

Enhancing Patient Outcomes: Vancomycin Therapeutic Drug Monitoring in Critically Ill Patients

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Introduction

Vancomycin is widely used for severe Gram-positive infections in adult critically ill patients, but its narrow therapeutic index necessitates therapeutic drug monitoring (TDM) to balance efficacy and toxicity.¹

This meta-analysis evaluates the impact of TDM and attainment of vancomycin pharmacokinetic/pharmacodynamic (PKPD) target on mortality, nephrotoxicity, and clinical cure rates in adult critically ill patients receiving vancomycin.

Methodology

A systematic literature search was conducted in PubMed, Scopus, Google Scholar, ProQuest, and Cochrane Library for studies on adult sepsis or critically ill patients receiving vancomycin. Outcomes assessed included mortality, nephrotoxicity, and clinical cure rates.

Search results from the database were initially imported into Rayyan (Rayyan Systems Inc., Cambridge, USA). The automatic deduplication function in Rayyan was utilized to eliminate duplicate entries. Following deduplication, two reviewers (GA and JM) independently evaluated the titles and abstracts of the remaining records within Rayyan.

Results

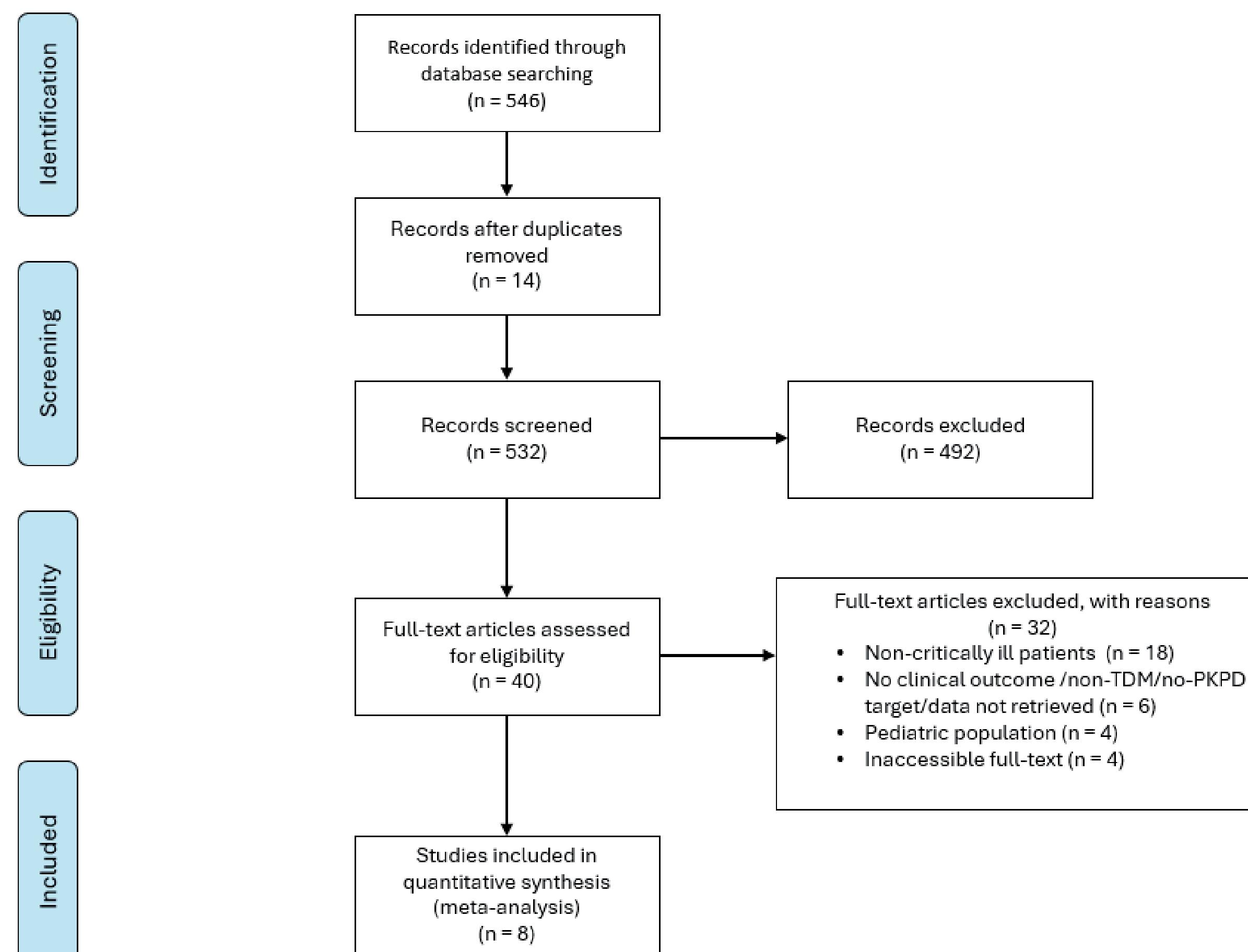


Figure 1. Prisma Flow Diagram

We evaluated the attainment of vancomycin PK/PD targets, defined as a trough concentration (C_{min}) of 15–20 ng/mL or AUC_{24}/MIC ratio of 400–600.

There is no difference in mortality RR 0.67 (95%CI 0.31-1.47) and clinical cure RR 1.33 (95%CI 0.79-2.26)

One study shows that achievement of vancomycin PKPD target is not associated with nephrotoxicity ($p=0.52$). However, the acute kidney injury (AKI) might be influenced by sepsis.

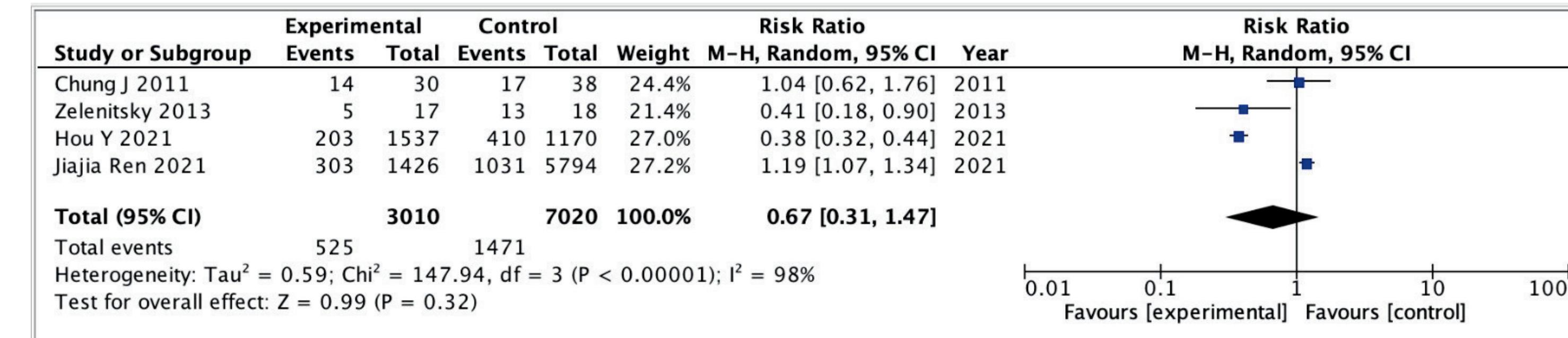


Figure 2. Forest plot comparing vancomycin PK/PD target attainment (achieved vs non-achieved) for mortality.

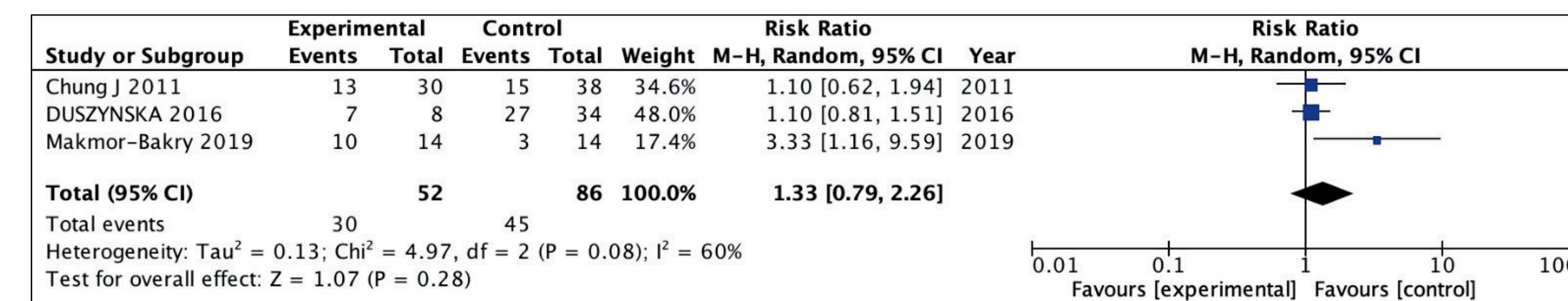


Figure 3. Forest plot comparing vancomycin PK/PD target attainment (achieved vs non-achieved) for clinical cure.

Conclusion

This meta-analysis demonstrated that TDM by attainment of vancomycin PK/PD targets tends to reduced mortality. However, enhancing the search strategy is essential to incorporate a broader range of studies for more robust findings.

References

- Roger C. Understanding antimicrobial pharmacokinetics in critically ill patients to optimize antimicrobial therapy: a narrative review. *J Intensive Med.* (2024) 4:287–98.
- Chung J, Oh JM, Cho EM, et al. Optimal Dose of Vancomycin for Treating Methicillin-Resistant *Staphylococcus aureus* Pneumonia in Critically Ill Patients. *Anesthesia and Intensive Care.* 2011;39(6):1030–1037.
- Ren J, Hou Y, Li J, et al. An evaluation on the association of vancomycin trough concentration with mortality in critically ill patients: A multicenter retrospective study. *Clin Transl Sci.* 2021;14:1780–1790.
- González-Delgado D, Vives M, Monedero P, Aldad A. Use of vancomycin and acute kidney injury in critically ill patients with sepsis or septic shock: A retrospective observational cohort study. *Rev Esp Anestesiol Reanim (Engl Ed).* 2025 Feb;72(2):501657.
- Makmor-Bakry M, Ahmat AN M F, Shamsuddin AF, et al. Association between single trough-based area under the curve estimation of vancomycin and treatment outcome among methicillin-resistant *Staphylococcus aureus* bacteraemia patients. *Anaesthesiology Intensive Therapy.* 2019;5(3):281–283.
- Duszynska W, Taccone FS, Hurkacz M, et al. Continuous vs. intermittent vancomycin therapy for Gram-positive infections not caused by methicillin-resistant *Staphylococcus aureus*. *Minerva Anestesiol* 2016 March;82(3):284–293.
- Zelenitsky S, Rubinstein E, Ariano R, et al. Cooperative Antimicrobial Therapy of Septic Shock-CATSS Database Research Group. Vancomycin pharmacodynamics and survival in patients with methicillin-resistant *Staphylococcus aureus*-associated septic shock. *Int J Antimicrob Agents.* 2013 Mar;41(3):255–260.
- Hou Y, Ren J, Li J, et al. Relationship Between Mean Vancomycin Trough Concentration and Mortality in Critically Ill Patients: A Multicenter Retrospective Study. *Front. Pharmacol.* 2021;12:690157.