

UHS

# VANCOMYCIN THERAPEUTIC DRUG MONITORING: AUC<sub>24</sub>/MIC RATIO & TROUGH BASED

And Vancomycin AUC Calculator

6-22-2020

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## About The AUC<sub>24</sub>/MIC Calculator

### I. Pharmacist Vancomycin AUC<sub>24</sub>/MIC Workshop:

#### A. **Case 1:** Walkthrough – *Empiric Dosing*

- 1. Patient Info
- 2. Kidney Function
- 3. Loading Dose (LD)
- 4. Volume of Distribution (Vd)
- 5. Vancomycin Clearance (CL<sub>Vanco</sub>)
- 6. Maintenance Dose Table
- 7. Levels / Labs
- 8. Progress Note

Calculator Generated Monitoring Form

#### B. **Case 1:** Walkthrough – *Post Levels*

- 1. Load patient or fill in information
- 2. Post dose level entry – Ke, t<sub>1/2</sub>
- 3. Volume of Distribution (Vd)
- 4. Maintenance Dose Table
- 5. Progress Note

#### C. **Case 2:** Jimmy Dean - Pneumonia

#### D. **Case 3:** MRN: 56789 - Sepsis

## I. Vancomycin Therapeutic Drug Monitoring Update

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- a. The old vancomycin trough of 15-20 mg/dL surrogate goal is outdated and linked to 30% increase in development of acute kidney injury (AKI)
- b. Under most circumstances, we can consider MRSA infections to have a minimum inhibitory concentration (MIC) = 1 mg/L (unless the MIC is known and above 1 by broth microdilution or other method verified for accuracy) review of literature has identified no evidence of MIC creep phenomenon.
- c. Transitioning to 24 hour area under the curve (AUC<sub>24</sub>)/MIC with a goal of 400-600 via direct PK/PD monitoring is a more accurate predictor of clinical efficacy

## II. Indications for AUC<sub>24</sub>/MIC monitoring:

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Invasive **MRSA infections**, including:

- a. Bacteremia
- b. Pneumonia
- c. Meningitis
- d. Endocarditis
- e. Osteomyelitis
- f. Sepsis
- g. Intra-abdominal infections

## III. EXCLUSIONS for AUC<sub>24</sub>/MIC dosing:

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- a. Skin and soft tissue infections (ABSSSI): 10 – 15 mg/dL trough target efficacious
- b. Enterococcal infections: 10 – 15 mg/dL trough target efficacious
- c. *Staphylococcus epidermidis* infections: 10 – 15 mg/dL
- d. Urinary tract infections
- e. Acute kidney injury/Rapidly changing renal function
- f. ERSD on Hemodialysis or Peritoneal Dialysis (*Chronic kidney disease, but stable residual renal function, should get AUC based dosing*)
- g. Surgical prophylaxis

## IV. Dosing:

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- a. Loading doses (20-35 mg/kg Actual Body Weight (ABW) up to 3000 mg based on patient population) for:
  - i. All ED patients will get loading dose due to uncertainty of critical illness
  - ii. Critically ill or ICU patients
  - iii. Documented serious MRSA infections
  - iv. Hemodialysis, Peritoneal Dialysis or CRRT Patients
  - v. Obese pediatric patients
- b. Maintenance doses will be based on empiric dosing calculator population estimates (maximum 4500 mg/day). In the calculator, any doses > 4500 mg/day will appear in red.
- c. Hemodialysis: 20 - 25 mg/kg ABW loading dose followed by 7.5 – 10 mg/kg maintenance dose after hemodialysis
- d. Continuous Renal Replacement (effluent rates 20 – 25 mg/kg/h): 20 - 25 mg/kg ABW loading dose followed by 7.5 – 10 mg/kg maintenance dose every 12 hours CVVHD, every 24 hours for CVVH; consideration should be given to the lowering Vd as fluid overload resolves (Nebraska Renal Dosing Guidelines)

- e. Peritoneal Dialysis: 20 – 25 mg/kg IV or IP loading dose, followed by 7.5 – 10 mg/kg IV or IP Q48-72hrs based on serum levels

## V. Post Dose Levels:

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- Two post dose levels are utilized to calculate AUC<sub>24</sub>/MIC ratio → should be ordered as Peak and Trough levels
- Priority for measuring levels:
  - i. Measuring levels after the first dose is recommended for:
    - a. Severe infection (Bacteremia, meningitis)
    - b. High risk for AKI (ICU residence, CKD, concurrent nephrotoxin exposure)
    - c. Obese - BMI ≥ 30 kg/m<sup>2</sup>
    - d. Large empiric maintenance doses
      - i. Adults ≥ 4000 mg/day
      - ii. Pediatrics ≥ 2500 mg/day
    - e. Continuous renal replacement (CRRT)
  - ii. All other levels should be measured at or close to steady state, typically after the 4<sup>th</sup> dose
- Level order timing; order two (2) random vancomycin levels at least one (1) estimated half-life (t<sub>1/2</sub>) apart.
  - First level - schedule at least one (1) hour after the end of the first dose infusion to allow for proper distribution.
  - Second level - should be at end of the dosing interval, before the next dose.
  - The dosing frequency of vancomycin may make it difficult to schedule two post levels at least 1 t<sub>1/2</sub>, apart (i.e. extended infusion time, short t<sub>1/2</sub>, short dosing interval), the levels may need to be drawn at shorter than one t<sub>1/2</sub> interval.
  - Ensure line where vancomycin was infusing is properly flushed prior to level collection to prevent falsely elevated levels.
- Hemodialysis: maintaining pre-dialysis concentrations between 15 and 20 mg/L is likely to achieve the AUC<sub>24</sub>/MIC of 400 to 600 mg·h/L in the previous 24 hours; pre-dialysis level preferred, may be drawn 4 hours after the end of hemodialysis prior to next dose if pre-dialysis window is missed.
- Continuous Renal Replacement Therapy (CRRT) – Monitor random level in first 24 hours with goal of 15 – 20 mg/L to ensure AUC<sub>24</sub>/MIC targets are met
- Peritoneal Dialysis – monitor one random level every 2 - 3 days as needed, re-dose when serum levels fall below 15 mcg/mL (ISPD Guidelines)

## VI. Monitoring Frequency:

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- a. Hemodynamically stable, await culture results. If vancomycin is to be continued, initial steady state monitoring and then weekly monitoring is sufficient.
- b. Hemodynamically unstable or at higher risk of nephrotoxicity (critically ill, concurrent nephrotoxins), more frequent monitoring recommended
- c. Hemodialysis: predialysis serum concentration monitoring should be performed weekly
- d. Peritoneal dialysis: serum concentration monitoring should be performed weekly once clearance rate identified\

- e. CRRT: daily evaluation of modality and ultrafiltration rate to guide level monitoring

## VII. Vancomycin Time Out at 24 – 48 Hours Checklist

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The following questions should be considered prior to continuing antibiotic therapy.

- i. Is a bacterial infection present? ☐ Yes ☐ No If No, vancomycin should be discontinued.
- ii. Has the site of infection been determined? ☐ No ☐ Yes If Yes, select one:

- ☐ Deep-seated endovascular infection (e.g., *S. aureus* bacteremia, endocarditis, meningitis, osteomyelitis, necrotizing fasciitis, mediastinitis, epidural or visceral abscess)
  - ☐ Diabetic foot infection
  - ☐ Intra-abdominal infection
  - ☐ IV catheter related bloodstream infection
  - ☐ Pneumonia
  - ☐ Sepsis
  - ☐ Skin/soft tissue infection (non-surgical site related)
  - ☐ Surgical site or device/prosthesis-related infection
  - ☐ Urinary tract infection
  - ☐ Other \_\_\_\_\_

- iii. Has an infectious disease physician recommended continuation of vancomycin?
  - ☐ Yes - continue vancomycin
  - ☐ No
- iv. Has the culprit bacterial pathogen(s) been identified?

- ☐ Yes, definitively known – therapy is for an infection known to be caused by a culture proven gram positive organism - continue vancomycin until at least susceptibilities are known.
  - ☐ Yes, definitively known – therapy is for an infection known to be caused by a culture proven gram positive organism susceptible only to vancomycin or patient has a serious beta-lactam allergy – continue vancomycin, determine length of therapy.
  - ☐ Yes, definitively known – therapy is for an infection known to be caused by a culture proven gram positive organism susceptible to beta-lactam antibiotics. Recommend vancomycin discontinuation - vancomycin may be less rapidly bactericidal than beta-lactam agents for methicillin-susceptible staphylococci (MSSA).
  - ☐ Possibly, a gram positive pathogen is suspected (microbiological results are pending) – follow-up in 48 hours.

- v. **Has the patient had a positive MRSA nasal surveillance culture or PCR within 24 hours of starting vancomycin?** ☐ Yes ☐ No - **Negative MRSA surveillance cultures have a 99% negative predictive value of MRSA HCAP.**

- vi. Is the patient clinically stable? ☐ No ☐ Yes - if Yes can the patient be switched to an oral antibiotic?

**VIII. Oral De-escalation Options According to Underlying Infection\*:** [\[back to table of contents ↩ \]](#)

Infection	MRSA COVERAGE WARRANTED	MRSA COVERAGE NOT WARRANTED
<b>Skin and soft tissue infection</b> (suspect MRSA if induration, fluctuance, or purulence is present; diffuse cellulitis suggests a streptococcal etiology)	<ul style="list-style-type: none"> <li>• TMP-SMZ 2 DS Tab q12h</li> <li>• Clindamycin 450 mg q8h</li> <li>• Doxy/minocycline 100 mg q12h</li> <li>• Linezolid 600 mg q12h</li> </ul>	<ul style="list-style-type: none"> <li>• Dicloxacillin 500 mg q6h</li> <li>• Cephalexin 500 mg q6h</li> </ul>
<b>Diabetic foot infection</b> (suspect MRSA if prior history of infection or colonization with MRSA)	<p>Mild to moderate infection:</p> <ul style="list-style-type: none"> <li>• Cephalexin 1000 mg TID <b>OR</b></li> <li>• Amoxicillin-clavulanate 875/125 mg q12h <b>OR</b></li> </ul> <p><b>PLUS</b></p> <ul style="list-style-type: none"> <li>• Doxy/minocycline 100 mg q12h <b>OR</b></li> <li>• SMT-TMZ 2 DS Tab q12h</li> </ul> <p>With or without metronidazole 500 mg TID</p> <ul style="list-style-type: none"> <li>• Severe PCN Allergy: Clindamycin 300 mg 450 q8h</li> </ul> <p>*Verify osteomyelitis has been ruled out via MRI</p>	<ul style="list-style-type: none"> <li>• Cephalexin 1000 mg TID</li> <li>• Amoxicillin-clavulanate 875/125 mg q12h</li> <li>• Severe PCN Allergy: Clindamycin 450 mg PO q8h</li> </ul>
<b>Community Acquired Pneumonia</b> (consider continuation of anti-MRSA therapy past 3d only in cases where lower respiratory cultures have grown MRSA or MRSA is otherwise strongly suspected)	<ul style="list-style-type: none"> <li>• Linezolid 600 mg q12h</li> <li>• Clindamycin 600 mg q8h*</li> </ul>	<ul style="list-style-type: none"> <li>• Doxycycline 100 mg BID</li> <li>• Azithromycin 500 mg Daily</li> <li>Levofloxacin 750 mg QD (in severe penicillin allergy)</li> </ul>
<b>MRSA Bacteremia</b> <u>Uncomplicated</u> (source: UTI, SSTI) - check with ID	<ul style="list-style-type: none"> <li>• Linezolid 600 mg q12h</li> </ul>	<p>For MSSA bacteremia, recommend to rule out endocarditis and consider nafcillin for high inoculum (i.e. repeated positive bacteremia) and transition to cefazolin. Consideration can be given to</p> <ul style="list-style-type: none"> <li>• SMT-TMZ 2 DS Tab q12h</li> <li>• Cephalexin 1 g TID</li> </ul>

\*Please corroborate with antimicrobial susceptibility testing before starting.

Other considerations for recommending the discontinuation of vancomycin:

- Patient is identified as low risk for MRSA infection:
  - Skin and soft tissue infection not present
  - No recent surgery or hemodialysis
  - No recent homelessness, hospitalization, incarceration, or nursing home residence
  - Patient has no surveillance or clinical culture proven MRSA within the past 12 months AND
  - Patient has not received parenteral antibiotics in preceding 90 days
  - **Clinical cultures obtained during the admission are negative for MRSA 48-72 hours after collection OR a cause of infection other than MRSA has been identified.**

## About The AUC<sub>24</sub>/MIC Calculator

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This vancomycin calculator uses a variety of published pharmacokinetic equations and principles to estimate an initial vancomycin dosing regimen for a patient based on population estimates. Subsequently, a regimen may be calculated based two vancomycin levels for severe MRSA infections. The AUC<sub>24</sub>/MIC is calculated using the trapezoidal method.

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### *Rule of Thumb*

*If vancomycin is likely not to be continued after 48-72 hours, go easy on the vancomycin LEVEL monitoring!*

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## Pharmacist Vancomycin AUC<sub>24</sub>/MIC Workshop:

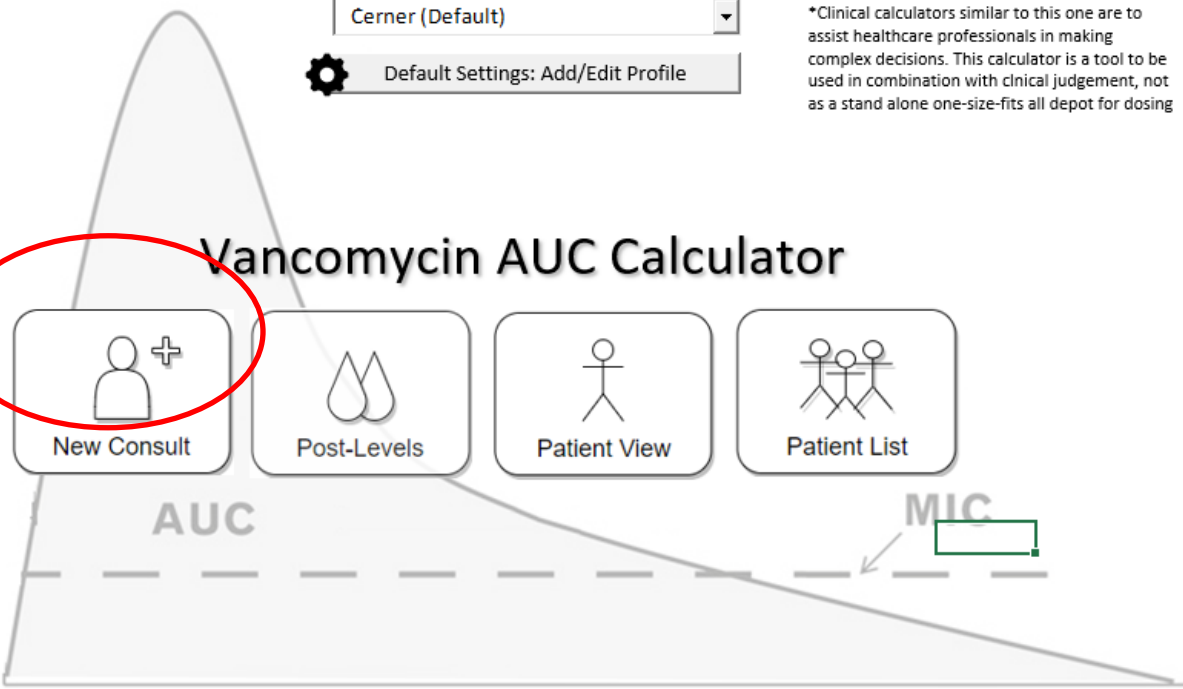
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1. Patient example
2. 2 Patient problems
  - a. Empiric Dosing
  - b. 2 Levels with first dose
  - c. 2 Levels at steady state



## Patient Example 1: New Consults - Empiric AUC/MIC

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\*Clinical calculators similar to this one are to assist healthcare professionals in making complex decisions. This calculator is a tool to be used in combination with clinical judgement, not as a stand alone one-size-fits all depot for dosing

**Exclusions**

- Hemodialysis, CRRT, AKI/Unstable Renal Function (Renal)
- UTI, Skin and soft tissue infections (ABSSSI), Surgical Prophylaxis (non-AUC)
- Enterococcal infections, Staphylococcus Epidermidis (non-MRSA Infections)

## 1. Patient Info:

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- 41 yo Female with MRSA Osteomyelitis
- Wt: 88.9 kg
- Ht: 157 cm

New Consult ✕

MRN: 12345      Age: 41 F      Provider: Dr John Jones  
 Name: Smith, Jane      Ht: 157 cm      Indication: Osteomyelitis  
 Location: 2W 214      Wt: 88.9 kg  
                                  TBW/IBW: 1.79  
                                  BMI: 36.1

1. Pt Info | 2. Kidney Function | 3. LD | 4. Vd | 5. CLVanco | 6. MD | 7. Levels / Labs | 8. Progress Note

1. Patient Identifiers

\* MRN

Last Name

First Name

Location

or  
continue inputting data

2. Diagnosis

Consulting Physician:

Suspected Indication:

3. Patient Characteristics

Age  years

Height

Weight

Gender

**Doses**

"Smith, Jane" last saved Fri, 6/5 01:16 pm

Load Patient Information

1. Choose the New Consult button
2. Enter the patient information into the calculator and choose Next. Choosing Next will save the information automatically.
3. Select save to add/update information in database
4. Entering the medical record number will allow patient to be identified during future admissions in the database
5. Previously added patients can be identified and loaded in the "Load Patient Information" section

## 2. Kidney Function

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- Patient example: This patient has stable renal function with a SCr 0.5 and no concurrent nephrotoxic medications, no amputations
- Enter patient's current serum creatinine into the calculator
- There is also an option to enter concurrent nephrotoxic agents and amputee status into the calculator. It will then provide a Caution pop-up for more careful monitoring.
- If patient is muscle wasted or cachectic, the SCr can be rounded by selecting "Yes"
- If patient is obese (>120% IBW) the AdjBW can be used to calculate CrCl by selecting "Yes"
- Select "Accept ### ml/min as CrCl"


New Consult ✕

MRN: 12345    Age: 41 F    SCr: 0.5 mg/dL    Provider: Dr John Jones  
 Name: Smith, Jane    Ht: 157 cm    CrCl: 152.8 mL/min    Indication: Osteomyelitis  
 Location: 2W 214    Wt: 88.9 kg    Using AdjBW: True  
 TBW/IBW: 1.79    BMI: 36.1

1. Pt Info | 2. Kidney Function | 3. LD | 4. Vd | 5. CLVanco | 6. MD | 7. Levels / Labs | 8. Progress Note

☐ Manually-Enter CrCl

4. Kidney Function

SCr Date (optional)  [\\*click here\\*](#)

\* SCr  mg/mL

Other Nephrotoxic Drugs:

☐ Amputee Next

\* Required if not manually-entering CrCl

Calculated CrCl

$(140 - \text{age } \{41\}) * \text{wt } \{65.4\}$   
 $\text{-----} * 0.85 = 152.8 \text{ mL/min}$   
 $72 * \text{SCr } \{0.5\}$   
 Pt is female, using correction factor

Manually-Enter CrCl  mL/min

Cachectic / Muscle Wasting Check

Age: 41 years  
 SCr: 0.5 mg/mL

Would you like to round SCr up to 1.0?

Obesity Check

BMI: 36.1    TBW: 88.9  
 TBW/IBW: 1.79    IBW: 49.7  
 AdjBW: 65.4

Would you like to use AdjBW in CrCl calculation?

\*TBW > 1.2 IBW, AdjBW recommended

Accept 152.8 mL/min as CrCl

Cancel << Back Next >> Save

"Smith, Jane" last saved Fri, 6/5 01:17 pm

Load Patient Information

+  Load

Anything entered in the "Manually-Enter CrCl" textbox will take priority over "Calculated CrCl"

### 3. LD – Loading Dose

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- New IDSA Vancomycin Guidelines from March 2020 recommend giving a loading dose for critically ill patients, ICU patients, those that require dialysis or renal replacement therapy. Consider whether patient requires a loading dose and if so, what category they fall into, and select “Calculate Load” or “No Load”.
- Loading dose max will be hospital specific, but according new guidelines may go up to 3000 mg.
- Calculator will estimate what time the loading dose will be given, adjust time based on expectations (consider time to dispense and potential delay from administering other antibiotics before vancomycin)
- Accept loading dose if giving, or hit next.

New Consult

MRN: 12345    Age: 41 F    SCr: 0.5 mg/dL    Provider: Dr John Jones  
 Name: Smith, Jane    Ht: 157 cm    CrCl: 152.8 mL/min    Indication: Osteomyelitis  
 Location: 2W 214    Wt: 88.9 kg    Using AdjBW: True  
 TBW/IBW: 1.79  
 BMI: 36.1

1. Pt Info | 2. Kidney Function | 3. LD | 4. Vd | 5. CLVanco | 6. MD | 7. Levels / Labs | 8. Progress Note

**Data Input**

Patient's weight: 88.9 kg

Dosing: 20 mg/kg

Max Dose: 2,000 mg

No Load **Calculate Load**

**Revise / Manually Enter Load Dose**

Load Dose: 1750 mg

Infuse Over: 1.8 hrs

Schedule at: Fri, 6/05 at 02:00 pm  
 6/05 16:00

**Table 1. ASHP / IDSA Recommendations**

Serious MRSA Infections: 20-35 mg/kg ABW\*  
 Critically ill: 25-35 mg/kg#  
 Obese (BMI > 30): 20-25 mg/kg+  
 HD: 20-25 mg/kg+  
 CRRT: 20-25 mg/kg+  
 Pediatrics (Obese): 20 mg/kg  
 Pediatrics: no loading dose

\* consider in treatment of serious MRSA infections.  
 # for intermittent or cont TBW not to exceed 3000mg  
 + using TBW not to exceed 3000mg in serious infections

**Calculations**

Calculated Dose:  $88.9 \times 20 = 1778$  mg

Rounded Dose: 1750 mg

**Accept "1750 mg" as load dose**

**Doses**  
 6/05 14:00 - 1750 mg

**LOAD DOSE:** 1750 mg over 1.8 hrs  
 on Fri, 6/05 at 14:00

Cancel << Back Next >> Save

"Smith, Jane" last saved Fri, 6/5 01:20 pm

Load Patient Information  
 + [ ] Load

NOTE: "Loading doses for severe infections in patients who are seriously ill"

## 4. Vd: Volume of distribution

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Select desired Volume of distribution based on Table and patient characteristics and hit Next. Will default to 0.65 Vd.

New Consult

MRN: 12345    Age: 41F    SCr: 0.5 mg/dL    Vd: 44.4 L    Provider: Dr John Jones  
Name: Smith, Jane    Ht: 157 cm    CrCl: 152.8 mL/min    Ke: 0.1487    Indication: Osteomyelitis  
Location: 2W 214    Wt: 88.9 kg    Using AdjBW: True    t1/2: 4.7 hrs    DOT: Day 1 (-144 min)  
TBW/IBW: 1.79    BMI: 36.1    CLVanco: 6.6 L/hr    Eqn Used: Crass

1. Pt Info | 2. Kidney Function | 3. LD | 4. Vd | 5. CLVanco | 6. MD | 7. Levels / Labs | 8. Progress Note

Estimate Vd  
\* Vd: 0.4 - 0.6

Vd Calculation  
Calculated Vd:  $0.5 * 88.9 \text{ kg} = 44.4 \text{ L}$

Vd Adjustment  
0.5  
Min: 0.4    Max: 0.6

Table 2. Population-based Vd estimates

Normal:	0.65
Dehydrated:	0.5 - 0.6
Obese:	0.4 - 0.6
Overhydrated:	0.7 - 0.85
Cystic fibrosis:	0.7 - 0.85
Septic Shock:	0.7 - 0.75
ICU:	0.7 - 0.75
Trauma:	0.7 - 0.75
ESRD:	0.7 - 0.75
Post-partum < 48 hrs:	0.7
Pregnant in 3rd trimester:	0.7

**Doses**  
6/05 16:00 - 1750 mg  
6/06 04:00 - 1250 mg  
6/06 16:00 - 1250 mg  
6/07 04:00 - 1250 mg  
6/07 16:00 - 1250 mg

edit    **LOAD DOSE:** 1750 mg over 1.8 hrs on Fri, 6/05 at 16:00

edit    **MAINTENANCE:** 1250 mg over 1.25 hrs every 12 hrs on Sat, 6/06 at 04:00  
AUC: 410 +/-    [\\*View AUC Calculation Steps](#)

Cancel    << Back    Next >>    Save

Smith, Jane" last saved Fri, 6/5 01:34 pm

Load Patient Information  
+    12345    Load

## 5. Cl Vanco

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- Select the vancomycin clearance equation to estimate vancomycin clearance based on the patients renal function +/- weight.
- Crass is more appropriate for obese patients. Matze may be used for all others.

New Consult ✕

MRN: 12345	Age: 41 F	SCR: 0.5 mg/dL	Vd: 44.4 L	Provider: Dr. John Jones
Name: Smith, Jane	Ht: 157 cm	CrCl: 152.8 mL/min	Ke: 0.1487	Indication: Bacteremia
Location: 2W 214	Wt: 88.9 kg	Using AdjBW: True	t1/2: 4.7 hrs	DOT: Day 1 (-6 min)
	TBW/TBW: 1.79		CLVanco: 6.6 L/hr	
	BMI: 36.1		Eqn Used: Crass	

1. Pt Info | 2. Kidney Function | 3. LD | 4. Vd | 5. CLVanco | 6. MD | 7. Levels / Labs | 8. Progress Note

Choose CLVanco Equation

\* CLVanco: Crass

Estimated PK Parameters

CLVanco: 6.6 L/hr

CrCl: 152.8 mL/min

Vd: 44.4 L

Ke: 0.1487

t1/2: 4.7 hrs

Table 3. CLVanco estimation equations

**Matzke:**  $[(CrCl * 0.689) + 3.66] * 0.06$   
 $\wedge$  for normal weight patients

**Crass:**  $9.656 - 0.078 * age - 2.009 * SCr + 1.09 * sex + 0.04 * TBW^{0.75}$   
 $\wedge$  for obese patients, where female = 0, male = 1

**Doses**

5/29 13:00 - 2000 mg

**LOAD DOSE:** 2000 mg over 2 hrs  
on Fri, 5/29 at 13:00

Cancel << Back Next >> Save

"Smith, Jane" last saved Fri, 5/29 12:54 pm

Load Patient Information

+  Load

## 6. Maintenance Dose Table

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- Potential doses will populate in the table based on a Target AUC<sub>24</sub>/MIC 400-600
- Boxes will populate with estimated AUC on top and troughs on bottom
- Choose an appropriate dosage regimen based on target AUC<sub>24</sub>/MIC 400-600 by selecting the box. Keep in mind the troughs may be low, but we are dosing on target AUC.
- The selected dosing regimen will appear, hit next

Maintenance Dose Table

Infusion Rate

1000 mg/hr

\* Target

AUC/MIC range 400-600

MIC

0.1 - 1.0

750mg

1000mg

1250mg

1500mg

1750mg

2000mg

0.8 hrs

1 hr

1.2 hrs

1.5 hrs

1.8 hrs

2 hrs

infusion times

☒

Q6H	480 14						mg h / L mg/dL
Q8H		490 12					mg h / L mg/dL
Q12H			410 7	500 9	600 11		mg h / L mg/dL
Q18H						460 5	mg h / L mg/dL
Q24H							mg h / L mg/dL
Q36H							mg h / L mg/dL
Q48H							mg h / L mg/dL

\* AUC calculations are estimated and rounded to nearest 10's.

PK Parameters

Population-based

Vd: 44.4 L

Ke: 0.1487

t1/2: 4.7 hrs

CLVanco: 6.6 L/hr

Legend

AUC/MIC

trough

TDD

dosing

Options

☒ Estimated trough

☐ Total Daily Dose (TDD)

☐ dosing in mg/kg

☐ Show all values

\*View AUC Calculation Steps

Exit

\* Click inside the blue box to view steps!

## 7. Levels/Labs

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- Under Schedule Labs, the desired time for post dose levels will populate based on when the loading dose was given. They should be collected after the 1<sup>st</sup> dose or at steady state, depending on the infection severity and patient risk for AKI.
- Hit Next

New Consult

MRN: 12345    Age: 41 F    SCr: 0.5 mg/dL    Vd: 44.4 L    Provider: Dr. John Jones  
Name: Smith, Jane    Ht: 157 cm    CrCl: 152.8 mL/min    Ke: 0.1487    Indication: Bacteremia  
Location: 2W 214    Wt: 88.9 kg    Using AdjBW: True    t1/2: 4.7 hrs    DOT: Day 0 (0 hrs in)  
TBW/IBW: 1.79    CLVanco: 6.5 L/hr    Eqn Used: Matzke  
BMI: 36.1

1. Pt Info | 2. Kidney Function | 3. LD | 4. Vd | 5. CLVanco | 6. MD | 7. Levels / Labs | 8. Progress Note

Load Dose (adjustable)  
Load Dose  mg  
Infuse Over  hrs

1st Interval (adjustable)  
Interval  hrs  
Reload

Schedule Labs  
☐ "Peak" Options    "Trough" Options

Doses  
5/29 13:00 - 2000 mg  
5/30 01:00 - 1250 mg  
5/30 13:00 - 1250 mg  
5/31 01:00 - 1250 mg  
5/31 13:00 - 1250 mg

**LOAD DOSE:** 2000 mg over 2 hrs  
on Fri, 5/29 at 13:00

**MAINTENANCE:** 1250 mg over 1.25 hrs every 12 hrs  
**AUC:** 410 +/- on Sat, 5/30 at 01:00  
[\\*View AUC Calculation Steps](#)

Cancel    << Back    Next >>    Save

Load Patient Information  
+  Load



## 8. Progress Note

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- This page will populate with the information that was used to determine the LD (if giving) and MD. It can be copied and pasted into a Cerner Progress Note.
- Hit "Create Monitoring Form"

New Consult

MRN: 12345 Name: Smith, Jane Location: 2W 214	Age: 41 F Ht: 157 cm Wt: 88.9 kg TBW/IBW: 1.79 BMI: 36.1	SCr: 0.5 mg/dL CrCl: 152.8 mL/min Using AdjBW: True	Vd: 44.4 L Ke: 0.1487 t1/2: 4.7 hrs CLVanco: 6.6 L/hr Eqn Used: Crass	Provider: Dr John Jones Indication: Osteomyelitis DOT: Day 1 (-19 min)
---	--	---	---	--

1. Pt Info
2. Kidney Function
3. LD
4. Vd
5. CLVanco
6. MD
7. Levels / Labs
8. Progress Note

Progress Note

Update Progress Note

Create Monitoring Form

Assessment

Day of Therapy: 1  
Ordering Physician: Dr John Jones  
Suspected Indication: Osteomyelitis  
Estimated Renal Function: CrCl 152.8 mL/min  
Obesity Check:  
-- Patient's TBW/IBW: 1.79  
-- Patient's BMI: 36.1  
-- Used AdjBW of 65.4 kg instead of 88.9 kg for CrCl Calculation  
-- Calculated CrCl decreased from 207.8 mL/min to 152.8 mL/min with adjustment

Plan

Based on weight, ordered loading dose: 1750 mg  
Target: AUC/MIC range 400-600  
Maintenance Dose: 1250 mg q12h  
--Estimated AUC24/MIC: 410 +/- 100\*  
--Estimated trough: 7 mg/dL +/- 5  
Will continue to follow clinical status and final culture results.

Thank you for the consult.

\*Rybak MJ, Le J, Lodise TP, et al. Therapeutic monitoring of vancomycin for serious methicillin-resistant Staphylococcus aureus infections: A revised consensus guideline and review by the American Society of Health-System Pharmacists, the Infectious Diseases Society of America,

Doses

6/05 14:00 - 1750 mg  
6/06 02:00 - 1250 mg  
6/06 14:00 - 1250 mg  
6/07 02:00 - 1250 mg  
6/07 14:00 - 1250 mg

edit
LOAD DOSE: 1750 mg over 1.8 hrs  
on Fri, 6/05 at 14:00

edit
MAINTENANCE: 1250 mg over 1.25 hrs every 12 hrs  
AUC: 410 +/- on Sat, 6/06 at 02:00  
[\\*View AUC Calculation Steps](#)

Cancel
<< Back
Next >>
Save

"Smith, Jane" last saved Fri, 6/5 01:41 pm

Load Patient Information

+
12345
Load

# Calculator Generated Monitoring Form:

[\[back to table of contents ↗\]](#)

Vancomycin Monitoring Form							
<b>Identifiers</b>		<b>Characteristics</b>		<b>Diagnosis</b>			
MRN:	12345	Age:	41 F	Provider:	Dr John Jones		
Name:	Smith, Jane	Ht:	157 cm	Indication:	Osteomyelitis		
Location:	2W 214	Wt:	88.9 kg	Target:	AUC/MIC range 400-600		
<b>Anthropomorphics</b>		<b>Kidney Function</b>		<b>Loading Dose</b>			
TBW:	88.9	TBW/IBW:	1.79	Scr:	0.5		
IBW:	49.7	BMI:	36.1	Bun:	0		
AdjBW:	65.4	CrCl:	152.8 mL/min	Dose:	1750 mg over 1.8 hrs		
		Drugs:		Scheduled:	Fri, 6/05 14:00		
				mg/kg	19.7 mg/kg		
<b>Day of Therapy /Date</b>	<b>Day 1 6/05</b>	<b>Day 2 6/06</b>	<b>Day 3 6/07</b>	<b>Day 4 6/08</b>	<b>Day 5 6/09</b>	<b>Day 6 6/10</b>	<b>Day 7 6/11</b>
Maintenance dose (mg)							
Maintenance dose (mg/kg)							
Frequency (hrs)							
Administration times per MAR							
<b>Labs</b>							
Trough Level/Time Drawn							
Trough Level Ordered for: (date/time)							
SCr (daily for adults)							
BUN (daily for adults)							
CrCl estimate (ml/min)							
WBC							
Procalcitonin							
Other nephrotoxic drugs: NSAIDs, ACE inhibitor, diuretics, piperazine, vanproprazole, etc.							
Culture & Sensitivity results / MRSA PCR results for respiratory and sepsis indications:	Nasal MRSA PCR ( ) Positive ( ) Negative Date: _____ Blood culture organism(s): _____ _____ ( ) final Date: _____ Resp culture; organism(s): _____ ( ) final Date: _____ Other: _____ _____ ( ) final Date: _____						
Evaluate for de-escalation		[ ] MRSA PCR follow up	[ ] Action on culture informatio n if applicable				
<b>Comments:</b>							

## Two post dose levels:

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- Use “Post-Level” portion of calculator once two post dose levels are available – ideally close to steady state (after 4<sup>th</sup> dose) and at least 1 half-life apart.

Cerner (Default) ▼


⚙️

Default Settings: Add/Edit Profile


### Vancomycin AUC Calculator




New Consult



Post-Levels



Patient View



Patient List

AUC

MIC

•Clinical calculators similar to this one are to assist healthcare professionals in making complex decisions. This calculator is a tool to be used in combination with clinical judgement, not as a stand alone one-size-fits all depot for dosing

**Exclusions**

- Hemodialysis, CRRT, AKI/Unstable Renal Function	(Renal)
- UTI, Skin and soft tissue infections (ABSSSI), Surgical Prophylaxis	(non-AUC)
- Enterococcal infections, Staphylococcus Epidermidis	(non-MRSA Infections)

## 1. Search patient and load patient information input from initial empiric dosing or fill in demographic information:

[\[back to table of contents ↩ \]](#)

Post Levels

MRN: 12345    Age: 41 F    SCr: 0.5 mg/dL    Population: Estimates    Provider: Dr John Jones  
Name: Smith, Jane    Ht: 157 cm    CrCl: 152.8 mL/min    Vd: 44.4 L    Indication: Bacteremia  
Location: 2W 214    Wt: 88.9 kg    Using AdjBW: True    Ke: 0.1487    DOT: Day 5 (116 hrs in)  
TBW/IBW: 1.79    t1/2: 4.7 hrs  
BMI: 36.1    CLVanco: 6.6 L/hr

1. Pt Info

2. Ke, t1/2

3. Vd

4. Dose Table

5. Progress Note

Equations Used

Load Patient

Load Patient Information

12345

Load

2. Diagnosis

Consulting Physician:  
Dr John Jones

Suspected Indication:  
Bacteremia

1. Patient Identifiers

MRN 12345

Last Name Smith

First Name Jane

Location 2W 214

3. Patient Characteristics

Age 41 years

Height 157 cm

Weight 88.9 kg

Gender Female

New

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Next >>

Save

## 2. Post dose level entry – patient specific $K_e$ , $t_{1/2}$ results [\[back to table of contents\]](#)

- Enter post dose levels, ensure times and dates are correct based on when last dose was given
- Hit the “Calculate the  $K_e$ ,  $t_{1/2}$ ” and Next
- The green check mark indicates there is at least one  $t_{1/2}$  between the levels

MRN: 12345

Age: 41 F

SCr: 0.5 mg/dL

Population: Estimates

Provider: Dr John Jones

Name: Smith, Jane

Ht: 157 cm

CrCl: 152.8 mL/min

Vd: 44.4 L

Indication: Osteomyelitis

Location: 2W 214

Wt: 88.9 kg

Using AdjBW: True

Ke: 0.1487

DOT: Day 1 (~17 min)

TBW/IBW: 1.79

BMI: 36.1

t1/2: 4.7 hrs

CLVanco: 6.6 L/hr

1. Pt Info

2. **Ke, t1/2**

3. Vd

4. Dose Table

5. Progress Note

Equations Used

Level(s)

1st post-dose level

32 mg/dL

Level 1 Date/Time

6/05 16:00

2nd post-dose level

10.1 mg/dL

Level 2 Date/Time

6/06 01:00

Calculate  $K_e$ ,  $t_{1/2}$

Ke, t1/2: Patient-Specific

Ke: 0.1281

t1/2: 5.4 hrs

Half-life check

t2 - t1	half-life
9	5.4

✓

Equation Used:

$$K_e = \frac{\ln(C_1/C_2)}{\Delta t}$$

where:

$K_e$  = elimination-rate constant

$C_1$  = measured peak concentration ~1 hour after infusion

$C_2$  = measured trough concentration ~30 min before next dose

$\Delta t$  = difference in time between lab samples in hrs

New

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Next >>

Save

"Smith, Jane" last saved Fri, 6/5 01:45 pm

### 3. Volume of Distribution

[\[back to table of contents ↩\]](#)

- Select Level Strategy: after 1<sup>st</sup> dose vs steady state
- Enter the dose the patient received, verify the infusion time, and date/time administered. If level is at steady state, enter and verify the dosing interval.
- Hit "Calculate Vd"
- Hit "Next"

Post Levels

MRN: 12345 Name: Smith, Jane Location: 2W 214	Age: 41 F Ht: 157 cm Wt: 88.9 kg TBW/IBW: 1.79 BMI: 36.1	SCr: 0.5 mg/dL CrCl: 152.8 mL/min Using AdjBW: True	Population: Estimates Vd: 44.4 L Ke: 0.1487 t1/2: 4.7 hrs CLVanco: 6.6 L/hr	Provider: Dr John Jones Indication: Osteomyelitis DOT: Day 1 (-17 min)
---	--	---	---	--

1. Pt Info | 2. Ke, t1/2 | 3. Vd | 4. Dose Table | 5. Progress Note | Equations Used

**Levels Strategy:** 1st Dose: Peak and Trough

1st Dose

Dose: 1750 mg  
Infusion time: 1.8 hrs  
Dose Date/Time: 6/05 14:00  
Calculate Vd

Vd: Patient-Specific  
Vd: 61.5 L

**Equation Used:**

$$V_d = \frac{(1 - e^{-K_e \cdot T_{inf}})}{K_e \cdot C_{peak,1}} \frac{Dose}{T_{inf}} \cdot e^{-K_e \cdot t'}$$

**where:**  
 $C_{peak,1}$  = measured peak concentration ~1 hour after infusion  
Dose = 1st dose  
 $T_{inf}$  = infusion time in hrs  
 $t'$  = time between end of infusion and collection of blood sample  
 $K_e$  = elimination constant  
 $V_d$  = Volume of distribution

Transfer Data to DMC Calculator

New << Back Next >> Save

\*Smith, Jane last saved Fri, 6/5 01:54 pm

#### 4. New Maintenance Dose Table:

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- If necessary, select a new maintenance dose based on the AUC target. Usually the lowest clinically effective AUC dose should be used, along with consideration for more convenient dosing (i.e. avoid q18H, q36H intervals if possible)
- Patient specific PK parameters are presented on the right

Maintenance Dose Table

Maintenance Dose Table

Infusion Rate

1000 mg/hr

\* Target

AUC/MIC range 400-600

MIC

0.1 - 1.0

	750mg	1000mg	1250mg	1500mg	1750mg	2000mg	
	0.8 hrs	1 hr	1.2 hrs	1.5 hrs	1.8 hrs	2 hrs	<input checked="" type="checkbox"/> infusion times
Q6H		540 17					mg h / L mg/dL
Q8H		410 11	510 14				mg h / L mg/dL
Q12H				420 9	490 10	570 12	mg h / L mg/dL
Q18H							mg h / L mg/dL
Q24H							mg h / L mg/dL
Q36H							mg h / L mg/dL
Q48H							mg h / L mg/dL

\* AUC calculations are estimated and rounded to nearest 10's.

PK Parameters

Patient-Specific

Vd: 61.5 L

Ke: 0.1281

t1/2: 5.4 hrs

CLVanco: 7.9 L/hr

Legend

AUC/MIC

trough

TDD

dosing

Options

☒ Estimated trough

☐ Total Daily Dose (TDD)

☐ dosing in mg/kg

☐ Show all values

\*View AUC Calculation Steps

Exit

\* Click inside the blue box to view steps!

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## 5. Progress Note Update

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- The progress note is now updated with the patient specific PK parameters and dosage adjustment information.

Post Levels

MRN: 12345

Name: Smith, Jane

Location: 2W 214

Age: 41 F

Ht: 157 cm

Wt: 88.9 kg

TBW/IBW: 1.79

BMI: 36.1

SCr: 0.5 mg/dL

CrCl: 152.8 mL/min

Using AdjBW: True

Patient: Specific

Vd: 61.5 L

Ke: 0.1281

t1/2: 5.4 hrs

CLVanco: 7.9 L/hr

Population: Estimates

Vd: 44.4 L

Ke: 0.1487

t1/2: 4.7 hrs

CLVanco: 6.6 L/hr

Provider: Dr John Jones

Indication: Osteomyelitis

DOT: Day 0 (0 hrs in)

1. Pt Info

2. Ke, t1/2

3. Vd

4. Dose Table

5. Progress Note

Equations Used

\* Target

AUC/MIC range 400-600

MIC

0.1 - 1.0

Start Date/Time

6/05 14:00

Progress Note

Update Progress Note

Suspected Indication: Osteomyelitis

Consulting Physician: Dr John Jones

Day of Therapy: Day 0

Target: AUC/MIC range 400-600

MIC: 0.1 - 1.0

Calculated Patient-Specific PK Parameters:

- Ke: 0.1281

- T1/2: 5.4 hrs

- Vd: 61.5 L

- CLVanco: 7.9 L/hr

Plan

-----

Based on Patient-Specific PK parameters, adjusted regimen to:

- Maintenance Dose: 1500 mg q12h

--Estimated AUC24/MIC: 420\*

--Estimated trough: 9 mg/dL

Thank you for the consult.

-----

\*Rybak MJ, Le J, Lodise TP, et al. Therapeutic monitoring of vancomycin for serious methicillin-resistant Staphylococcus aureus infections: A revised consensus guideline and review by the American Society of Health-System Pharmacists, the Infectious Diseases Society of America, the Pediatric Infectious Diseases Society, and the Society of Infectious Diseases Pharmacists. American journal of health-system pharmacy: AJHP : official journal of the American Society of Health-System Pharmacists. https://www.ncbi.nlm.nih.gov/pubmed/32191793. Published May 19, 2020.

6/05 14:00 - 1750 mg

6/06 02:00 - 1750 mg

6/06 14:00 - 1750 mg

6/07 02:00 - 1750 mg

6/07 14:00 - 1750 mg

New

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Next >>

Save

"Smith, Jane" last saved Fri, 6/5 02:35 pm

edit

MAINTENANCE: 1750 mg over 1.8 hrs every 12 hrs

AUC: 500 +/- on Sat, 6/06

\*View AUC Calculation Steps

NEW MAINTENANCE DOSE

1500 mg over 1.5 hrs every 12 hrs



**Patient 2:**[\[back to table of contents ↩ \]](#)

MRN: 123456, Location: 314 (ICU)

Name: Jimmy Dean

Age: 72

Gender: Male

Height/weight: 180.34 cm 102.3 kg measured

SrCr 1.3 – stable

Other medications: Metformin, metoprolol, aspirin, Lisinopril &amp; Pip/tazo

WBC 18,000, temperature 39.5 C

Indication: Pneumonia

**Questions:**

1. Creatinine Clearance: \_\_\_\_\_ ml/min
2. Loading dose:
  - a. Patient should receive a loading dose? ☐ Yes ☐ No
  - b. Why or why not: \_\_\_\_\_
  - c. If yes, loading dose selected: \_\_\_\_\_
3. Vd selected & why: \_\_\_\_\_
4. CL Vanco Equation Selected: \_\_\_\_\_
5. Maintenance Dose: \_\_\_\_\_
6. Schedule post-dose levels after:
  - ☐ 1<sup>st</sup> dose why? \_\_\_\_\_
  - ☐ 4<sup>th</sup> dose; why? \_\_\_\_\_
  - ☐ Wait and re-evaluate in 24 hours; why? \_\_\_\_\_

**Patient 2 continued:**

Loading dose (2000 mg) administered on 6/5 @ 12:00 (over 2 hours)

1<sup>st</sup> Post dose level = 31.2 on 6/5 @ 15:002<sup>nd</sup> Post dose level: 30 minutes prior to subsequent dose = 7.8 on 6/6 @ 00:30**Questions:**

1. Patient specific Vd: \_\_\_\_\_ L
2. New maintenance dose: \_\_\_\_\_ mg Q \_\_\_\_\_ h
3. Estimated AUC: \_\_\_\_\_

Why did you choose this regimen?

---



---



---

What is the total gram/day? \_\_\_\_\_

Does this place the patient at additional risk for nephrotoxicity.

**Patient Case 3:**[\[back to table of contents ↗ \]](#)

MRN 56789, Location: 612 (Med/Surg)

Age: 59 years

Gender: Male

Height/weight: 180.34 cm 63.3 kg measured

SrCr 0.8 (4/27/20 0352) stable

WBC 9.31, Afebrile

Indication: Sepsis

## Questions:

1. Creatinine Clearance: \_\_\_\_\_ ml/min
2. Loading dose:
  - a. Patient should receive a loading dose? ☐ Yes ☐ No
  - b. Why or why not: \_\_\_\_\_
  - c. If yes, loading dose selected: \_\_\_\_\_
3. Vd selected & why: \_\_\_\_\_
4. CL Vanco Equation Selected: \_\_\_\_\_
5. Maintenance Dose: \_\_\_\_\_
6. Schedule post-dose levels after:
  - ☐ 1<sup>st</sup> dose why? \_\_\_\_\_
  - ☐ 4<sup>th</sup> dose; why? \_\_\_\_\_
  - ☐ Wait and re-evaluate in 24 hours; why? \_\_\_\_\_

**Patient 3 continued:**

Maintenance Regimen Selected (no LD given): Vancomycin 1 gm q12h, 1 dose at 1734 on 2/10 over 1 hr

"Peak": 2/12 @ 2001 - 24.3

"Trough": 2/12 @ 0510 - 15.9

## Questions:

7. Patient specific Vd: \_\_\_\_\_ L
8. New maintenance dose: \_\_\_\_\_ mg Q \_\_\_\_\_ h
9. Estimated AUC: \_\_\_\_\_

Why did you choose this regimen?

---



---



---

What is the total gram/day? \_\_\_\_\_

Does this place the patient at additional risk for nephrotoxicity.

How would you treat this patient differently if the vancomycin was indicated for cellulitis?

---

**IX. References:**[\[back to table of contents ↗ \]](#)

1. Rybak MR, Le J, Lodise TP et al. Therapeutic monitoring of vancomycin for serious methicillin-resistant *Staphylococcus aureus* infections: A revised consensus guideline and review by the American Society of Health-System Pharmacists, the Infectious Diseases Society of America, the Pediatric Infectious Diseases Society, and the Society of Infectious Diseases Pharmacists. *Am J Health-Syst Pharm*. 19 Mar 2020; <https://doi.org/10.1093/ajhp/zxaa036>.
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