

7/8 Follow-up

In working with the calculator update today and trying to put in some patients to try it out prior to the planned Go -Live, we've come up with a couple more questions. We have decided that we needed to clear these up on the call tomorrow prior to our official go live.

I wanted to lay out our questions to help streamline the call and in case other sites have come across them as well:

Question 1 - CrCl calculation

- updated calculation to default to IBW. Yikes!

1) Creatinine Clearance calculator – appears to be using TBW on all patients (rather than IBW) unless TBW >1.2 IBW

a.) **ABW 63.5kg, IBW 57kg**

1. Pt Info | 2. Kidney Function | 3. LD | 4. Vd | 5. CLVanco | 6. M

☐ Manually-Enter CrCl

4. Kidney Function

* SCr mg/mL [*click here*](#)

SCr Date (optional)

Other Nephrotoxic Drugs:

☐ Amputee

* Required if not manually-entering CrCl

Calculated CrCl

$$\frac{(140 - \text{age } \{63\}) * \text{wt } \{63.5\}}{72 * \text{SCr } \{0.495\}} * 0.85 = 116.6 \text{ mL/min}$$

Pt is female, using correction factor

MRN: 56789 TBW: 63.3 kg SCr: 0.8 mg/dL
 Age: 59 M IBW: 75.3 kg CrCl: 105.9 mL/min
 Ht: 180.3 cm AdjBW: 70.5 kg
 TBW/IBW: 0.84
 BMI: 19.5


Updated weight context

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)

* SCr mg/mL  [*click here*](#)

Other Nephrotoxic Drugs:

☐ Amputee

* Required if not manually-entering CrCl

Next

Calculated CrCl

$(140 - \text{age } \{59\}) * \text{wt } \{63.3 \text{ kg}\} * 0.85 = 105.9 \text{ mL/min}$

72 * SCr {0.8}

Pt is male, no correction made

Manually-Enter CrCl

mL/min

Accept 105.9 mL/min as CrCl

Cachectic / Muscle Wasting Check

Age: 59 years
 SCr: 0.8 mg/mL

Would you like to round SCr up to 1.0?

Yes No


Changed CrCl calculation

1. Defaults to IBW
2. If TBW < IBW, defaults to TBW
3. If TBW/IBW > 1.2, will ask if you want to use AdjBW

Question 2 - Infusion Rate / Site / Pharmacist preferences

- 2) Maintenance dose infusion rate is defaulting to GlobalRPh rate vs Cerner Infusion rate – can this be changed? We're using the Cerner rates almost exclusively.

Henderson

1  Default Settings: Add/Edit Profile

*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

Vancomycin AUC

New Consult Post-Levels Patient

AUC

Can add / edit profile preferences at the top of Landing Page

- Thought almost each pharmacist could change preferences
- Wanted to make sure if there was a preference, there could be an option to select it, so if a preference isn't there, I think it would be nice if there was one!

Exclusions

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

(Renal)
 (non-AUC)
 (non-MRSA Infections)

VancoAUC_v1.2.2_Jul-07.xlsm - Saved

File Home Insert Page Layout Formulas Data Review View Developer Acrobat

Henderson

*Clinical calculators similar to this one are to assist healthcare professionals in making 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

Site Settings

Site: Henderson

Load Dose Dosing: 25 mg/kg

Load Dose Max: 3,000 mg

Infusion Rate: 1000 mg/hr

Additional Infusion Time: 1000 mg/hr Cerner Rate
GlobalRPh Custom
600 mg/hr Less side effects
750 mg/hr

Cancel Update

New Consult

AUC

MIC

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

(non-MRSA infections)

Landing Page dbMisc dbSite Updates

Here's where you can select which rate you want!

VancoAUC_v1.2.2_Jul-07.xlsm - Saved

File Home Insert Page Layout Formulas Data Review View Developer Acrobat

Henderson

*Clinical calculators similar to this one are to assist healthcare professionals in making 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

Site Settings

Site: Cerner (Default)
George Washington
Wellington Regional Medical Center
Henderson

Load Dose Max: []

Infusion Rate: []

Additional Infusion Time: []

Cancel Add

New Consult

AUC

MIC

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

(Renal)
(non-AUC)
(non-MRSA infections)

Landing Page dbMisc dbSite Updates

If you select the empty part or clear the site field, the "Update" button will change to "Add" and you can create another profile

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)*

*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

Question 3 - Automatically populating CL equation

- tried to update, let me know if it's not working!

3) CL equation – no longer populating automatically off TBW/IBW ration – was previously. Not a deal-breaker but was nice when it auto-populated

MRN: 56789
Name: Patient3, ZZTest
Age: 59 M
Ht: 180.3 cm

1 TBW: 120 kg
IBW: 75.3 kg
AdjBW: 93.2 kg
TBW/IBW: 1.59
BMI: 36.9

SCr: 0.8 mg/dL
CrCl: 168.8 mL/min

Population: Estimates
Vd: 78 L
Ke: 0.0768
t1/2: 9 hrs
CLVanco: 6 L/hr

2 * CLVanco: Crass

Estimated PK Parameters

CLVanco: 6 L/hr
CrCl: 168.8 mL/min
Vd: 78 L
Ke: 0.0768
t1/2: 9 hrs

Table 3. CLVanco estimation equations

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

Crass: $9.656 - 0.078 * age - 2.009 * SCr +$

I changed pt's weight to 120kg to get an obese patient, and I think it defaulted to Crass. If it's still not working, let me know and I'll try to troubleshoot!

Updated code (if it didn't include Matzke!):

```

If NewConsult.MultiPage.value = pg5_CLVanco Then
    if pt.char.BMI >= 30 Then
        NewConsult.cmbCLVanco = "Crass"
    else
        NewConsult.cmbCLVanco = "Matze"
    End if
End if

```

Question 4 - Defaulting dose in PostLevels

- tried to fix logic!

4) When processing post dose levels, if using levels after the loading dose, the "maintenance dose" defaults to the loading dose amount with maintenance dose frequency when adjusting the dose?

Tried to adjust the logic so that:

- if it's a **First Dose** peak and trough, then if there is a load dose, it goes for that before picking the maintenance dose.
- if it's a **Steady-state** peak and trough, then it will go straight for the maintenance dose if possible.

Here's the code when trying to prepopulate

```

If PostLevels.cmbLevels = "First Dose: Peak and Trough" Then
    If pt.ld.givenQ Then
        If pt.ld.dose.strength <> 0 Then
            PostLevels.cmbDose = pt.ld.dose.strength
            PostLevels.tbTinf = pt.ld.dose.infusionTimeRounded
            PostLevels.cmbInfusionTimeUnits = "hrs"
            If Cdbl(pt.ld.dose.administeredAt) > 0 Then
                PostLevels.lblDoseDateTime = Format(pt.ld.dose.administeredAt,
"MM/DD HH:MM")
            End If
        End If
    End If
Else
    If pt.md.dose.strength <> 0 Then
        PostLevels.cmbDose = pt.md.dose.strength
        PostLevels.tbTinf = pt.md.dose.infusionTimeRounded
        PostLevels.cmbInfusionTimeUnits = "hrs"
        If Cdbl(pt.md.dose.administeredAt) > 0 Then
            PostLevels.lblDoseDateTime = Format(pt.md.dose.administeredAt,
"MM/DD HH:MM")
        End If
    End If
End If
ElseIf PostLevels.cmbLevels = "SS: Peak and Trough" Then
    If pt.md.dose.strength <> 0 Then
        PostLevels.cmbDose = pt.md.dose.strength
        PostLevels.tbTinf = pt.md.dose.infusionTimeRounded
        PostLevels.cmbInfusionTimeUnits = "hrs"
        If Cdbl(pt.md.dose.administeredAt) > 0 Then
            PostLevels.lblDoseDateTime = Format(pt.md.dose.administeredAt,
"MM/DD HH:MM")
        End If
    End If
End If

```

```

End If
End If
End If

```

- a. Unfortunately, I tried to recreate this but am now getting the actual maintenance doses (yay!)– not sure exactly what we did to populate the higher dose issue.

Question 5 - Vd steady-state equation

- tried to update! Let me know if it looks right!

5) Steady state level issues: “t” not defined – per the equations at the end appears to be Tinf?

Equation Used:

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

where:

$C_{peak,ss}$ = measured peak concentration ~1 hour after infusion
 Dose = maintenance 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
 τ = dosing interval

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

Levels Strategy: SS: Peak and Trough

Maintenance Dose

Dose mg
Infusion time hrs
Dose Date/Time
[* click here *](#)

Vd: Patient-Specific

Vd:

dosing interval hrs

Calc

Updated equation!

Equation Used:

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

where:

$C_{peak,ss}$ = measured peak concentration ~1 hour after infusion
 Dose = maintenance dose
 T_{inf} = infusion time in hours
 t' = time between end of infusion and collection of blood sample
 K_e = elimination rate constant
 V_d = Volume of distribution
 τ = dosing interval

Transfer Data to DMC Calculator

Question - Patient #3

- The numbers look off!

a.

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

Levels Strategy: SS: Peak and Trough

Maintenance Dose

Dose: 1000 mg Infusion time: 1 hrs Dose Date/Time: 02/10 17:34

dosing interval: 12 hrs **Calculate Vd**

Vd: Patient-Specific

Vd: 9.5 L

Estimated Concentrations

Cmax: 258
Ceol: 246
Cpeak: 235
Ctough: 151
Cmin: 148

Equation Used:

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

where:
 $C_{peak,ss}$ = measured peak concentration ~1 hour after infusion
 Dose = maintenance 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
 τ = dosing interval

Transfer Data to DMC Calculator

Cancel << Back Next >> Save

"Tutone, Tommy" last saved Tue, 7/7 05:16 pm

- b. For patient 3 example – Vd populating as 9.5L – we are calculating ~88L??? Previous calculator gave 98.7L (6/24 version). Therefore calculated AUC based on this VD of 9.5L comes out to 4640 w/ trough of 151.

Yeah, I feel like the numbers are off on this one! Good question. I'm not sure if the example is good. There had been a problem with the Vd calculation prior, but I think it's been fixed. With the Detroit Medical Center calculator, you can transfer the data over to double-check value.

Question 6 - Monitoring Form from Patient View

- Good point, I think this is on the Patient's page. I haven't fixed this, but I'm intending to try to come up with a solution
- 6) Creating the monitoring form – no patients are populating in the dropdown to select and create a form?

Henderson

Default Settings: Add/Edit Profile

*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

Vancomycin AUC Calculator

New Consult

Post-Levels

Patient View

Patient List

AUC

MIC

Exclusions

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

I'm still trying to work on this section, so I don't it quite works well.

MRN: 56789	TBW: 63.3 kg	SCr: 0.8 mg/dL	Patient: Specific	Population: Estimates
Name: Patient3, ZZTest	IBW: 75.3 kg	CrCl: 105.9 mL/min	Vd: 9.5 L	Vd: 41.1 L
Age: 59 M	AdjBW: 70.5 kg		Ke: 0.0464	Ke: 0.1117
Ht: 180.3 cm	TBW/IBW: 0.84		t1/2: 14.9 hrs	t1/2: 6.2 hrs
	BMI: 19.5		CLVanco: 0.4 L/hr	CLVanco: 4.6 L/hr

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

Day of Therapy: 1

Ordering Physician:

Suspected Indication:

Estimated Renal Function: CrCl 105.9 mL/min

Plan

Target: AUC/MIC range 400-600

Maintenance Dose: 1000 mg q12h

--Estimated AUC24/MIC: 460 +/- 100*

--Estimated trough: 10 mg/dL +/- 5

Levels:

--Peak: 7/09 15:30 after 4th dose

--Trough: 7/10 0:30 after 4th dose

Will continue to follow clinical status and final culture results.

Doses

7/08 01:00 - 1000 mg

7/08 13:00 - 1000 mg

7/09 01:00 - 1000 mg

7/09 13:00 - 1000 mg

LOAD DOSE: No load dose given

edit

Cancel
<< Back
Next >>
Save

Patient3, ZZTest last saved Wed, 7/8 12:08 am

MAINTENANCE: 1000 mg over 1 hr every 12 hrs

edit

AUC: 460 +/- on Wed, 7/08 at 01:00

[*View AUC Calculation Steps](#)

Monitoring of vancomycin for serious infections: American Society of Health-System Pharmacists, Society of Infectious Diseases Pharmacists. Published May 19, 2020.

DOT: Day 1 (-52 min) Regimen: 1000 mg q12h

AUC (Pop): 460

AUC (Pt): 4640

Scheduled: 7/08 01:00

Creating the monitor form should be still accessible at the end of empiric dosing section.

Question 7 - AUC Calculation Steps - Too large for screen!

- Tried to fix, tried to add scroll bar and make image smaller

7) When clicking on "View AUC Calculation Steps" the screen that populates doesn't show all of the equations and we're unable to scroll or scale it down.

UserForm1

Trapezoid Method Adapted from

Contents lists available at ScienceDirect
Advanced Drug Delivery Reviews
journal homepage: www.elsevier.com/locate/addr

Innovative approaches to optimizing the delivery of vancomycin in individual patients

Manjunath P. Pai^a, Michael Neely^{b,c}, Keith A. Rodvold^d, Thomas P. Lodise^{a,*}

M.P. Pai et al. / Advanced Drug Delivery Reviews 77 (2014) 50–57

Fig. Expected area under the curve captured based on an expected vancomycin concentration time profile.

The area between the start (same as C_t) and theoretical end of infusion (C_{eof}) for a given infusion time (t') can be related as the area of a trapezoid:

$$AUC_{0-t'} = (C_{eof} + C_t) \times 0.5 \times t' \leftarrow AUC_{infusion}$$

The area under a mono-exponential curve from the time of the end of infusion (t_1) to the time of the end of the dosing interval (t_2) is:

$$AUC_{t_1-t_2} = \int_{t_1}^{t_2} C_{eof} \cdot e^{-k_e(t-t_1)} dt = \int_{t_2}^{\infty} C_t \cdot e^{-k_e(t-t_2)} dt$$

$$AUC_{t_1-t_2} = \frac{C_{eof} - C_t}{k_e} \leftarrow AUC_{elimination}$$

So the area under scenario 1 can be simplified to

$$AUC_{0-t_2} = \frac{t' \times (C_{eof} + C_t)}{2} + \frac{C_{eof} - C_t}{k_e}$$

AUC_{infusion} **AUC_{elimination}**

Under all these scenarios, the AUC_{24} will be a function of the number of identical doses administered during that interval. Thus, in the specific example presented, the computation will lead to AUC estimation over an 8 hour interval (AUC_8). The AUC_{24} can be calculated by multiplying this estimate by 3 ($AUC_8 \times 3$).

Steps Adapted from

Faculty Presenters:
**Vancomycin Dosing:
From Trough to AUC**

Jason M. Pogue, PharmD, BCPS, BCIDP
Clinical Professor, Infectious Diseases
Department of Clinical Pharmacy

SIDP SOCIETY OF INFECTIOUS DISEASES PHARMACISTS
SIDPEC

STEP 1: estimate C_{max} based on dose and Tau

$$C_{max} = \frac{\left(\frac{Dose}{Vd}\right)}{(1 - e^{-k_e \tau})}$$

$$C_{Max} = (Dose / Vd) / (1 - \text{Exp}(-k_e * \text{Tau}))$$

STEP 2: estimate C_{min} based on dose and Tau

$$C_{min} = C_{max} * (e^{-k_e * (\text{Tau} - t)})$$

$$C_{Min} = C_{Max} * \text{Exp}(-k_e * (\text{Tau} - t))$$

STEP 3: Use linear trapezoidal rule to calculate AUC during infusion

$$AUC_{inf} = \frac{(C_{max} + C_{min})}{2} * t$$

$$AUC_{inf} = (C_{Max} + C_{Min}) / 2 * t$$

STEP 4: Use logarithmic trapezoidal rule to calculate AUC during elimination

$$AUC_{elim} = \frac{(C_{max} - C_{min})}{k_e}$$

$$AUC_{eli} = (C_{Max} - C_{Min}) / k_e$$

STEP 5: Sum areas from above and multiply by # doses per 24 hours

$$AUC_{24} = (AUC_{inf} + AUC_{elim}) * \left(\frac{24}{\text{Tau}}\right)$$

$$AUC_{24} = (AUC_{inf} + AUC_{eli}) * (24 / \text{Tau})$$

STEP 6: Divide AUC24 by MIC to get AUC/MIC (assume MIC of 1 to start)

$$AUC_MIC = AUC_{24} / MIC$$

Added scroll bar!

Also, tried to make userform smaller so that it would fit on a screen!

Question 8 - Multi-tasking with other excel files while using AUC Calculator

8) Unable to use our existing Excel sheet at the same time as the calculator – forces shut down of Calculator – any workaround to this?

- Good question. The windows are excel **userforms** .. and can take precedence until you unload the userform. I wonder if you could **ALT+TAB** while using the calculator to the other sheet? Not sure what a good answer would be.

Question 9 - DMC Calculator not linked

9) DMC calculator not linked, is this on a Sharepoint? (also how do we access the Sharepoint?)

I'll attach the Detroit Medical Calculator to the e-mail. I don't think I'm able to transfer the data to the Detroit Medical calculator unless it is already downloaded and in the same directory/folder. I guess I could try to find and add a link to the file!

Sorry for so many issues! Hopefully we can sort them all out on the call J

Thanks for all the questions! I'm hoping that it helps and not hurts the processes already in place!

Regards,
Kurt