Vancomycin Dosing Chart
Marshall Pierce, Pharm.D.

Initial Dosing

1. Calculate the patient's lean body weight.
   Males (kg) = 50 kg + 2.3 (height in inches > 60 inches)
   Female (kg) = 45.5 kg + 2.3 (height in inches > 60 inches)

2. Calculate the patient's creatinine clearance (ml/min) normalized to 1.73 meters squared.
   Males = $\frac{(140\text{-age}) \times (\text{Lean body weight or actual weight which ever is less}) * 1.73}{\text{Scr mg/dl} \times 72 * (\text{Surface Area of Patient in Meter Squared})}$
   Females = 0.85 x above

3. Use a loading dose of 20-25 mg/kg based on total body weight for a peak of 20-30 mcg/ml.

4. Using the patient's actual body weight select a maintenance dose of 8, 10, 12.5, or 15 mg/kg that gives a dose of approximately of 2000, 1750, 1500, 1250, 1000, 750 or 500 mg. Round the dose to according to your institutions guidelines to avoid unnecessary compounding and wastage whenever possible. Note: for every 1 mg/kg difference between the patient's actual dose and the chart dose the predicted level will be approximately 1 mcg/ml in error when aiming for a trough of 10 mcg/ml.

5. Using the chart for the selected mg/kg dose find the patient's creatinine clearance on the chart. Go down the column under the patient's Clcr., changing the dosage interval, until you find your goal trough.

6. You now have the patient's dose (mg/kg) and dosage interval.

Retrospective Dosing: Dosage Interval Adjustment Using Steady State Serum Levels

1. Use the chart for the patient's mg/kg dose. Find the patient's current dosage interval row on the chart. Go across the row until you find the closest trough to the patient's actual level. The patient's elimination rate will be at the top of this column. Now go up or down this column, changing the dosage interval, selecting the dosing interval for the trough you desire.

2. You now have the new dosage interval for the patient.

How the Chart Works

1. The chart predicts steady state vancomycin levels using standard one compartment pharmacokinetic equations.

$$\text{Cmin steady state} = \frac{\text{Dose}_{mg/kg}\,(1-e^{-KelT'})\,e^{-Kel(Tau - T')}}{\text{Vd}_{0.65l/kg}\,K\,T'\,(1-e^{-Kel\,Tau})}$$

   Kel = 0.00107 (Clcr per1.73 meters squared) + 0.0052106005

   Vd = 0.65 l/kg (actual body weight)

2. As you move across a row to the right Clcr decreases along with the calculated K or fit K which cause the predicted trough to increase.

3. As you move down a column, increasing the dosage interval, the predicted trough decreases.

4. Computer programs fit actual serum levels by altering the Vd and the K (or Cl) until the predicted levels converge on the actual measured levels within certain constraints. The peak is mainly determined by the Vd and the trough is mainly determined by the K or Cl.

   When only trough levels are available the Vd is held constant and the K (or Cl) is varied until the predicted trough level converges on the actual trough. This is what is process when moving across a dosage interval row until you get as close as possible to the actual level for a steady state dose and frequency.

Validation of the Chart

Pharmacokinetic dosing computer programs and nomograms use population mean parameters for initial dosing. Once serum levels are available computer programs individualize pharmacokinetic parameters (Cl, Vd) using the patient's known serum level and dosing history when peak and trough values are available. If only trough values are available, the Vd is set at the population estimate and the Clearance or elimination rate constant is estimated. The individualized parameters are then used to predict serum levels for further dosage adjustments.

Volume of distribution, Vd, has the greatest impact on peak serum levels. Clearance and the volume of distribution affect trough levels, but changes in clearance have the greatest impact due to the offsetting effect of Vd on K. Trough levels changes are inversely related to changes in clearance.

Trough vancomycin serum levels are usually monitored as vancomycin displays time depended killing. The time the serum level is above the MIC is the best predictor of clinical success. Peak levels are not related to clinical outcome. This has led to the recommendation that peak levels should not be monitored.

Independent kinetic parameters are clearance (renal function dependent for vancomycin) and volume of distribution (weight dependent). Elimination rate is determined by clearance and volume of distribution and is not an independent parameter.

$K = Cl / V.$

Validation of the chart was determined as follows:

The methodology used in the chart of holding the volume of distribution at 0.65 l/kg while finding the elimination rate constant that would predict the patient's trough serum level was applied.

Clearance (l/kg/hr) and volume of distribution (0.4 l/kg, 0.65 l/kg, 0.9 l/kg) were used to calculate the elimination rate constant for the three volume of distributions and then used to serum predicted level at steady state.

$K = Cl\ (l/kg/hr) / V\ (l/kg).$

The value of the fit elimination rate constant with a volume of distribution 0.65 l/g was used to predict trough levels for the range of clcr 140, 50, and 5 ml/min and doses (20 mg/kg, 15 mg/kg and 10 mg/kg). These predicted levels were then compared to the predicted levels using the true Vd and clearance.

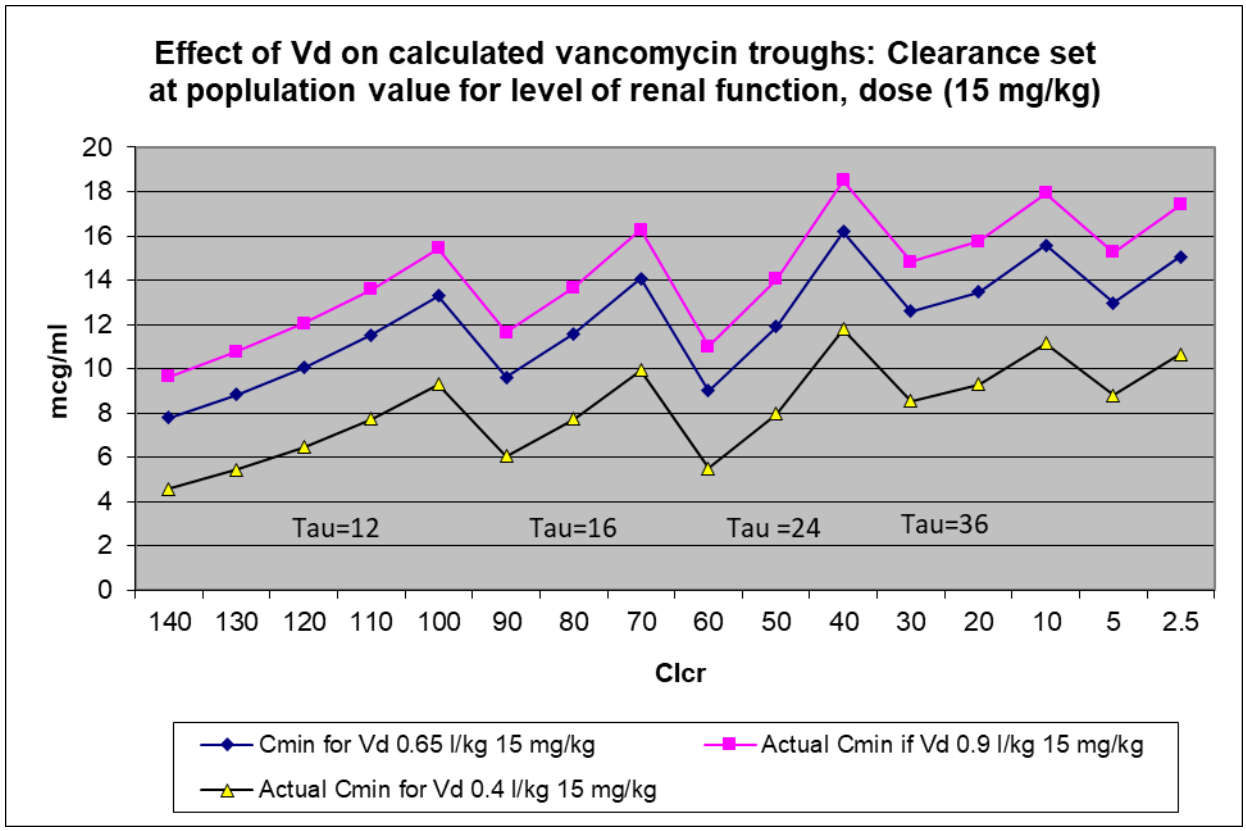
A true trough was calculated for a patient with the following kinetic parameters and compared to the charts predicted levels using a Vd of 0.65 l/kg:

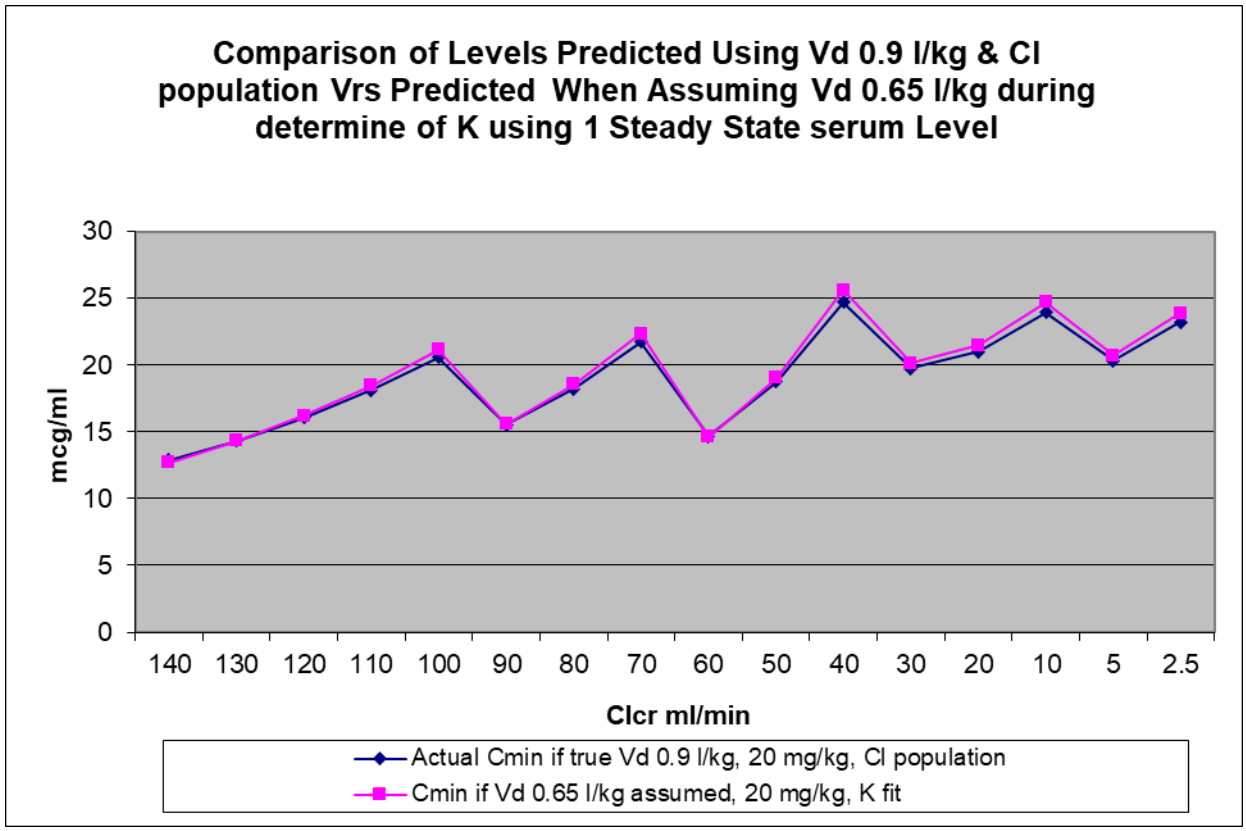
Clearance set at the population mean of patients with a creatinine clearance of 140, 50 and 5 ml/min.
- True volume of distribution 0.9 l/kg
- True volume of distribution 0.4 l/kg.

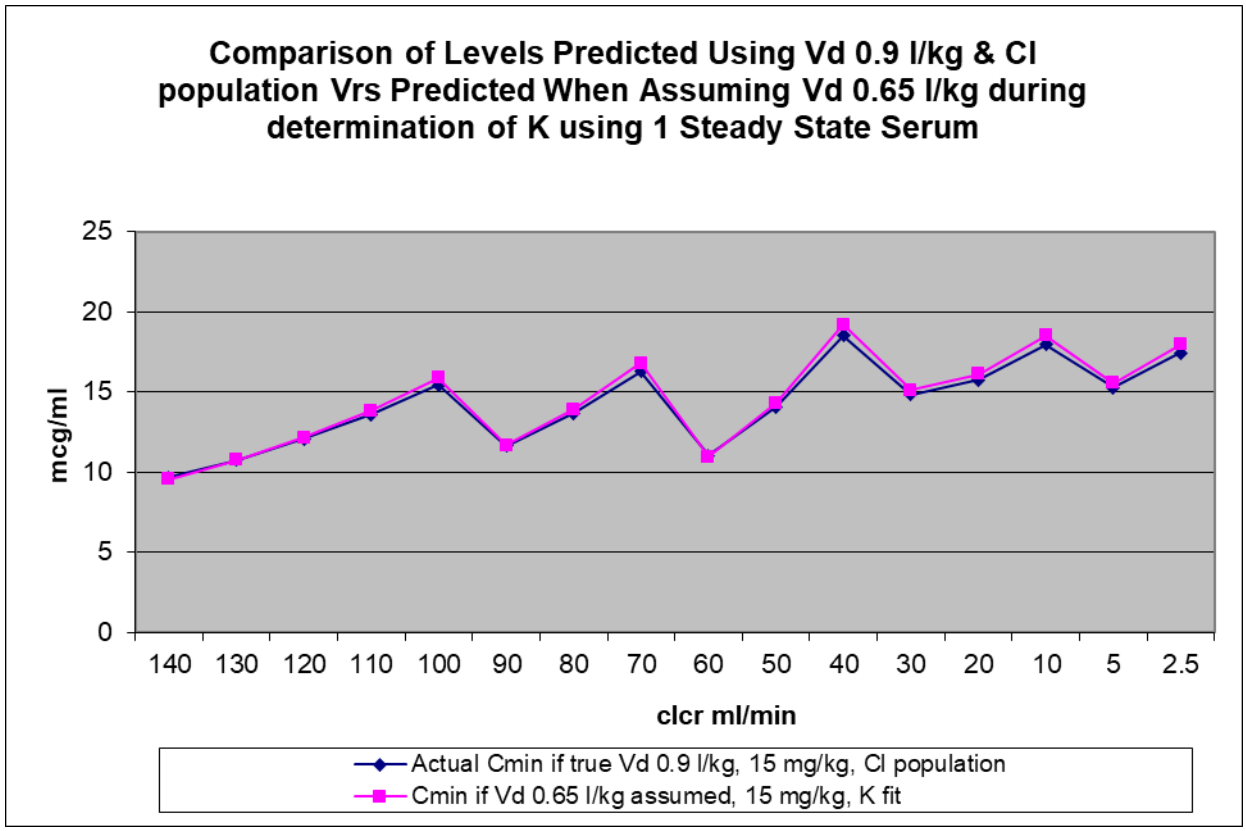
Clearance set at 1.5 times the population mean of patients with a creatinine clearance of 140, 50 and 5 ml/min.
- True volume of distribution 0.9 l/kg
- True volume of distribution 0.4 l/kg.

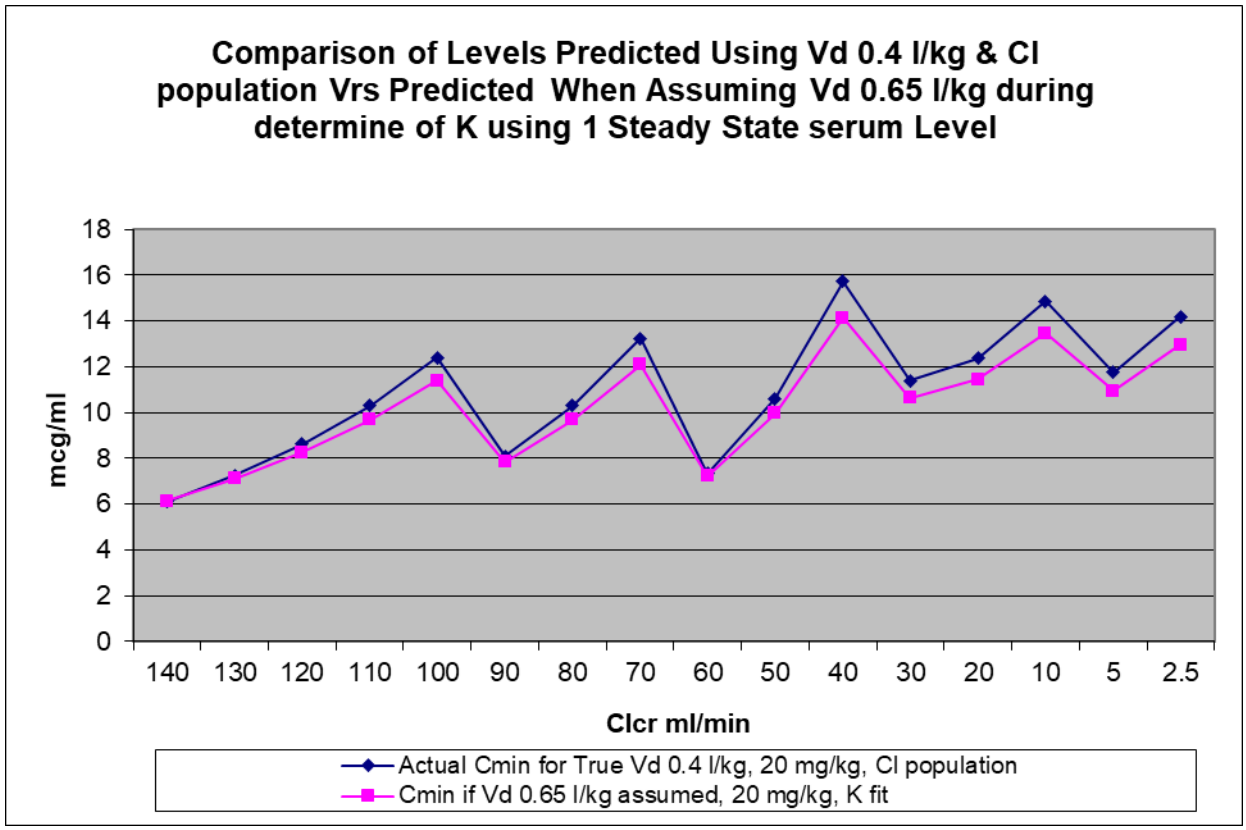
Clearance set at 0.5 times the population mean of patients with a creatinine clearance of 140, 50 and 5 ml/min.
- True volume of distribution 0.9 l/kg
- True volume of distribution 0.4 l/kg.

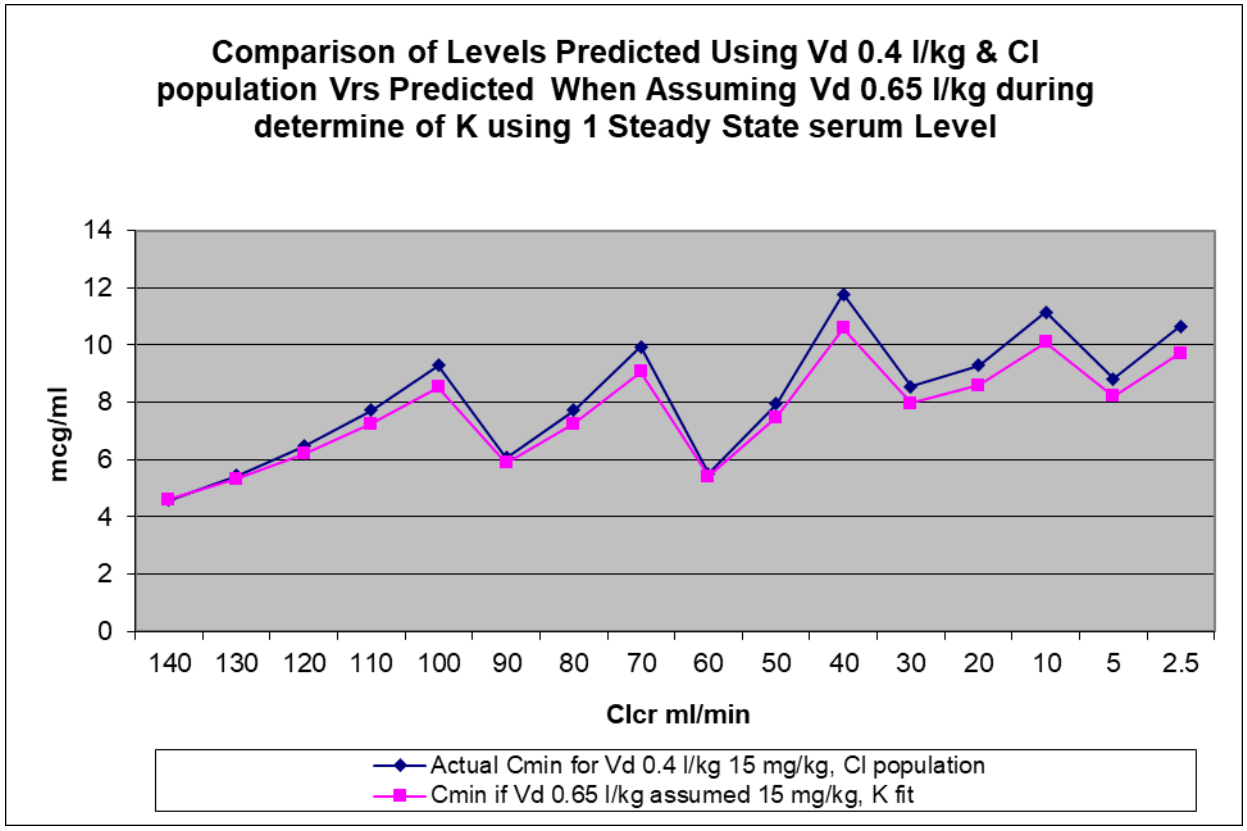
This data demonstrate that the chart is accurate and unbiased. The error in assuming a volume of distribution of 0.65 l/kg is corrected by using one steady state serum level to find the elimination rate constant/volume of distribution combination that predicted the patient's actual trough. This combination then can be used to accurately predicted trough levels for the patient with the same or different doses (mg/kg) and varying dosing frequencies.

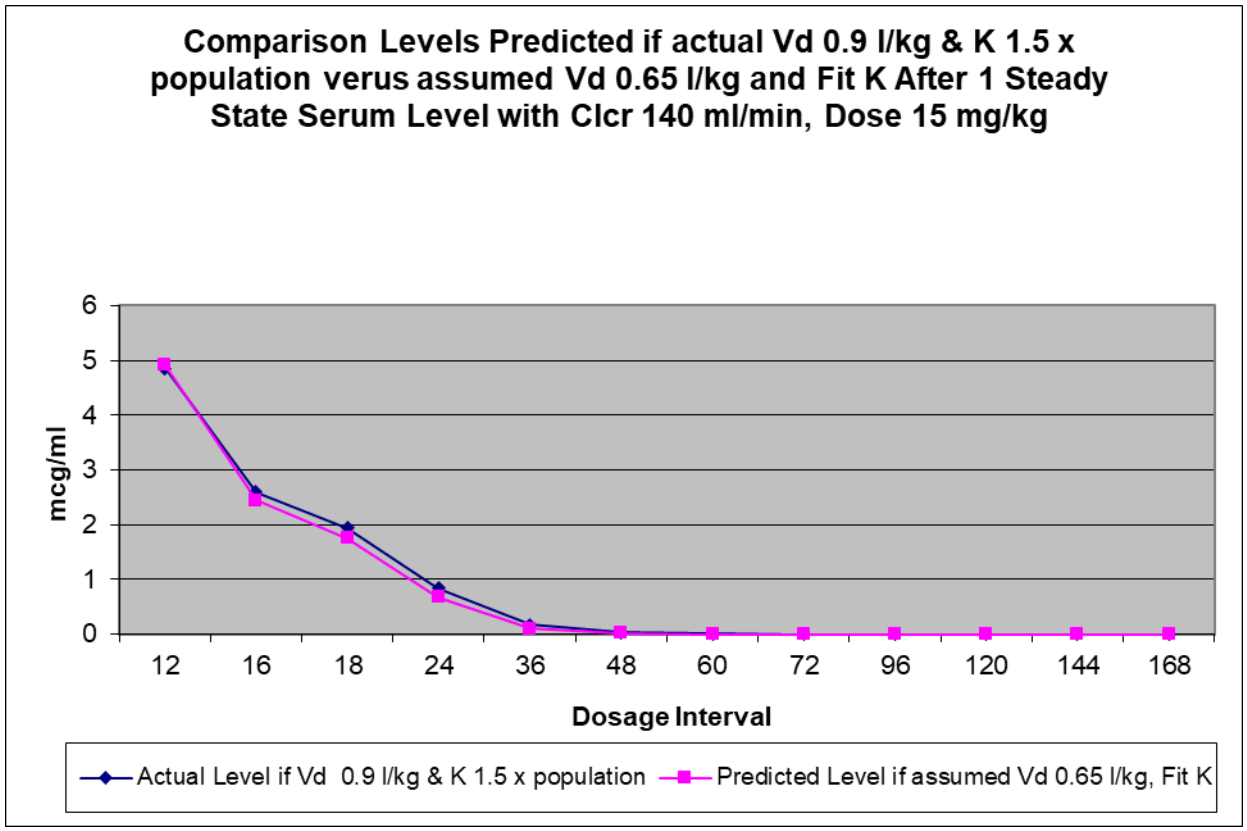

Effect of Vd on calculated vancomycin troughs: Clearance set at poplulation value for level of renal function, dose (15 mg/kg)
mcg/ml
20
18
16
14
12
10
8
6
4
2
0
Tau=12
Tau=16
Tau =24
Tau=36
140 130 120 110 100 90 80 70 60 50 40 30 20 10 5 2.5
Clcr
Cmin for Vd 0.65 l/kg 15 mg/kg
Actual Cmin if Vd 0.9 l/kg 15 mg/kg
Actual Cmin for Vd 0.4 l/kg 15 mg/kg

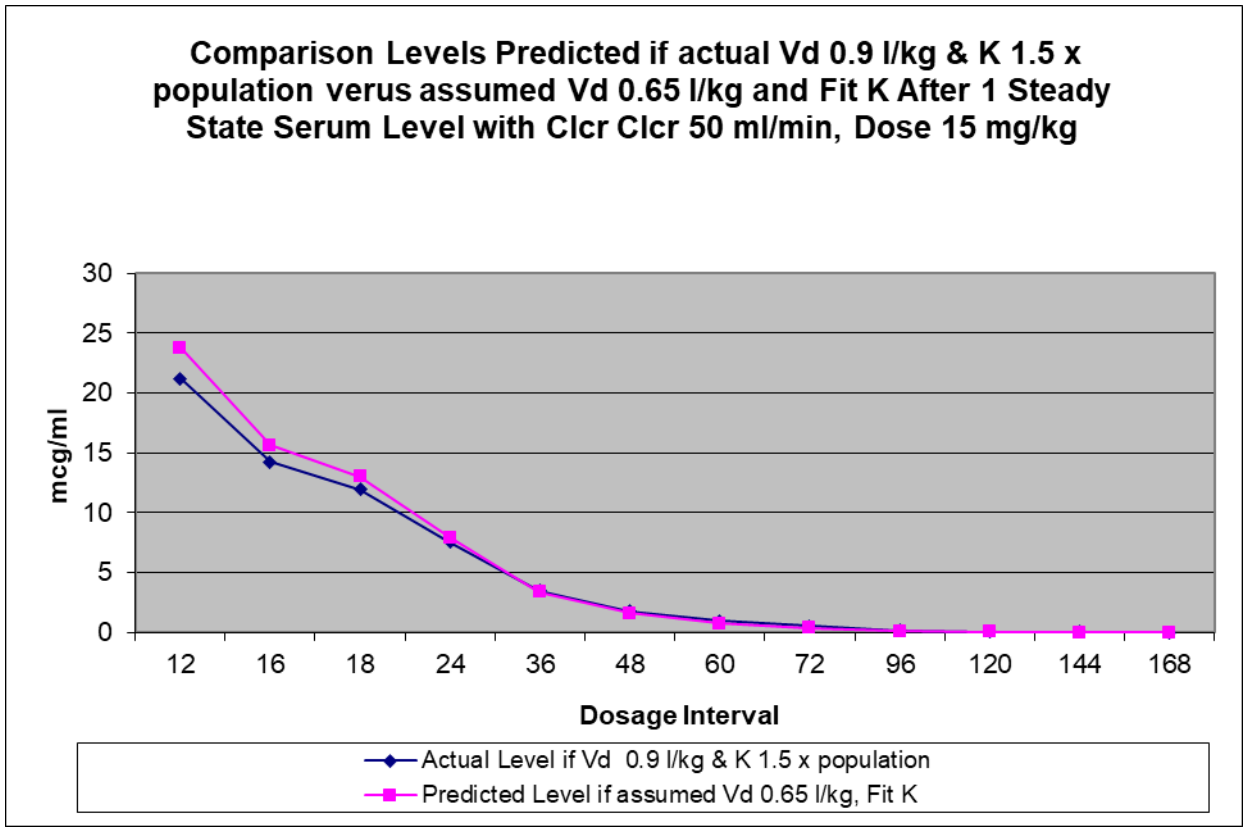

Comparison of Levels Predicted Using Vd 0.9 l/kg & Cl population Vrs Predicted When Assuming Vd 0.65 l/kg during determine of K using 1 Steady State serum Level
mcg/ml
30
25
20
15
10
5
0
140 130 120 110 100 90 80 70 60 50 40 30 20 10 5 2.5
Clcr ml/min
Actual Cmin if true Vd 0.9 l/kg, 20 mg/kg, Cl population
Cmin if Vd 0.65 l/kg assumed, 20 mg/kg, K fit

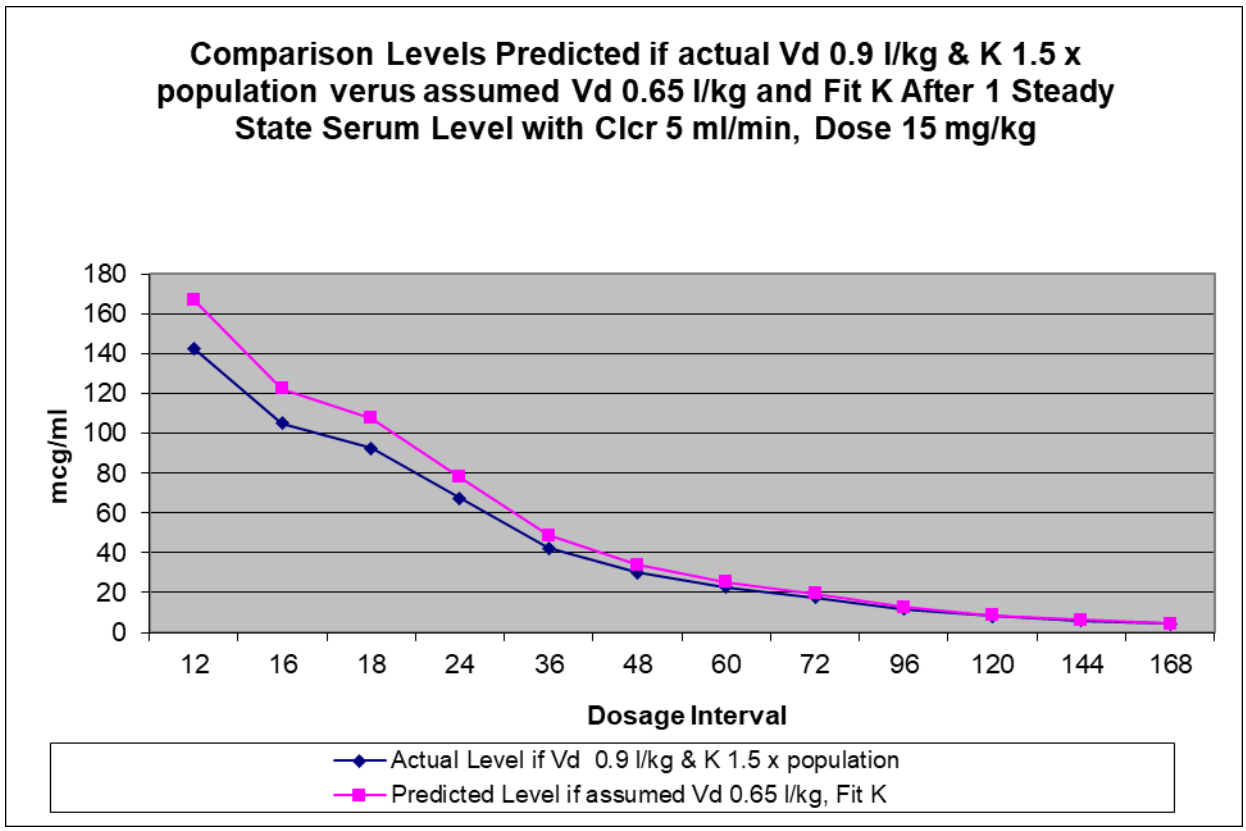

Comparison of Levels Predicted Using Vd 0.9 l/kg & Cl population Vrs Predicted When Assuming Vd 0.65 l/kg during determination of K using 1 Steady State Serum
mcg/ml
25
20
15
10
5
0
140 130 120 110 100 90 80 70 60 50 40 30 20 10 5 2.5
clcr ml/min
Actual Cmin if true Vd 0.9 l/kg, 15 mg/kg, Cl population
Cmin if Vd 0.65 l/kg assumed, 15 mg/kg, K fit

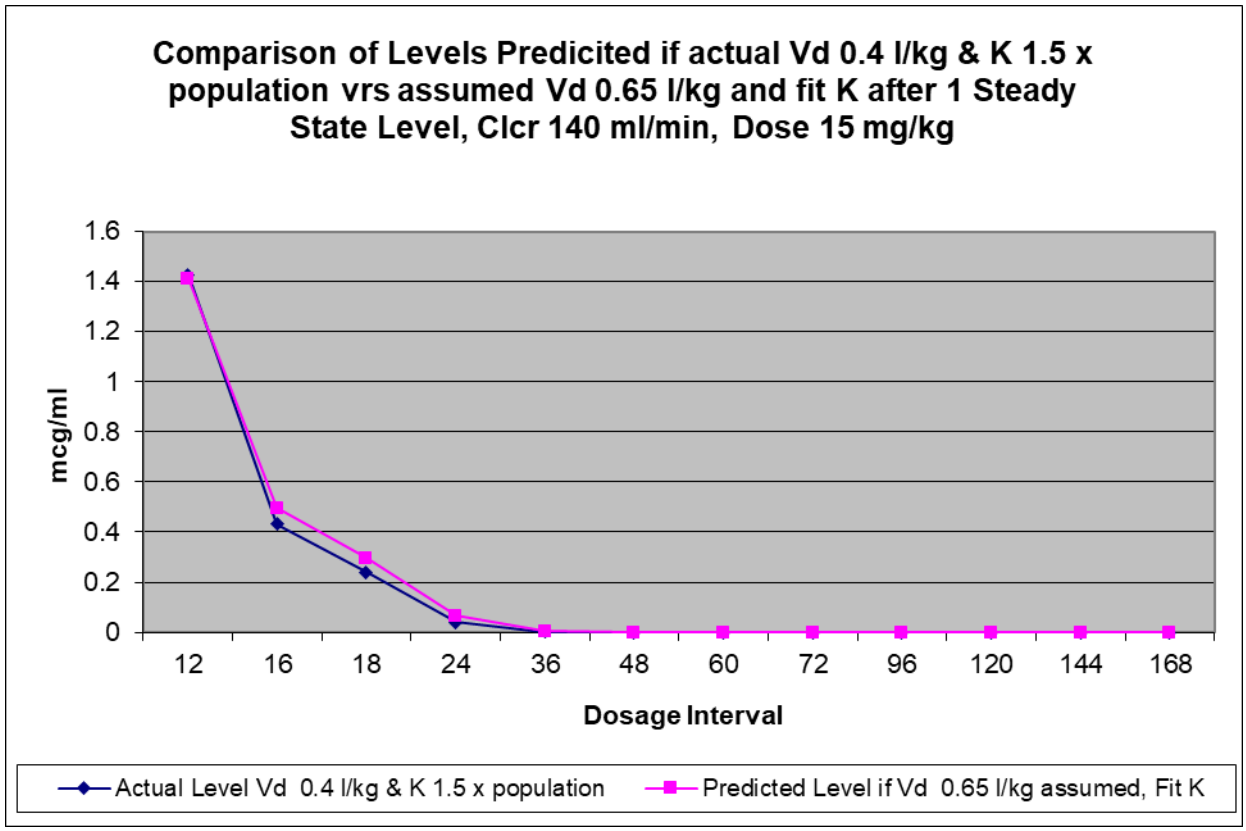

Comparison of Levels Predicted Using Vd 0.4 l/kg & Cl population Vrs Predicted When Assuming Vd 0.65 l/kg during determine of K using 1 Steady State serum Level
mcg/ml
18
16
14
12
10
8
6
4
2
0
140 130 120 110 100 90 80 70 60 50 40 30 20 10 5 2.5
Clcr ml/min
Actual Cmin for True Vd 0.4 l/kg, 20 mg/kg, Cl population
Cmin if Vd 0.65 l/kg assumed, 20 mg/kg, K fit

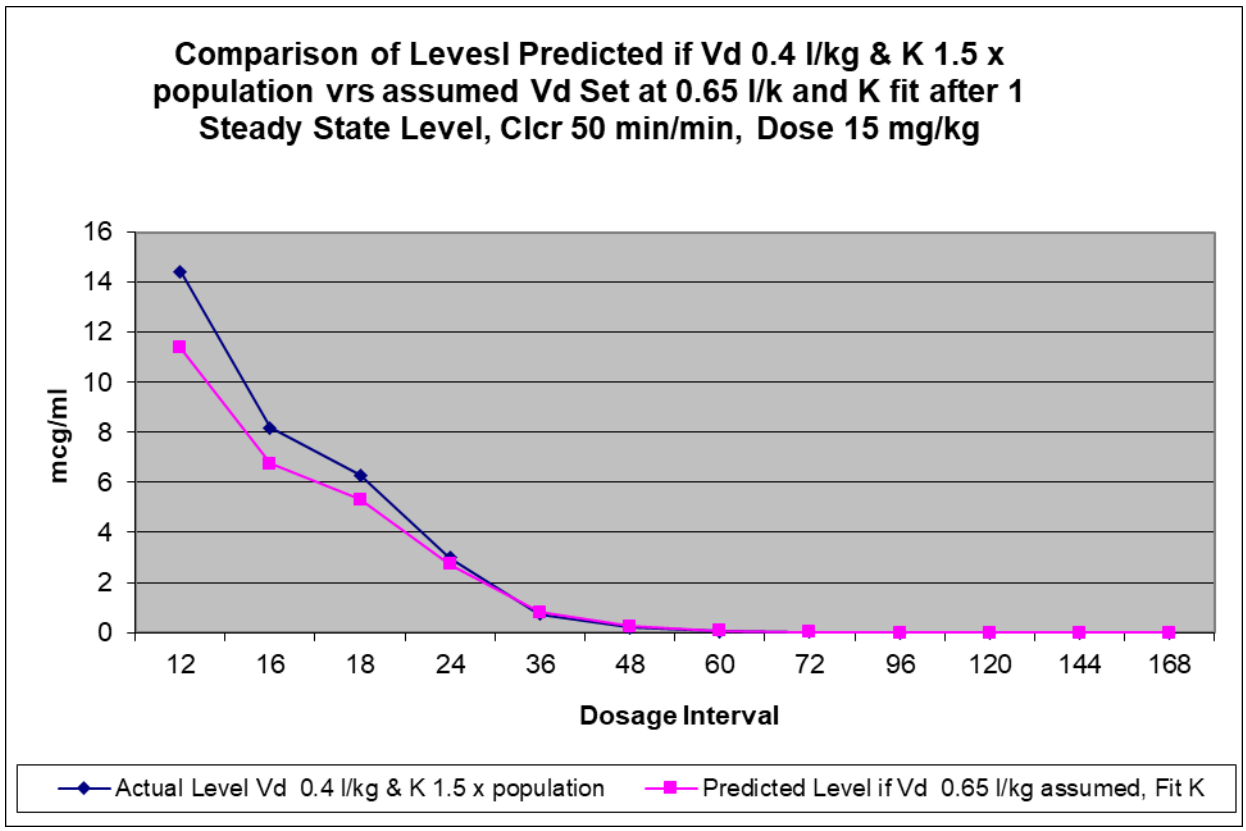

Comparison of Levels Predicted Using Vd 0.4 l/kg & Cl population Vrs Predicted When Assuming Vd 0.65 l/kg during determine of K using 1 Steady State serum Level
mcg/ml
14
12
10
8
6
4
2
0
140 130 120 110 100 90 80 70 60 50 40 30 20 10 5 2.5
Clcr ml/min
Actual Cmin for Vd 0.4 l/kg 15 mg/kg, Cl population
Cmin if Vd 0.65 l/kg assumed 15 mg/kg, K fit

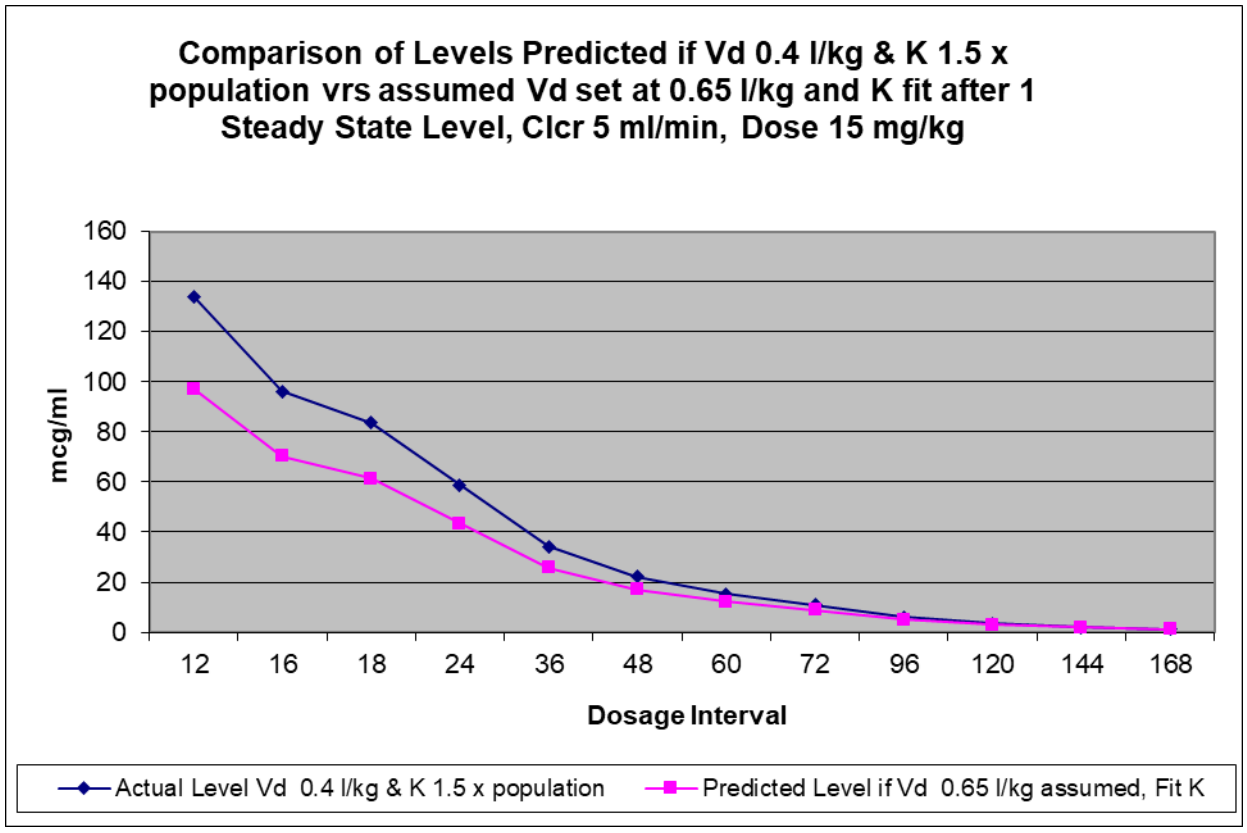

Comparison Levels Predicted if actual Vd 0.9 l/kg & K 1.5 x population verus assumed Vd 0.65 l/kg and Fit K After 1 Steady State Serum Level with Clcr 140 ml/min, Dose 15 mg/kg
mcg/ml
6
5
4
3
2
1
0
12 16 18 24 36 48 60 72 96 120 144 168
Dosage Interval
Actual Level if Vd 0.9 l/kg & K 1.5 x population
Predicted Level if assumed Vd 0.65 l/kg, Fit K

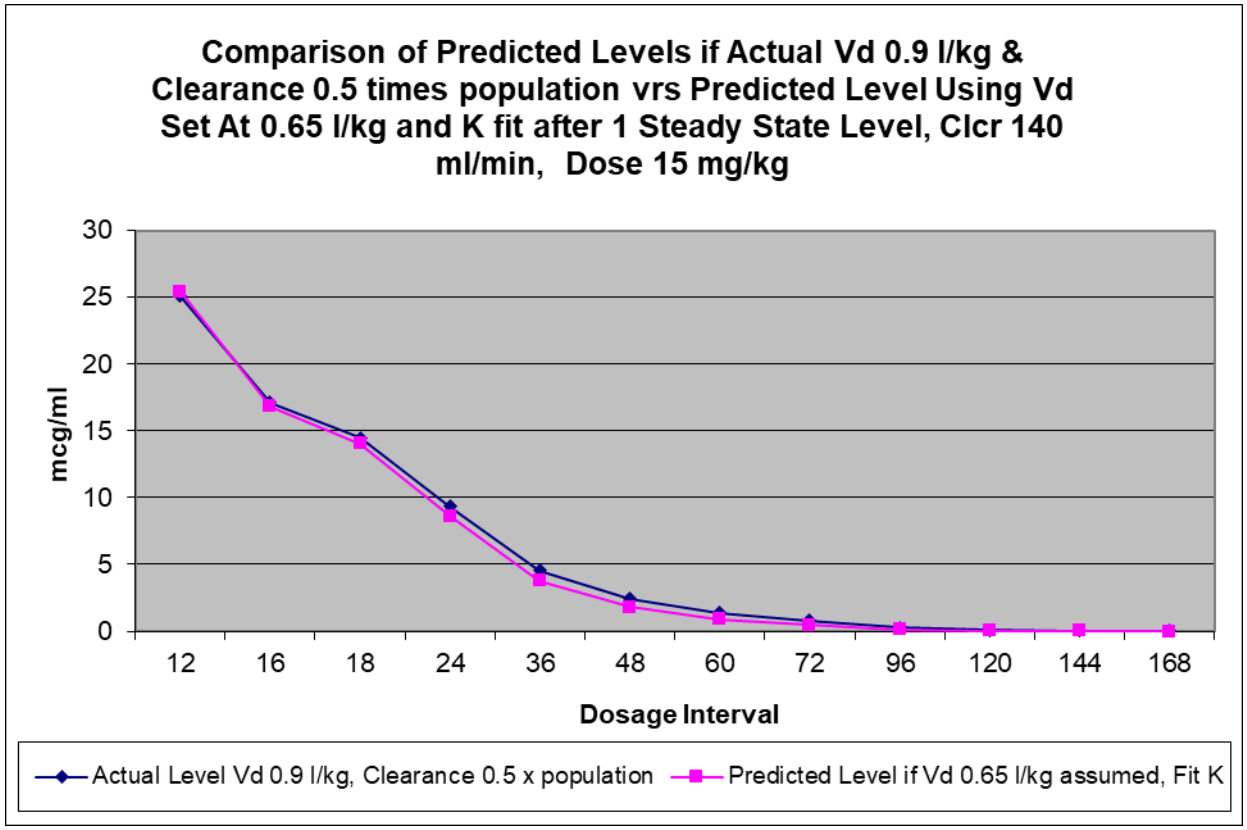

Comparison Levels Predicted if actual Vd 0.9 l/kg & K 1.5 x population verus assumed Vd 0.65 l/kg and Fit K After 1 Steady State Serum Level with Clcr Clcr 50 ml/min, Dose 15 mg/kg
mcg/ml
30
25
20
15
10
5
0
12
16
18
24
36
48
60
72
96
120
144
168
Dosage Interval
Actual Level if Vd 0.9 l/kg & K 1.5 x population
Predicted Level if assumed Vd 0.65 l/kg, Fit K

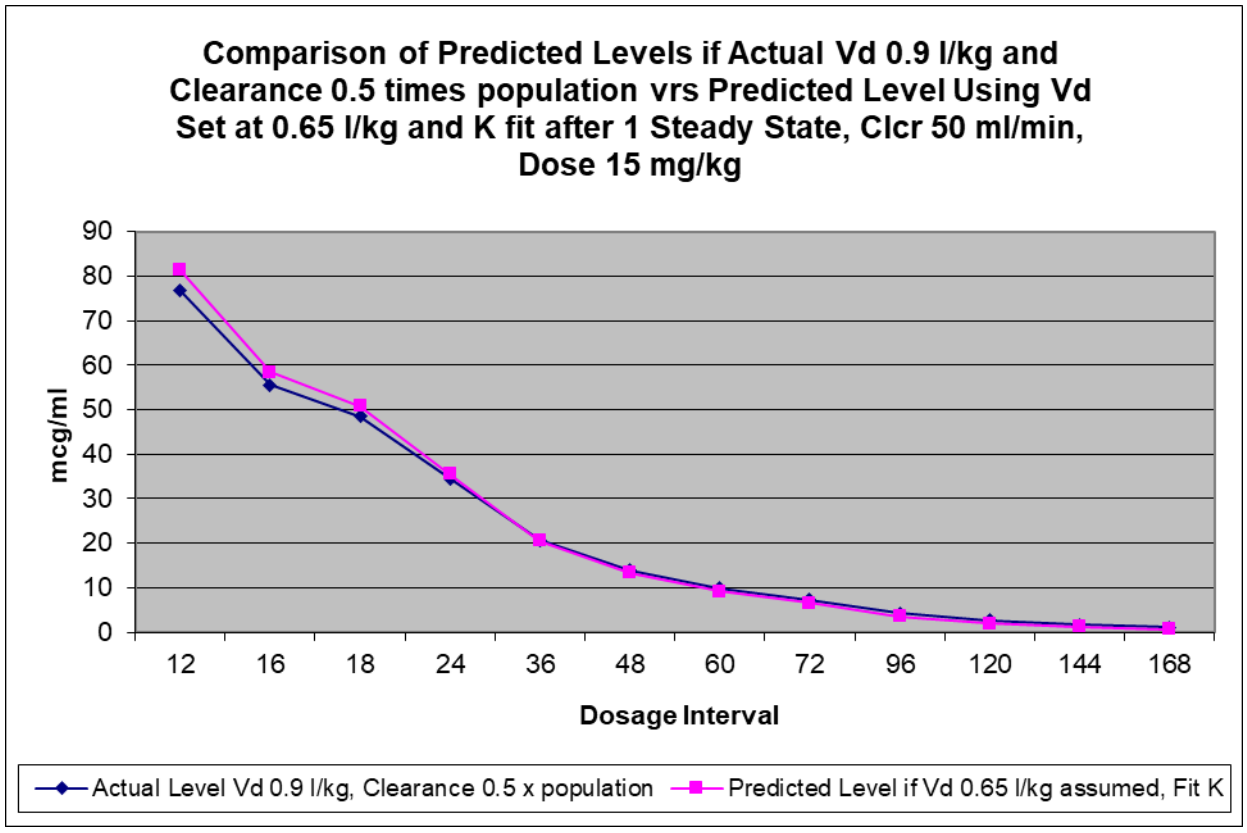

Comparison Levels Predicted if actual Vd 0.9 l/kg & K 1.5 x population verus assumed Vd 0.65 l/kg and Fit K After 1 Steady State Serum Level with Clcr 5 ml/min, Dose 15 mg/kg
mcg/ml
180
160
140
120
100
80
60
40
20
0
12
16
18
24
36
48
60
72
96
120
144
168
Dosage Interval
Actual Level if Vd 0.9 l/kg & K 1.5 x population
Predicted Level if assumed Vd 0.65 l/kg, Fit K

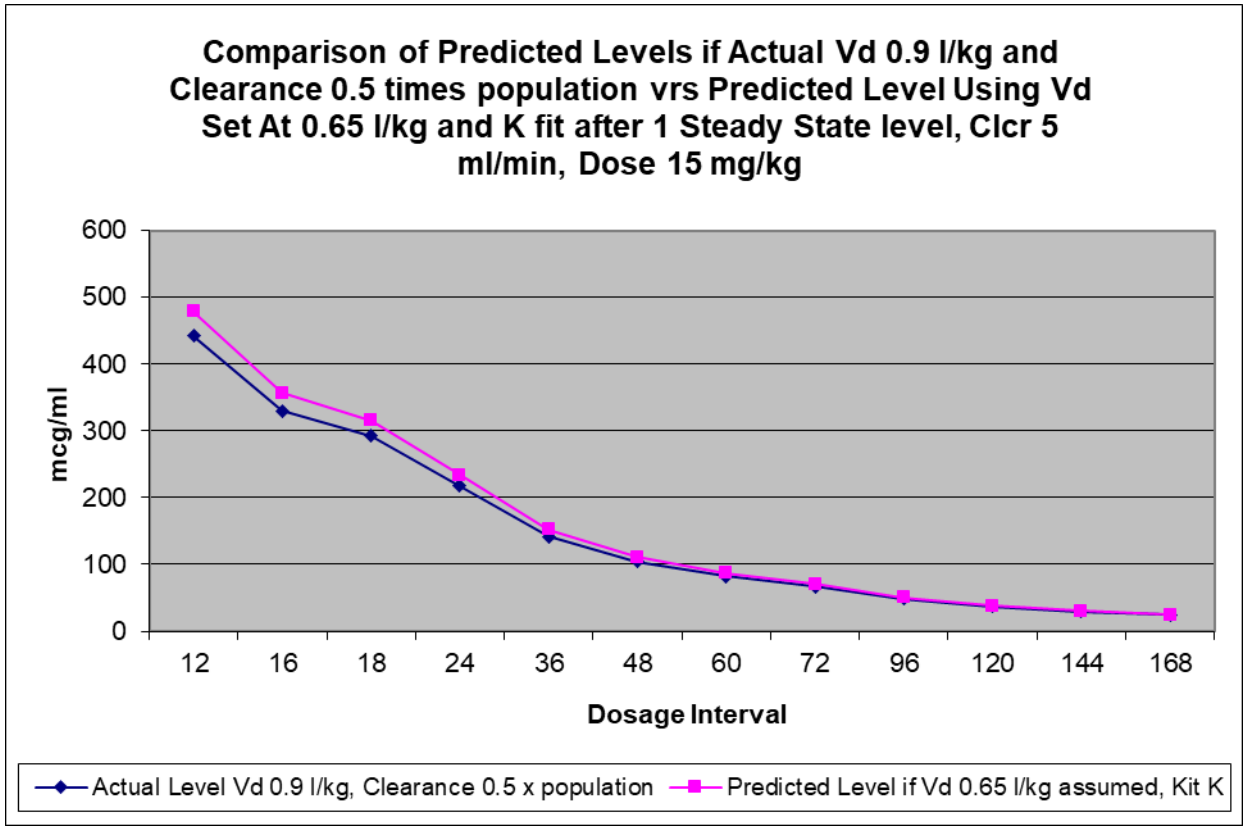

Comparison of Levels Predicited if actual Vd 0.4 l/kg & K 1.5 x population vrs assumed Vd 0.65 l/kg and fit K after 1 Steady State Level, Clcr 140 ml/min, Dose 15 mg/kg
mcg/ml
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
12
16
18
24
36
48
60
72
96
120
144
168
Dosage Interval
Actual Level Vd 0.4 l/kg & K 1.5 x population
Predicted Level if Vd 0.65 l/kg assumed, Fit K

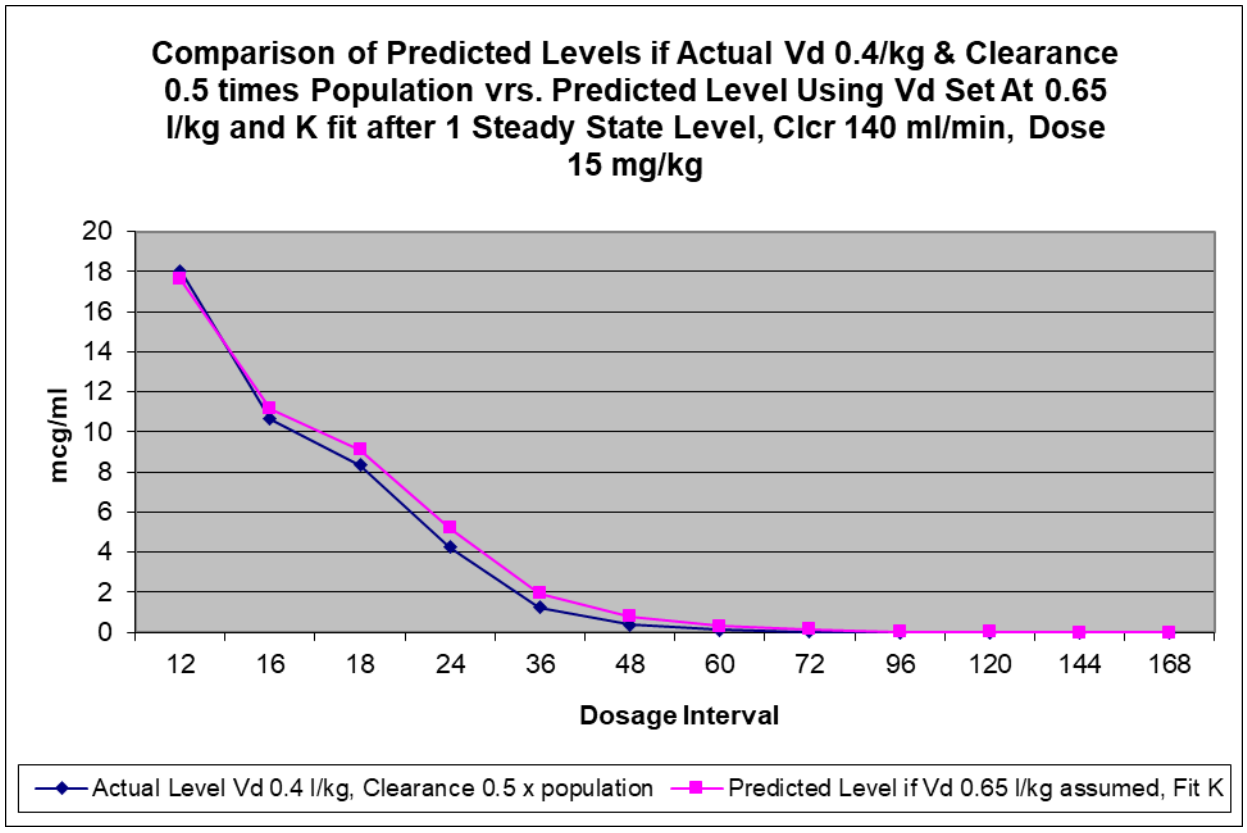

Comparison of Levesl Predicted if Vd 0.4 l/kg & K 1.5 x population vrs assumed Vd Set at 0.65 l/k and K fit after 1 Steady State Level, Clcr 50 min/min, Dose 15 mg/kg
mcg/ml
16
14
12
10
8
6
4
2
0
12
16
18
24
36
48
60
72
96
120
144
168
Dosage Interval
Actual Level Vd 0.4 l/kg & K 1.5 x population
Predicted Level if Vd 0.65 l/kg assumed, Fit K

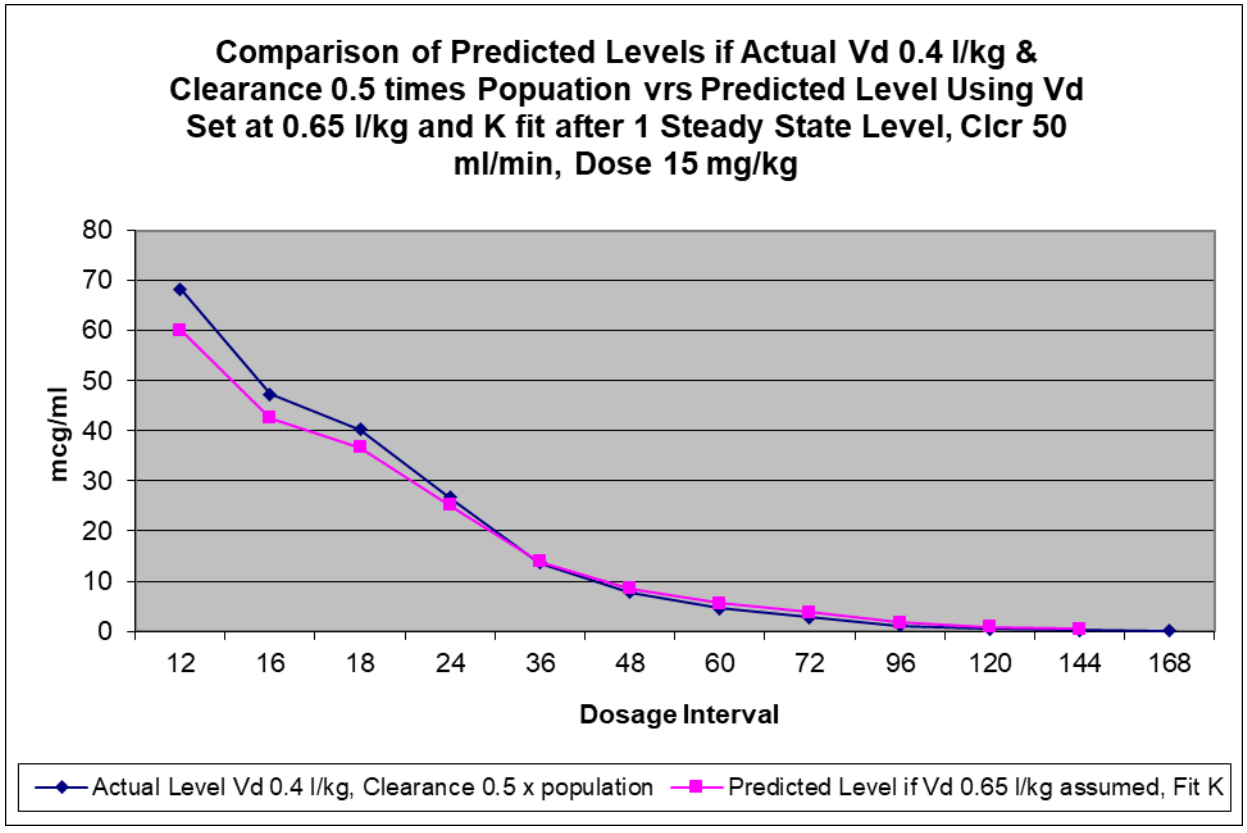

Comparison of Levels Predicted if Vd 0.4 l/kg & K 1.5 x population vrs assumed Vd set at 0.65 l/kg and K fit after 1 Steady State Level, Clcr 5 ml/min, Dose 15 mg/kg
mcg/ml
160
140
120
100
80
60
40
20
0
12
16
18
24
36
48
60
72
96
120
144
168
Dosage Interval
Actual Level Vd 0.4 l/kg & K 1.5 x population
Predicted Level if Vd 0.65 l/kg assumed, Fit K

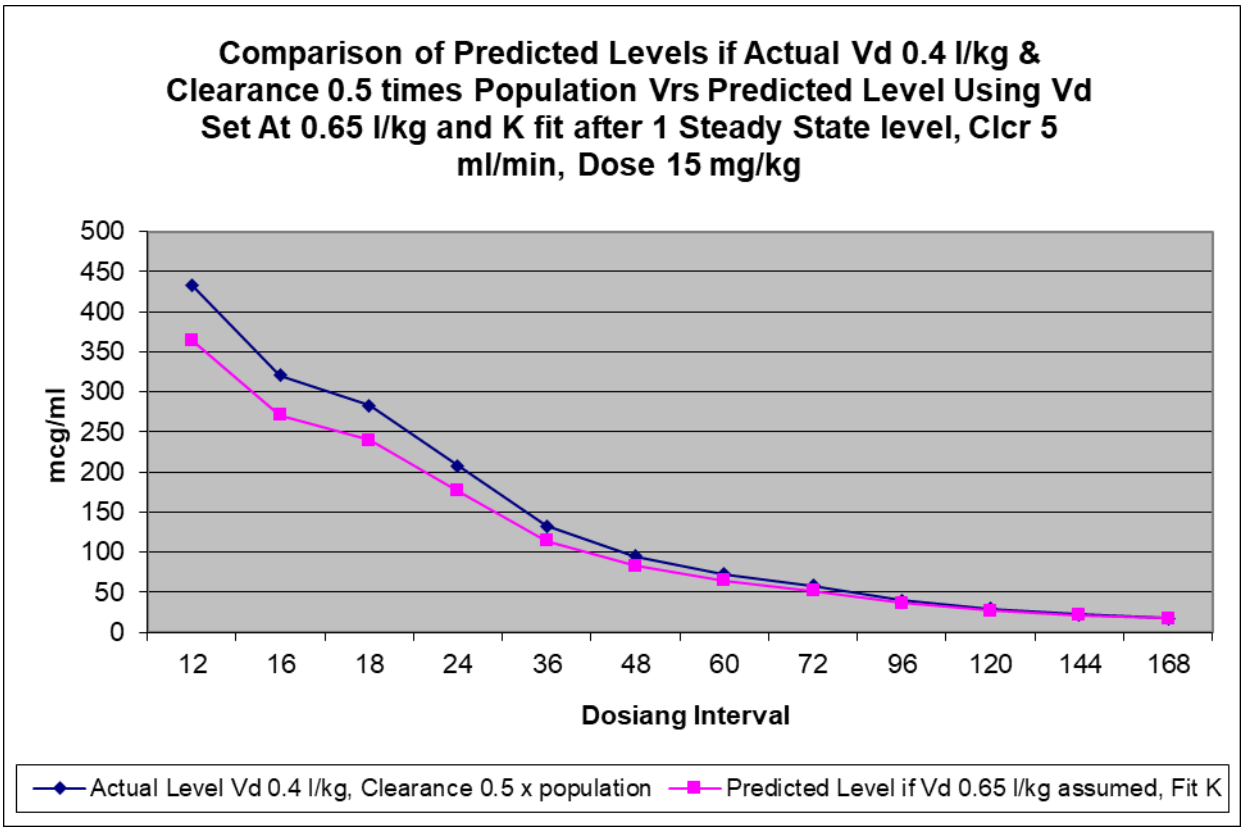

Comparison of Predicted Levels if Actual Vd 0.9 l/kg & Clearance 0.5 times population vrs Predicted Level Using Vd Set At 0.65 l/kg and K fit after 1 Steady State Level, Clcr 140 ml/min, Dose 15 mg/kg
mcg/ml
30
25
20
15
10
5
0
12
16
18
24
36
48
60
72
96
120
144
168
Dosage Interval
Actual Level Vd 0.9 l/kg, Clearance 0.5 x population
Predicted Level if Vd 0.65 l/kg assumed, Fit K


Comparison of Predicted Levels if Actual Vd 0.9 l/kg and Clearance 0.5 times population vrs Predicted Level Using Vd Set at 0.65 l/kg and K fit after 1 Steady State, Clcr 50 ml/min, Dose 15 mg/kg
mcg/ml
90
80
70
60
50
40
30
20
10
0
12
16
18
24
36
48
60
72
96
120
144
168
Dosage Interval
Actual Level Vd 0.9 l/kg, Clearance 0.5 x population
Predicted Level if Vd 0.65 l/kg assumed, Fit K


Comparison of Predicted Levels if Actual Vd 0.9 l/kg and Clearance 0.5 times population vrs Predicted Level Using Vd Set At 0.65 l/kg and K fit after 1 Steady State level, Clcr 5 ml/min, Dose 15 mg/kg
mcg/ml
600
500
400
300
200
100
0
12
16
18
24
36
48
60
72
96
120
144
168
Dosage Interval
Actual Level Vd 0.9 l/kg, Clearance 0.5 x population
Predicted Level if Vd 0.65 l/kg assumed, Kit K


Comparison of Predicted Levels if Actual Vd 0.4/kg & Clearance 0.5 times Population vrs. Predicted Level Using Vd Set At 0.65 l/kg and K fit after 1 Steady State Level, Clcr 140 ml/min, Dose 15 mg/kg
mcg/ml
0
2
4
6
8
10
12
14
16
18
20
12
16
18
24
36
48
60
72
96
120
144
168
Dosage Interval
Actual Level Vd 0.4 l/kg, Clearance 0.5 x population
Predicted Level if Vd 0.65 l/kg assumed, Fit K


Comparison of Predicted Levels if Actual Vd 0.4 l/kg & Clearance 0.5 times Popuation vrs Predicted Level Using Vd Set at 0.65 l/kg and K fit after 1 Steady State Level, Clcr 50 ml/min, Dose 15 mg/kg
mcg/ml
0
10
20
30
40
50
60
70
80
12
16
18
24
36
48
60
72
96
120
144
168
Dosage Interval
Actual Level Vd 0.4 l/kg, Clearance 0.5 x population
Predicted Level if Vd 0.65 l/kg assumed, Fit K


Comparison of Predicted Levels if Actual Vd 0.4 l/kg & Clearance 0.5 times Population Vrs Predicted Level Using Vd Set At 0.65 l/kg and K fit after 1 Steady State level, Clcr 5 ml/min, Dose 15 mg/kg
mcg/ml
500
450
400
350
300
250
200
150
100
50
0
12
16
18
24
36
48
60
72
96
120
144
168
Dosiang Interval
Actual Level Vd 0.4 l/kg, Clearance 0.5 x population
Predicted Level if Vd 0.65 l/kg assumed, Fit K