

Vancomycin

Vancomycin Hydrochloride - Glycopeptide Antibiotic

Antimicrobials / Glycopeptides

Evidence status: current

ICU High-Yield Summary

Parenteral glycopeptide for serious susceptible Gram-positive infections, especially MRSA; in serious invasive MRSA, use an appropriate loading strategy when rapid exposure is needed and AUC-guided monitoring (target AUC₂₄/MIC 400-600 when MIC is assumed 1 mg/L) rather than routine trough-only 15-20 mg/L targeting.

Mechanism of Action

Cell Wall Peptidoglycan D-Ala-D-Ala Binding

1. Binds with high affinity to the D-alanyl-D-alanine terminus of cell wall peptidoglycan precursors. 2. Sterically inhibits transglycosylation and transpeptidation, halting peptidoglycan polymer elongation. 3. Alters bacterial cell membrane permeability and impairs RNA synthesis. 4. Produces slow bactericidal cell death against Gram-positive bacteria.

ICU Clinical Reasoning

Why I Choose It

A standard empiric anti-MRSA option when the syndrome and local epidemiology warrant MRSA coverage (for example selected HAP/VAP, severe sepsis with MRSA risk, purulent/NSTI syndromes, or suspected catheter-related infection). | Important oral therapy for *Clostridioides difficile* infection: vancomycin is an acceptable alternative to fidaxomicin for many initial/non-fulminant episodes and remains the backbone of fulminant CDI therapy at higher enteral dosing; oral vancomycin has minimal systemic absorption in most patients. | Well-established therapeutic drug monitoring (TDM) protocols based on Bayesian AUC estimation.

Why I Avoid / Key Limitations

Nephrotoxicity risk rises with excessive vancomycin exposure (especially AUC above the recommended range), duration, critical illness and other nephrotoxic exposures. Observational studies linked vancomycin plus piperacillin-tazobactam to more creatinine-defined AKI, but ACORN did not show more AKI/death versus cefepime. | Infusion-related Vancomycin Flushing Syndrome ('Red Man Syndrome') if infused too rapidly (<1 hour per 1000 mg). | For definitive MSSA bacteremia, an anti-staphylococcal beta-lactam (such as cefazolin or nafcillin/oxacillin) is generally preferred when tolerated; observational data associate definitive vancomycin therapy with worse outcomes than beta-lactams.

Bedside Pearl

For serious suspected/confirmed MRSA infection in a critically ill patient, use an actual-body-weight loading strategy when rapid target attainment is needed (2020 consensus: commonly 20-35 mg/kg, maximum 3 g) and transition to AUC-guided dosing (target AUC₂₄/MIC 400-600 when MIC is assumed 1 mg/L). AUC-guided monitoring reduces excessive exposure/nephrotoxicity risk compared with trough-only targeting, but do not promise a fixed '50% AKI reduction.'

Dosing & Administration

Routine ICU Dosing

Serious MRSA infection: consider an actual-body-weight loading dose (commonly 20-35 mg/kg in critically ill adults; max 3000 mg), then individualize maintenance dosing using renal function and preferably Bayesian/AUC-guided monitoring rather than a fixed q8-12h regimen for every ICU patient.

Hemodialysis

Use a dialysis-specific protocol that accounts for high-flux membrane, timing relative to dialysis and residual kidney function. The 2020 consensus uses predialysis concentrations of about 15-20 mg/L as a practical surrogate likely to achieve AUC 400-600 when MIC is 1 mg/L; actual post-HD dose and timing require TDM rather than a universal 10-15 mg/kg rule.

CRRT

At conventional CRRT effluent rates around 20-25 mL/kg/h, the 2020 consensus suggests a 20-25 mg/kg actual-body-weight load and an initial maintenance range of 7.5-10 mg/kg q12h, followed by serum concentration/AUC-guided adjustment within the first 24 hours. Higher/lower effluent rates, interruptions, filter performance, residual renal function and changing volume status can materially alter clearance-do not use one fixed CRRT regimen.

Renal Dose Table

Stable renal function: Choose an initial weight- and renal-function-based maintenance regimen, then individualize to measured AUC₂₄/MIC 400-600 for serious MRSA. Fixed CrCl-to-q8/q12/q24 tables are starting estimates, not definitive ICU dosing. | AKI / rapidly changing renal function: Do not rely on a static creatinine-clearance interval table. Give an appropriate loading dose when rapid exposure is needed, obtain early concentrations/AUC, and redose according to changing clearance, renal-replacement modality and clinical trajectory. | Severe renal impairment without dialysis: Use extended/intermittent maintenance dosing guided by measured concentrations/AUC and serial renal function; avoid an automatic 'redose at trough 15-20 mg/L' rule for all patients.

Syndrome-Specific Regimens

Severe MRSA Infection / HAP / VAP / Septic Shock: For critically ill adults with serious MRSA infection, a loading dose within the 2020 consensus range (20-35 mg/kg actual body weight; max 3 g) may be used when rapid target attainment is needed. Maintenance dose/interval should be individualized to renal function and measured AUC rather than fixed q8-12h dosing. | Clostridioides difficile Colitis (Oral Route ONLY): Non-fulminant CDI: vancomycin 125 mg PO q6h for 10 days is an acceptable regimen (fidaxomicin is preferred when feasible in the 2021 IDSA/SHEA focused update). Fulminant CDI: vancomycin 500 mg enterally q6h plus IV metronidazole, with rectal vancomycin considered if ileus is present.

Organ Failure Considerations

Renal Failure & AKI

Primary renal elimination. Glomerular filtration dysfunction causes rapid accumulation. High AUC₂₄ (>600 mg/L) directly induces renal tubular cell injury and apoptosis.

Hepatic Impairment

No dose reduction required for isolated liver dysfunction.

Toxicity & Safety

Major Warnings

Nephrotoxicity: risk increases as exposure rises, particularly above the recommended AUC range; avoid presenting a trough threshold or piperacillin-tazobactam combination as a deterministic cause in every patient. | Vancomycin Flushing Syndrome (Red Man Syndrome): Non-immunologic histamine release triggered by rapid IV infusion rates. | Ototoxicity: Auditory nerve damage (rare, typically associated with extreme overdose or concurrent aminoglycosides).

Organ Toxicities

Renal: Acute Tubular Injury, interstitial nephritis, serum creatinine elevation. | Dermatologic / Systemic: Flushing of neck/upper torso, pruritus, hypotension (Red Man Syndrome). | Hematologic: Reversible neutropenia, thrombocytopenia, drug fever.

Drug Interactions

Bedside Interactions

Piperacillin-Tazobactam (Zosyn): Observed association with creatinine-defined AKI in many nonrandomized studies; mechanism and causal contribution remain debated; consequence: Many observational cohorts report more creatinine-defined AKI with vancomycin + piperacillin-tazobactam, but randomized ACORN data did not show a significant difference in the composite of AKI or death versus cefepime.; ICU action: Monitor renal function and antimicrobial indication. Do not automatically switch piperacillin-tazobactam to cefepime solely to prevent AKI; ACORN found no significant AKI/death difference and more neurologic dysfunction with cefepime. | Aminoglycosides / Loop Diuretics: Additive nephrotoxic and ototoxic damage; consequence: Increased risk of renal failure and hearing loss; ICU action: Monitor renal function closely and perform vancomycin TDM at a frequency appropriate to illness severity, renal stability and treatment duration; daily AUC estimation is not required for every stable patient.

Monitoring & TDM

Monitoring

Therapeutic Drug Monitoring (TDM): Target AUC₂₄/MIC 400-600 mg/L using Bayesian software or 2-point peak/trough levels | If AUC monitoring is unavailable, use an institutionally validated concentration-based strategy; the 2020 consensus moved away from routine trough-only 15-20 mg/L targeting for serious MRSA because it can drive excessive exposure/nephrotoxicity. | Serum Creatinine and BUN daily | IV infusion: administer sufficiently slowly to reduce infusion reactions; commonly at least 60 minutes and no faster than about 10-15 mg/min, with longer infusions for larger doses or prior infusion reactions per local policy.

TDM

targetAUC: 400-600 mg/L (assuming MRSA MIC ≤ 1 mg/L) | targetTrough: Trough-only 15-20 mg/L is no longer the preferred general target for serious MRSA; hemodialysis is a special case where predialysis 15-20 mg/L is used pragmatically to approximate AUC 400-600. | timing: For serious MRSA, obtain AUC-relevant concentrations early-generally within the first 24-48 hours, and earlier/more often when renal function is unstable or renal replacement therapy changes. Do not wait automatically for a 4th/5th-dose steady-state trough.

Antimicrobial Spectrum

Gram Positive

Covered: Methicillin-resistant *Staphylococcus aureus* (MRSA) | Methicillin-susceptible *Staphylococcus aureus* (MSSA) | Coagulase-negative *Staphylococci* (CoNS) | *Streptococcus pneumoniae* (penicillin-resistant) | *Enterococcus faecalis* (vancomycin-susceptible) | *Clostridioides difficile* (ORAL route only) | Not covered: Vancomycin-resistant *Enterococcus* (VRE *faecium* *vanA/vanB*) | VRSA | VISA (relative resistance)

Gram Negative

Covered: None listed | Not covered: All Gram-negative bacteria (Large molecular weight prevents penetration through outer membrane porins)

Anaerobes

Covered: *Clostridium perfringens* | *Peptostreptococcus* spp. | *Clostridioides difficile* (ORAL route only) | Not covered: *Bacteroides fragilis* | Gram-negative anaerobes

Notable Gaps

All Gram-negative Bacilli (*E. coli*, *Pseudomonas*) | VRE (*vanA/vanB*) | Oral Vancomycin is NOT absorbed systemically

Evidence & Source Traceability

Claim-Level Citations

2020 ASHP/IDSA/SIDP Consensus Guidelines recommend AUC₂₄/MIC 400-600 mg·h/L over trough-only monitoring to reduce AKI. - Therapeutic monitoring of vancomycin in adult patients: A consensus guideline by ASHP, IDSA, PIDS, SIDP. Am J Health-Syst Pharm 2020;77(11):835-864. (<https://pubmed.ncbi.nlm.nih.gov/32191793/>) | For critically ill adults with serious MRSA infection, the 2020 consensus allows actual-body-weight loading doses of 20-35 mg/kg (maximum 3 g) when rapid target attainment is needed. - Rybak MJ, et al. 2020 ASHP/IDSA/PIDS/SIDP vancomycin therapeutic-monitoring consensus guideline. Am J Health-Syst Pharm. 2020;77:835-864. (<https://pubmed.ncbi.nlm.nih.gov/32191793/>)

Guideline IDs

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