1. Sustained release theophylline was given 200 mg every 24 hours. The steady state measured concentration was 6 mg/L. The patient is still having symptoms so you would like to achieve a concentration of 12 mg/L. What are the two possible dosage adjustments that would help you to achieve this?

   $D_{new} = D_{current} * (C_{desired}/C_{measured}) =$
   - Change dose: 200 mg/ 24hr * (12 mg/L / 6 mg/L) = 400 * (12 /6) = 400 mg every 24 hours
   - Change interval: 24 hr * (6 mg/L / 12 mg/L) = 12 hr so it would be 200 mg every 12 hours

2. A drug that is given every 12 hours had a trough that was measured at 11 pm, the drug was infused from 11 pm to 12:30 am and the peak was measured at 1:45 am. When computing the elimination rate the change in time was how many hours?

   $t_2 - t_1 = Tau - t_{inf} - t_{pinf} = 12\text{ hr} - 1.5\text{ hr} - 1.25\text{ hr} = 9.25\text{ hours}$

3. A drug that is given every 8 hours had a trough that was measured at 11:45 pm, the drug was infused from midnight to 12:30 am and the peak was measured at 1:15 am. When computing the elimination rate the change in time was how many hours?

   $t_2 - t_1 = Tau - t_{inf} - t_{pinf} = 8\text{ hr} - 0.5\text{ hr} - 0.75\text{ hr} = 6.75\text{ hours}$

4. A 49 YO WM weights 75 Kg and the medical record indicates that his IBW is 73 Kg. He has a SrCr = 1.4 mg/dl is going to require vancomycin. You have estimated his CrCl to be 66 ml/min. What would be the equation (with the relevant numbers) for the prospectively determined elimination rate constant, K_e?

   $K_e = (44 + 8.3*CrCl)/10000 = (44 + 8.3*66)/10000 = 0.0592\text{ Hr}^{-1}$

5. A peak was measured at 28 mg/L and the trough was 10 mg/L. The dosing interval was every 8 hours, the infusion was 1.5 hours and the peak was measured 1 hour later. What would the equation (with the relevant numbers) for the elimination rate constant, K_e, look like?

   $K_e = Ln\ (C_{pk}/C_{tr}) / t_2 - t_1 = Ln\ (28/10) / 8 - 2.5 = Ln(28/10)/5.5\text{ Hr} = 0.187\text{ Hr}^{-1}$

6. A peak was measured at 8.8 mg/L and the trough was 1.0 mg/L. The time from when the peak was measured until the next dose was given was 7.0 hours. What would be the equation (with the relevant numbers) for the elimination rate constant, K_e, look like?

   $K_e = Ln\ (C_{pk}/C_{tr}) / t_2 - t_1 = Ln\ (8.8/1.0) / 7.0 = 0.311\text{ Hr}^{-1}$

7. Drug levels were measured for this patient and the PK was 18.9 mg/L and the TR was 7.7 mg/L. The dose of vancomycin is 1000 mg Q12H and the levels were measured at steady state. The TR was at

11:50 am. The drug was infused for 90 minutes starting at noon and the peak was measured at 2:45 pm. What would be the equation (with the relevant numbers) for the elimination rate constant, K_e?

$K_e = \text{Ln}(C_{pk}/C_{tr}) / \text{Tau} - t_{inf} - t_{pinf} = \text{Ln}(18.9/7.7) / (12\text{ Hr} - 1.5\text{ Hr} - 1.25\text{ Hr}) = 0.097\text{ Hr}^{-1}$

8. Using that K_e you just determined (0.097 Hr^{-1}) and assuming your target maximum concentrations is 36 mg/L and that you calculated the V_{ss} to be 63.4 L and that you want the new Tau to continue at Q12H, what would be your equation for the new rate of input (with the relevant numbers) ?

$R_0 = C_{desired} * K_e * V_{ss} * (1-e^{(-Ke*Tau)})/(1-e^{(-Ke*Tinf)})$
$= 36\text{ mg/L} * 0.097\text{ Hr}^{-1} * 63.4\text{ L} * (1-e^{-0.097*12})/(1-e^{-0.097*1.5}) = 1124\text{ mg/Hr}$

9. The rate of input, R_0, rounded to 1000 mg/Hr. What would be the practical dose that you recommend every 12 hours, making the assumption that you will infuse the vancomycin over 1.5 hours?

$\text{Dose} = R_0 * T_{inf} = 1124\text{ mg/Hr} * 1.5\text{ Hr} = 1686\text{ mg}$ → Practical 1500 or 1750 mg

10. If a peak was measured at 6.2 mg/L and the K_e was calculated to be 0.243 Hr^{-1} and the peak was measured 0.75 hours after a 0.5 hour infusion; what would the equation (with the relevant numbers) look like for the concentration at the end of the infusion?

$C_0 = C_{pk} / e^{-Ke*Tpinf} = 6.2 / e^{-0.243*0.75} = 7.4\text{ mg/L}$

11. If a peak was measured at 24.3 mg/L and the K_e was calculated to be 0.065 Hr^{-1} and the peak was drawn 1.25 hours after a 1.5 hour infusion; what would the equation (with the relevant numbers) look like for the concentration at the end of the infusion?

$C_0 = C_{pk} / e^{-Ke*Tpinf} = 24.3 / e^{-0.065*1.25} = 26.4\text{ mg/L}$

12. Using the C_0 of 26.4 mg/L from the previous problem, what would the equation look like for calculating the patient's steady state volume of distribution knowing that the trough was 6.4 mg/L and the dose they had received was 1000 mg?

$V_{ss} = (R_0/K_e) * (1-e^{-Ke*Tinf}) / (C_0 - C_{tr} * e^{-Ke*Tinf}) = ((1000\text{ mg}/1.5\text{ Hr})/0.065\text{ Hr}^{-1}) * (1-e^{-0.065*1.5}) / (26.4\text{ mg/Hr} - 6.4\text{ mg/Hr} * e^{-0.065*1.5}) = 46.3\text{ L}$

13. You have computed a C_0 of 5.3 mg/L for a gentamicin patient. They had received 80 mg every 8 hours with a 0.5 hour infusion. When the levels came back (P/T = 4.8/0.6 mg/L) a K_e was calculated at 0.297 Hr^{-1}. Please show what the equation would look like for calculating the patient's steady state volume of distribution,

$V_{ss} = (R_0/K_e) * (1-e^{-Ke*Tinf}) / (C_0 - C_{tr} * e^{-Ke*Tinf}) = ((80\text{ mg}/0.5\text{ Hr})/0.297\text{ Hr}^{-1}) * (1-e^{-0.297*0.5}) / (5.3\text{ mg/Hr} - 0.6\text{ mg/Hr} * e^{-0.297*0.5}) = 15.5\text{ L}$

14. Prospectively estimate the volume of distribution for a 26 year old male whose dosing weight you have estimated to be 67 Kg. The volume of distribution factor for vancomycin is 0.7 L/Kg.

V_{ss} = DWT * $V_{d,factor}$ = 67 Kg * 0.7 L/Kg = 46.9 L

15. You have an elderly patient with poor renal function and you need to compute a new dosing interval for vancomycin. Your target peak is 36 and trough is 15 mg/L. You computed a K_e of 0.060 Hr^{-1}. Show the equation to estimate a new dosing interval, with all of the appropriate numbers inserted.

Tau = [Ln($C_{Max,desired}$/$C_{Min,desired}$) / K_e]+ T_{inf} = Ln (36/15) / 0.060 + 1.5 = 16.1Hr

16. You calculated your Tau from the previous problem and came up with 16.1 hours. Please recommend a practical Tau that will be used?

24 hours (16 and 18 hours are round numbers but they are not practical for routine drug administration. If you go shorter, 12 hours, it puts the person at risk of toxicity, so be conservative and recommend every 24 hours.

17. You need to compute a new dosing interval for gentamicin (infused over 30 minutes). The patient has a serious infection (pneumonia). The calculated K_e was 0.325 Hr^{-1}. Show the equation to estimate a new dosing interval, with all of the appropriate numbers inserted.

Tau = [Ln($C_{Max,desired}$/$C_{Min,desired}$) / K_e] + T_{inf} = From the equation sheet table, choose a target pk of 7 and tr of 1 = Ln (7/1) / 0.325 + 0.5 Hr. = 6.49 Hr

18. You calculated your Tau from the previous problem and came up with 6.49 hours. Please recommend a practical Tau that will be used:

6 hours

19. You are computing a new dose for gentamicin to treat meningitis, a life threatening infection. You have used the blood level data and you have calculated the patient's K_e to be 0.377 $Hr.^{-1}$, the V_{ss} to be 11.3 L. A standard infusion had been given at 80 mg every 8 hours, but you have estimated the new dosing interval should be every 6 hours. What would the equation look like to compute the new rate of input?

R_0 = $C_{Max,desired}$ * K_e * V_{ss} * $(1 - e^{-Ke*Tau})$ / $(1 - e^{-Ke*Tinf})$ = 9 mg/L * 0.377 Hr^{-1} * 11.3 L * $(1 - e^{-0.377*6})$ / $(1 - e^{-0.377*0.5})$ =199.9 mg/Hr

20. You did the calculation from the previous problem and you came up with 199 mg/Hr. What practical dose would you recommend?

Dose = R_0 * T_{inf} = 199 mg/Hr * 0.5 Hr = 100 mg (rounding to the nearest 10 mg for gentamicin)

21. You are computing a new dose for vancomycin. You have used the blood level data and you have

calculated the patient's K_e to be 0.05 Hr.$^{-1}$, the V_{ss} to be 59.8 L. A standard infusion had been given at 1000 mg every 12 hours, but a trough level came back high and you have estimated the new dosing interval should be every 24 hours. Choose a target peak of 36 mg/L and assume the infusion will be 1.5 hours. What would the equation look like to compute the new rate of input?

$R_0 = C_{Max,desired} * K_e * V_{ss} * (1 - e^{-Ke*Tau}) / (1 - e^{-Ke*Tinf}) = 36\ mg/L * 0.05\ Hr^{-1} * 59.8\ L * (1 - e^{-0.05*24}) / (1 - e^{-0.05*1.5}) = 1041\ mg/Hr$

22. You did the calculation from the previous problem and you came up with 1041 mg/Hr. What practical dose would you recommend?

Dose = $R_0 * T_{inf}$ = 1041 mg/Hr * 1.5 Hr = 1561 mg so recommend 1500 mg (rounding to the nearest 250 mg for vancomycin)

23. A new rate of input (R_0) has been computed for vancomycin to be 667 mg/hr. The K_e was computed to be 0.065 Hr^{-1}, the V_{ss} to be 50 L and the dosing interval has been selected to be 12 hours and the drug will be infused over 1.5 hours. What would be the equation (with the relevant numbers) for the new steady state peak concentration look like?

$C_{ss,pk} = R_0 * (1 - e^{-Ke\ tinf}) / (V_{ss} * K_e *(1- e^{-KeTau})$
$= (667\ mg/Hr)\ (1 - e^{-0.065*1.5}) / (50\ L*0.065/Hr)*(1 - e^{-0.065*12}) = 35.2\ mg/L$

24. The new peak from the previous problem was 35.2 mg/L, what would the equation look like for the new trough (with all the appropriate numbers inserted)?

$C_{ss,tr} = C_{ss,pk} * e^{-Ke(Tau-tinf)} = (35.2\ mg/L) * e^{-0.065*(12-1.5)} = 17.7\ mg/L$

25. A new rate of input (R0) has been computed for gentamicin to be 240 mg/hr. The K_e was computed to be 0.30 Hr^{-1}, the V_{ss} to be 18 L and the dosing interval has been selected to be 8 hours and the drug will be infused over 0.5 hours. What would be the equation (with the relevant numbers) for the new s teady state peak concentration look like?

$C_{ss,pk} = R_0 * (1 - e^{-Ke\ tinf}) / (V_{ss} * K_e *(1- e^{-KeTau})$
$= (240\ mg/Hr)\ (1 - e^{-0.30*0.5}) / (18\ L*0.30/Hr)*(1 - e^{-0.30*8}) = 6.8\ mg/L$

26. The new peak from the previous problem was 6.8 mg/L, what would the equation look like for the new trough (with all the appropriate numbers inserted)?

$C_{ss,tr} = C_{ss,pk} * e^{-Ke(Tau-tinf)} = (6.8\ mg/L) * e^{-0.30*(8-0.5)} = 0.71\ mg/L$
