidelines recommended a loading dose of 15 – 20 mg/kg and a maintenance dose of 500 mg (7.5 – 10 mg/kg) every 24 hours in CVVHDF. More recent updates from the same Japanese group (2022) emphasize model-informed precision dosing rather than fixed regimens. Furthermore, 2020 guidelines from the Chinese Pharmacological Society decline to provide specific initial dosing recommendations for RRT patients, citing the inherent difficulty in predicting vancomycin pharmacokinetics in these complex clinical scenarios.

Rationale Vancomycin dosing in critically ill patients receiving CRRT remains a clinical challenge due to significant variability in drug clearance and patient-specific factors. While various studies have been published, there is currently no comprehensive mapping that synthesizes findings across single-dose, multiple-dose, and population pharmacokinetic studies. This scoping review is necessary to consolidate these heterogeneous findings and identify precisely where evidence is lacking to guide safer clinical practice, future studies and guidelines.

METHODS

Strategy of data synthesis All pertinent studies through April 2026 were identified using the following databases: Ovid MEDLINE via PubMed, the Cochrane Central Register of Controlled Trials, and ClinicalTrials.gov

The following searching strategies were used for each database:

Ovid MEDLINE via PubMed
1. ("Vancomycin"[Mesh]) AND "Continuous Renal Replacement Therapy"[Mesh]
2. (Vancomycin[Title]) AND ((Continuous Renal Replacement Therapy[Title]) OR (CRRT[Title]) OR (Continuous Veno-Venous Hemofiltration[Title]) OR (CVVH[Title]) OR (Continuous veno-venous hemodialysis[Title]) OR (CVVHD[Title]) OR (Continuous venovenous hemodiafiltration[Title]) OR (CVVHDF[Title]) OR (hemofiltration[Title]))

Cochrane Central Register of Controlled Trials
1. (Vancomycin) AND ((Continuous Renal Replacement Therapy) OR (CRRT) OR (Continuous Veno-Venous Hemofiltration) OR (CVVH) OR (Continuous veno-venous hemodialysis) OR (CVVHD) OR (Continuous venovenous hemodiafiltration) OR (CVVHDF) OR (hemofiltration))

ClinicalTrials.gov
1. vancomycin AND ("continuous renal replacement therapy" OR CRRT OR CVVH OR CVVHD OR CVVHDF OR hemofiltration).

Eligibility criteria Studies must have met the following criteria:
- Published in the English language.
- Studies were restricted to those involving exclusively adult populations (≥18 years) identified as critically ill and concurrently receiving CRRT.
- Studies evaluated vancomycin dosing and pharmacokinetics through single-dose, multiple-dose, population pharmacokinetic, or dose simulation analyses.
- Only experimental or observational study designs with complete results and fully accessible articles were considered.

Source of evidence screening and selection Screening was conducted in two stages: first stage was title and abstract screening followed by second stage of full-text review. Two authors independently screened all identified studies for eligibility against the pre-defined inclusion criteria using a standardized tool. A senior author performed the final review of the selections, and any disagreements was resolved through consensus-based team discussion.

Data management To manage the identified records, search results were exported to CSV files and deduplicated in Microsoft Excel. The refined list was then transferred to a standardized Microsoft Word document for screening.

Reporting results / Analysis of the evidence We assessed the quality of pharmacokinetics reporting by verifying the inclusion of key CRRT operational data: modality, flow rates, CRRT dose (prescribed and delivered), filter characteristics, dilution methods, sieving coefficients, anticoagulation strategies, and residual diuresis. This is to ensure a comprehensive evaluation of each study. Data were reported using a descriptive approach only.

Presentation of the results The review findings were synthesized and presented using a PRISMA-ScR flow diagram to document the study selection process. Summary tables were employed to describe included studies by design, methodology, CRRT modalities and settings, vancomycin pharmacokinetic parameters, and dosing recommendations. A narrative synthesis accompanies these visuals to describe the current evidence landscape.

Language restriction English-language only.

Country(ies) involved Saudi Arabia and United States of America.

Keywords vancomycin, pharmacokinetics, CRRT, ICU, critical care.

Dissemination plans The findings of this scoping review were disseminated as an oral presentation at the Society of Critical Care Medicine (SCCM) 2026 Critical Care Congress. The full manuscript is currently undergoing peer review for publication.

Contributions of each author

Author 1 - Maha Assadoon - Conceptualization, literature search, methodology, data extraction, screening, data analysis, and drafting and revising the manuscript.
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