SHC Vancomycin Dosing Guide

A: Initial dosing considerations
B. Pharmacodynamic Targets: goal AUC and troughs
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D: Initial Vancomycin Maintenance Dosing and Serum Concentration Monitoring
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A. Initial Dosing Considerations

1. Review the following prior to initiation of therapy:
   a. Indication, relevant and pending microbial culture(s)
   b. Age, gender, height, weight, BMI
   c. Renal replacement therapy
   d. Special populations (obese, elderly, severely malnourished [BMI<16], amputees, pregnancy)
   e. Prior vancomycin dosing history (if applicable)
   f. Potential drug interactions
   g. Serum creatinine (SCr), urine output (if available), creatinine clearance (CrCl)
      i. Calculate CrCl using the Cockcroft-Gault equation (Figure 1)
         a) Elderly or severely malnourished: rounding SCR up is associated with underestimation of CrCl- clinical discretion advised [Smythe 1994, Young 2017, Barber 2016, Winter 2012]
         b) Use ideal body weight (IBW) for non-obese patients
         c) Use adjusted body weight (ABW) for obese patients [BMI ≥30 kg/m²]
   h. Adverse Effects
      i. “Vancomycin infusion reaction” is characterized by hypotension and/or a maculopapular rash appearing on the face, neck, trunk, and/or upper extremities.
      ii. If this occurs, pharmacist may slow the infusion rate (e.g. to 90-120 mins per 1 gm.) ± increase the dilution volume upon provider request ± recommend diphenhydramine 25-50mg premedication to the provider

IBW (male) = 50 kg + (2.3 x height in inches > 60 inches)
IBW (female) = 45 kg + (2.3 x height inches > 60 inches)
ABW (kg) = IBW + 0.4 (TBW – IBW)

Figure 1. Cockcroft-Gault Equation

\[
\text{CrCl} \left( \frac{ml}{min} \right) = \frac{(140 - \text{age}) \times \text{IBW} \times 0.85 \text{ for females}}{\text{Scr} \times 72}
\]
B. Pharmacodynamic Targets: goal AUC and troughs

<table>
<thead>
<tr>
<th>Indication</th>
<th>Target PD Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Most indications</td>
<td></td>
</tr>
<tr>
<td>AUC-based protocol†</td>
<td></td>
</tr>
<tr>
<td>Trough-based protocol (IHD, PD, nocturnal CRRT, dose-by-level)</td>
<td></td>
</tr>
<tr>
<td>Continuous IV infusion</td>
<td></td>
</tr>
<tr>
<td><strong>Meningitis/ventriculitis (empiric or definitive)</strong></td>
<td></td>
</tr>
<tr>
<td>Trough-based protocol</td>
<td>Trough 15-20 mg/L</td>
</tr>
</tbody>
</table>

†Exclusions from AUC-based dosing: rapidly fluctuating SCr, AKI (see section D footnote), intermittent hemodialysis (IHD), peritoneal dialysis (PD), nocturnal CRRT, CNS infections

C: Loading dose

I. **Purpose:**
   Achieves rapid attainment of targeted concentrations and AUC/MIC of >400 mg-h/L on day 1 of therapy for bacterial killing in in vitro and clinical outcomes in vivo studies

II. **Targeted populations:**
   - Preferred in seriously and/or critically-ill patients with suspected or documented serious MRSA infections (e.g. severe sepsis or septic shock requiring coverage for *S. aureus*)

III. **Standard load for patients with normal renal function:** 20-35mg/kg TBW (maximum 3g)
   The decision of whether to employ a loading dose, as well as the magnitude of this dose, should be driven by the severity of infection and the urgency to achieve a therapeutic concentration rather than body size alone. InsightRX has a loading dose feature that can help simulate exposure.

<table>
<thead>
<tr>
<th>Patient Weight</th>
<th>Standard Loading Dose ~25 mg/kg TBW</th>
<th>Modified Loading Dose 20-25 mg/kg TBW</th>
</tr>
</thead>
<tbody>
<tr>
<td>36 – 45 kg</td>
<td>1,000 mg x 1</td>
<td>750 mg x 1</td>
</tr>
<tr>
<td>46 – 55 kg</td>
<td>1,250 mg x 1</td>
<td>1,000 mg x 1</td>
</tr>
<tr>
<td>56 – 65 kg</td>
<td>1,500 mg x 1</td>
<td>1,250 mg x 1</td>
</tr>
<tr>
<td>66 – 75 kg</td>
<td>1,750 mg x 1</td>
<td>1,500 mg x 1</td>
</tr>
<tr>
<td>76 – 120 kg</td>
<td>2,000 mg x 1</td>
<td>1,750 mg x 1</td>
</tr>
<tr>
<td>&gt; 120 kg</td>
<td>2,000-3,000 mg x 1</td>
<td>2,000 mg x 1</td>
</tr>
</tbody>
</table>

*Time maintenance dose start based on renal function: e.g. wait 24h to start maintenance regimen if CrCl = 30
Use total body weight (TBW); Round doses to nearest 250mg. Infuse each 1000mg over 60 minutes.
**D: Initial Vancomycin Maintenance Dosing and Initial/Repeat Monitoring**

I. **Round** doses to nearest 250mg

II. **Maximum dose**: 2g per dose and 4.5g per 24 hours initially (including load)

III. **Vancomycin Levels with InsightRX**

   A. **Initial**: A single level should be drawn within the first 24-48 hours after the first dose.
      
      i. An earlier initial level may be helpful in ensuring therapeutic concentrations in certain clinical scenarios (i.e. critically ill patients, patients with high or low BMI, etc.)
      
      ii. Levels may be drawn at any point during the dosing interval (except during infusion or distribution phase) and do not need to be drawn at steady state with InsightRX
      
      iii. Consider drawing two levels to improve predictions in certain patients, such as those with obesity, critical illness, low Scr due to low muscle mass, or intermediate/poor model fit
         
         1. These levels do not have to be from the same dosing interval, but should ideally be drawn at different time points of the dosing interval (i.e. not two troughs)

   B. **Repeat**: If dosing parameters remain stable (i.e. renal function, weight, etc.) and the model fit seems appropriate, repeat levels may be spaced out (i.e. after 48-72 hours). Changes in dosing parameters or dose should prompt repeat levels.

IV. **Repeat Scr**: q1-3 days if hemodynamically stable. Check daily if at high risk of nephrotoxicity.

V. ** Estimate dose based on renal function/renal replacement modality**

<table>
<thead>
<tr>
<th>Creatinine Clearance (mL/min)</th>
<th>Dose &amp; Frequency</th>
<th>Timing of Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;130</td>
<td>ICU only: 15mg/kg x1 (max 3g), then use InsightRX for continuous infusion dose</td>
<td>Random level 24 hours after start of infusion</td>
</tr>
<tr>
<td>10-129</td>
<td>Use InsightRX (refer to Appendix A: section A for general dosing guidance if model does not fit well and predicted regimens seem clinically inappropriate)</td>
<td>Initial level drawn within first 24-48 hours after initial dose (drawn at least 1hr after end of infusion)</td>
</tr>
<tr>
<td>&lt;10 or AKI*, dose by level</td>
<td>Trough within 24 hours of last dose, or with AM labs or every other day</td>
<td>Single pre-dialysis level (preferred)</td>
</tr>
<tr>
<td>Hemodialysis</td>
<td>Alternative: single level 4 hours after completion of dialysis session</td>
<td></td>
</tr>
<tr>
<td>CRRT‡ or nocturnal CRRT</td>
<td>Q24H: Peak 1hr after 2nd or 3rd dose; Trough 30 min before 3rd or 4th dose, respectively</td>
<td></td>
</tr>
</tbody>
</table>

† Loading and maintenance doses based on T-2L/hr dialysate flow and ultrafiltration rates, approximates CrCl 30-50 mL/min

*AKI (based on KDIGO, RIFLE, AKIN classifications):

i. Scr change by ≥ 0.3 mg/dL within 48h or 50% from baseline or within last 7 days
ii. CrCl change by >25 - 50%
iii. Urine output < 0.5 mL/kg/hr over 6 hours (oliguria)
iv. Scr ≥0.5 mg/dL, or a 50% increase from baseline in consecutive daily readings, or a decrease in CrCl of 50% from baseline on 2 consecutive days in the absence of an alternative explanation

<table>
<thead>
<tr>
<th>Peritoneal dialysis</th>
<th>Dosing for intraperitoneal (IP) instillation: see Lexicomp (NOT part of protocol) [Li, 2016] Intermittent (1 exchange/day): 15-30mg/kg IP initially, then dose by level*</th>
<th>Intra-peritoneal dosing (off-protocol): Level with AM labs on day 3 after any dose administered (allow fluid redistribution before drawing random level)</th>
</tr>
</thead>
</table>

*Supplemental doses may be needed for APD patients

### E: Dose Revisions

InsightRX uses Bayesian software to predict vancomycin exposure based on pharmacokinetic modeling and patient-specific information (i.e. creatinine, prior vancomycin levels). See [SHC InsightRX Vancomycin Tip Sheet](#) for more information.

**Supratherapeutic levels and/or AKI**: general approach

A. Do not restart vancomycin until the random/trough level is estimated or confirmed to be at/near 10-20 mg/dL. Allow sufficient time for drug clearance before restarting next dose. Predictive graphs on InsightRX may aid in predicting when levels will decline below supratherapeutic.

B. Actions may include: pre-emptive dose adjustment, holding dose, checking level, discussion with provider, reassessing the need for vancomycin therapy.

C. Consider Scr/renal trajectory when determining next dose and/or level
   
   1. Ex) rapidly declining Scr may indicate improving renal function warranting earlier redosing vs. rapidly rising Scr indicating ongoing AKI- dose by level may be indicated
**F: Intermittent Hemodialysis Dosing Algorithm**

**Goal pre-HD trough 15-20**
Vancomycin Loading Dose ~20-25 mg/kg (max 2000mg)

- Draw pre-HD level (either before session or with AM labs on day of scheduled session)

- Pre-HD level < 10mcg/mL: give 10-15mg/kg post HD
- Pre-HD level 10-15 mcg/mL: give 500-750 mg or 7.5-10mg/kg post HD
- Pre-HD level 15-20 mcg/mL: give 250-500mg or 5 mg/kg post HD
- Pre-HD level 20-25 mcg/mL: hold x1 or give 250 mg or 2.5 mg/kg post HD
- Pre-HD level > 25 mcg/mL: hold vancomycin until level back in range

- Check level 4 to 6 hours after next HD session. Re-dose if level < 20-25

- Repeat algorithm based on level prior to next HD session

*consider dosing 20% higher pre-HD depending on acuity/severity of infection and potential harm/risk from underdosing while awaiting dialysis completion before giving post-HD dose*
G: Continuous Infusion Vancomycin

Indicated Populations:
• Critically ill patients with augmented renal function defined as CrCl > 130 ml/min

Exclusions:
• Anticipated therapy <48 hours (ex: treatment of empiric pulmonary infection where nasal PCR and provide quick de-escalation, post-op prophylaxis)
• History of neuro-muscular disease, quadriplegia/paraplegia (disease states resulting in low SCr and falsely elevated CrCl)
  • Age > 50 years
  • Weight < 50 kg
  • Meningitis

Administration
• Infusion Time (Loading Dose): Total dose to be given as 1000 mg/hour
• Infusion Time (Maintenance Dose): Total dose to be given over 24 hours starting immediately after initial dose.

Initial Dosing: use total body weight (TBW) for dosing

<table>
<thead>
<tr>
<th>Augmented Renal Function</th>
<th>Loading Dose</th>
<th>Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>15 mg/kg TBW [max 3000 mg]</td>
<td>Calculate 24-hour requirement using: InsightRX (custom dose with infusion length over 24 hours)</td>
</tr>
</tbody>
</table>

Monitoring
• Draw a random level at 24 hours after the start of the continuous infusion
• Goal level: 17-25 mg/L
  • If therapeutic: recheck another level at 72 hours; earlier if changes in renal function suspected to lead to out of range level, e.g. SCr change > 25%
  • If subtherapeutic: increase the dose (see adjusting doses below) and recheck level in 24 hours
  • If supratherapeutic: hold dose and reduce the dose (see adjusting doses below) and recheck level in 24 hours

Converting Between Intermittent Dosing and Continuous Dosing:
• Patients who are therapeutic on intermittent dosing do not require a loading dose
• Patients on continuous infusion vancomycin therapy may accumulate vancomycin and therefore may require lower total daily doses compared to intermittent therapy
  • If patients therapeutic on intermittent dosing
    ▪ Add up total daily vancomycin dose
    ▪ Reduce by 10-15%
    ▪ Round to the nearest 250 mg (this will be the starting dose of continuous infusion)
  • If patients are sub-therapeutic or supra-therapeutic on intermittent dosing
    ▪ Dosing for continuous infusion should be calculated on a case-by-case basis using existing data.
  • Can use InsightRX to guide dosing
H: Discharge on vancomycin

General approach for discharge: specify desired vancomycin trough range based on prior trough levels associated with therapeutic AUC

- Select a trough range as approximately +/- 2 of the trough level corresponding to target AUC, assuming the AUC is not already at the upper or lower limits. Please use clinical discretion.

### Goal vancomycin troughs for discharge

<table>
<thead>
<tr>
<th>Description</th>
<th>Target trough range</th>
<th>Notes</th>
</tr>
</thead>
</table>
| Prior therapeutic AUC available    | Individualized: select a 5-point range close to trough associated with therapeutic AUC (400-600 mg*h/L) | * Ex 1. if trough was 12 with AUC 500, discharge target trough range 10-15 mg/L.  
  * Ex 2. if trough was 12 with AUC 400, discharge target trough range 12-17 mg/L.  
  * Option to calculate: Calculate lower (x) and upper (y) limits of target range using linear proportionality  
    * Using Ex 1 above:  
      o Lower limit: 12/500 = x/400 = 9.6 = 10  
      o Upper limit: 12/500 = y/600 = 14.4 = 15 |
| No prior therapeutic AUC available | 12-17 mg/L                  | * Logistical barriers: requires advanced planning with case management for insurance approval, ensure outpatient pharmacy or SNF feasibility, etc.  
  * Related info: see Section G for how to transition off continuous infusion |
| Intermittent hemodialysis           | 15-20 mg/L                  |                                                                      |
| Continuous infusion                 | Random level: 17-25 mg/L     |                                                                      |

I. DOCUMENT INFORMATION

A. Original Author/Date
   Emily Mui, PharmD: 08/2013

B. Gatekeeper
   Pharmacy Department

C. Distribution
   This procedure is kept in the Pharmacy Policies and Procedure Manual

D. Review/Revision History:
   Lina Meng, PharmD: 06/2015
   Janjri Desai, PharmD: 10/2015, 03/2016, 08/2016
   Lina Meng, PharmD: 08/2016, Emily Mui, PharmD: 08/2016
   Calvin Diep, PharmD; Liz Keil, PharmD; Jamie Kuo, PharmD; Lina Meng, PharmD: 05/2021, 01/2022
   Brian Lu, PharmD: 02/2023

E. Approvals
   Antibiotic Subcommittee: 08/2013, 11/2016, 10/2020, 05/2021, 03/2022, 03/2023
   Pharmacy and Therapeutics Committee: 11/2015, 03/2016, 05/2021, 04/2022

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APPENDIX A: Vancomycin dosing via PK equations/AUC calculator

A: Initial Vancomycin Maintenance Dosing and Initial/Repeat Monitoring (AUC calculator)

I. Round doses to nearest 250mg
II. Maximum dose: 2gm per dose and 4.5g per 24 hr initially (including load)
III. Repeat Vancomycin Levels
   A. After the target AUC or trough level is achieved at steady state, trough levels should be checked every 2 to 5 days until completion of therapy or discharge. Check peak/trough after any dose initiation/change.
      i. Levels should be checked sooner when clinically warranted (i.e.: change in clinical status or renal function, concern of accumulation/supratherapeutic levels, ≥25% change in trough/SCr)
   B. If follow-up trough is within expected range, the AUC is likely within range as well
   C. If follow-up trough is outside expected range, obtain another level to recalculate AUC
   D. Troubleshooting: if a level is missed, draw level with the next dose if at steady state. Otherwise, re-send new paired peak/trough

<table>
<thead>
<tr>
<th>Expected target trough range correlating to AUC</th>
<th>Examples</th>
</tr>
</thead>
</table>
| Individualized: select a 5-point range close to trough associated with therapeutic AUC (400-600 mg*h/L) | • Ex 1. if trough was 12 with AUC 500, target trough range 10-15 mg/L.  
• Ex 2. if trough was 12 with AUC 400, target trough range 12-17 mg/L.  
Option to calculate: Calculate lower (x) and upper (y) limits of target range using linear proportionality |

<table>
<thead>
<tr>
<th>Creatinine Clearance (mL/min)</th>
<th>Dose &amp; Frequency Total body weight (TBW)</th>
<th>TDD Range</th>
<th>Timing of Peak/Trough Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;130</td>
<td>ICU only: 15mg/kg x 1 (max 3g), then use PK calculator for daily dose given as continuous infusion</td>
<td>40-45 mg/kg</td>
<td>Random level 24 hours after start of infusion</td>
</tr>
<tr>
<td>&gt; 90</td>
<td>15 mg/kg Q8-12H* Obese: use PK calculator</td>
<td>30 – 45 mg/kg/day</td>
<td>Peak 1hr after 4th / trough 30 min before 5th dose, or Peak 1hr after 3rd/ trough 30 min before 4th dose</td>
</tr>
<tr>
<td>51-89</td>
<td>10–20 mg/kg Q12H Obese: use PK calculator</td>
<td>20–40 mg/kg/day</td>
<td>Q12H: Peak 1hr after 4th / trough 30 min before 5th dose, or Peak 1hr after 3rd/ trough 30 min before 4th dose</td>
</tr>
</tbody>
</table>
| 30-50                        | 10-15 mg/kg Q12H to 20 mg/kg Q24H Obese: use PK calculator | 20 – 30 mg/kg/day | Q12H: as above  
Q24H: Peak 1hr after 3rd/ trough 30 min before 4th dose |
| 10-29                        | 10 – 15 mg/kg Q24H to 15 mg/kg Q48H Obese: use PK calculator | 7.5 – 15 mg/kg/day | Q24H – Peak 1hr after 3rd/ trough 30 min before 4th dose  
Q48H – Peak 1hr after 2nd dose; trough 30 min before 3rd dose |
| CRRT or nocturnal CRRT       | Initial: 20-25 mg/kg x 1 (max 2gm) Maintenance: 10 – 15 mg/kg Q24H | N/A | Q24H: Peak 1hr after 2nd or 3rd dose; Trough 30 min before 3rd or 4th dose, respectively |

† Note: For those with CrCL_adjBW > 120mL/min, Q8H may be considered if t½ < 8hr (use Excel for t½ calculation, or appendix G)  
‡ Loading and maintenance doses based on 1-2L/hr dialysate flow and ultrafiltration rates, approximates CrCL 30-50 mL/min
B: Dose Revisions (AUC calculator)

**AUC calculator:** This calculator is based on the Sawchuk-Zaske method and the equations used are summarized here. \(^1\) Click here for link to AUC calculator on Microsoft Excel.

\[
AUC = \frac{t (C_{\text{max}} + C_{\text{min}})}{2} + \frac{C_{\text{max}} - C_{\text{min}}}{k}
\]

where:
- \(t\) = infusion duration
- \(k = \frac{\ln C_1}{\Delta t}\)

- This AUC value applies to that calculated in a single dosing interval \(\Delta t\) must be multiplied by the dosing frequency when applicable to obtain the total AUC\(_{0-24}\)

- \(C_{\text{max}}\) (true peak) and \(C_{\text{min}}\) (true trough) are back-calculated from measured values using this equation: \(C_2 = C_1 \times e^{-k \cdot t}\).
  (Details are in Part H)

**Linear proportion method:** Once a calculated AUC or trough is obtained, changes to the total daily dose (TDD) have a corresponding proportional change in troughs and AUCs when maintaining the same dosing interval, assuming stable renal function and steady state conditions.

\[
\frac{AUC \ (\text{calculated})}{AUC \ (\text{desired})} = \frac{\text{Current TDD}}{\text{New TDD}} \quad \frac{C_{\text{min}} \ (\text{observed})}{C_{\text{min}} \ (\text{desired})} = \frac{\text{Current TDD}}{\text{New TDD}}
\]

E.g.: 1250mg IV Q12H results in an AUC of 800. To target an AUC 600, reduce to 1g q12h (rounded up from 1875mg/day). Alternatively, converting the same TDD to a q8h regimen would result in a higher trough but would not impact the AUC.

\[
\text{New TDD} = \frac{600 \times 2500\text{mg}}{800} = 1875\text{mg}
\]
C: Continuous Infusion Vancomycin (AUC calculator)

**Initial Dosing:** use total body weight (TBW) for dosing

<table>
<thead>
<tr>
<th>Loading Dose</th>
<th>Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Augmented Renal Function</td>
<td>15 mg/kg TBW [max 3000 mg]</td>
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<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Monitoring**
- Draw a random level at 24 hours after the start of the continuous infusion
- Goal level: 17-25 mg/L
  - If therapeutic: recheck another level at 72 hours; earlier if changes in renal function suspected to lead to out-of-range level, e.g. SCr change > 25%
  - If subtherapeutic: increase the dose (see adjusting doses below) and recheck level in 24 hours
  - If supratherapeutic: hold dose and reduce the dose (see adjusting doses below) and recheck level in 24 hours

**Adjusting Doses:**
- Subtherapeutic or Supratherapeutic: Proportional calculation (assuming SCr stable)
  \[
  \frac{\text{Current 24-hour dose}}{\text{Current vancomycin level}} = \frac{\text{X (revised dose)}}{\text{Desired vancomycin level}}
  \]

* If supratherapeutic, may consider re-checking level and resume continuous infusion when level is < 25 mg/mL

**Converting from Intermittent Dosing to Continuous Dosing:**
- Patients who are therapeutic on intermittent dosing do not require a loading dose
- Patients on continuous infusion vancomycin therapy may accumulate vancomycin and therefore may require lower total daily doses compared to intermittent therapy
  - If patients therapeutic on intermittent dosing
    - Add up total daily vancomycin dose
    - Reduce by 10-15%
    - Round to the nearest 250 mg (this will be the starting dose of continuous infusion)
  - If patients are sub-therapeutic or supra-therapeutic on intermittent dosing
    - Dosing for continuous infusion should be calculated on a case-by-case basis using existing data.
    - Can use InsightRX to guide dosing

**Converting from Continuous Dosing to Intermittent Dosing:**
If therapeutic on continuous infusion vancomycin dosing, add up 24-hour dose and divide by appropriate dosing interval
D: PK Equations (same as those used in SHC Vancomycin Excel AUC Calculator)

**AUC-based dosing: initial dosing**
1. Step 1: estimate \( \text{Cl}_{\text{vanco}} \text{ (L/hr)} = k_e \times V_d \)
   a. In general populations: Matzke Equation: \( k_e = 0.00083 \times \text{CrCl} + 0.0044 \)
   b. In obese patients: Crass et al 2018: \( \text{Cl}_{\text{vanco}} = 9.656-0.078 \times \text{age} - 2.009 \times \text{SCR} + 1.09 \times \text{sex} + 0.04 \times \text{TBW} \)
      where female = 0 and male = 1.
2. Step 2: estimate total daily dose = \( \text{Cl}_{\text{vanco}} \times \text{goal AUC0-24} \)

**AUC-based dosing: revision from 2 levels**

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
<th>Equation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Verify that doses were given on time and drawn appropriately</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Calculate the patient's observed ( k_o ) from 2 levels</td>
<td>( k_o = \frac{\ln \frac{C_1}{C_2}}{t_2-t_1} ), where ( C_1 ) usually is the peak, ( C_2 ) is usually the trough</td>
</tr>
<tr>
<td>3</td>
<td>Calculate half-life, ( t_{1/2} )</td>
<td>( t_{1/2} = \frac{0.693}{k_e} )</td>
</tr>
<tr>
<td>4</td>
<td>Calculate true peak, ( C_{\text{max}} )</td>
<td>( C_{\text{max}} = \frac{C_1}{e^{k_e} t} ), t = infusion time</td>
</tr>
<tr>
<td>5</td>
<td>Calculate true trough, ( C_{\text{min}} )</td>
<td>( C_{\text{min}} = C_{\text{max}} \times e^{-k_e \times (T\text{au} - t)} ) where ( t ) = infusin time</td>
</tr>
<tr>
<td>6</td>
<td>Calculate ( V_d ) (steady state conditions) <em>optional step: not required to determine AUC</em></td>
<td>( V_d = \frac{\text{Dose} \times (1 - e^{-k_e t})}{k_e \times (C_{\text{max}} - C_{\text{min}})} ) where ( t ) = infusion time</td>
</tr>
<tr>
<td>7</td>
<td>Calculate vancomycin clearance <em>optional step: not required to determine AUC</em></td>
<td>( \text{CL}_{\text{min}} = V_d \times k_o )</td>
</tr>
<tr>
<td>8</td>
<td>If ( C_{\text{min}} ) is high, calculate the time needed to reach desired range</td>
<td>( \text{Time for } C_{\text{min}} \text{ to reach } C_{\text{desired}} = \frac{\ln C_{\text{min}}}{k_e} )</td>
</tr>
<tr>
<td>9</td>
<td>Calculate AUC during infusion using linear trapezoidal rule</td>
<td>( \text{AUC}<em>{\text{inf}} = t \times \left( \frac{C</em>{\text{max}} + C_{\text{min}}}{2} \right) )</td>
</tr>
<tr>
<td>10</td>
<td>Calculate AUC during elimination using logarithmic trapezoidal rule</td>
<td>( \text{AUC}<em>{\text{elim}} = \frac{(C</em>{\text{max}} - C_{\text{min}})}{k_e} )</td>
</tr>
<tr>
<td>11</td>
<td>Calculate AUC(_{24})</td>
<td>( \text{AUC}<em>{0-24} = (\text{AUC}</em>{\text{inf}} + \text{AUC}_{\text{elim}}) \times \frac{24}{\text{tau}} )</td>
</tr>
<tr>
<td>12</td>
<td>Estimate total daily dose need to achieve target AUC(_{24}) <strong>Tip:</strong> new ( \text{tau} = 1 ) to ( 1.5 \times ) the half-life</td>
<td>( \text{New TDD} = \text{Current TDD} \times \frac{\text{AUC}<em>{0-24} \text{ (desired)}}{\text{AUC}</em>{0-24} \text{ (calculated)}} )</td>
</tr>
<tr>
<td>13</td>
<td>Calculate predicted steady state ( C_{\text{max}} ) for new dosing regimen</td>
<td>( C_{ss, \text{max}} = \frac{\text{New dose}}{\text{CL} \times t} \times \frac{1 - e^{-k_e \tau}}{1 - e^{-k_e \text{tau}}} )</td>
</tr>
<tr>
<td>14</td>
<td>Calculate predicted steady state ( C_{\text{min}} ) for new dosing regimen</td>
<td>Same as step 5</td>
</tr>
<tr>
<td>15</td>
<td>Calculate predicted AUC based on new dosing regimen</td>
<td>Same as steps 9-11</td>
</tr>
</tbody>
</table>


**Abbreviations**
- \( t \): infusion time; \( \text{Tau} \): dosing interval; \( Ke \): elimination rate constant; \( V_d \): volume of distribution; \( C_1 \): concentration at time \( t_1 \) (i.e. first of 2 levels drawn following dose); \( C_2 \): concentration at time \( t_2 \) (i.e. second of 2 levels drawn following dose) \( t_1 \): time at which \( C_1 \) is drawn; \( t_2 \): time at which \( C_2 \) is drawn
- \( CL_{\text{min}} \): vancomycin clearance
- \( \text{TDD} \): total daily dose
- \( AUC \): area under the concentration-time curve
- \( AUC_{0-24} \): 24 hour area under the concentration-time curve