PHARM.D • YEAR 4

Biopharmaceutics & Pharmacokinetic

CHAPTER 3

One-Compartment Open Model

PPT CHAPTER COVER



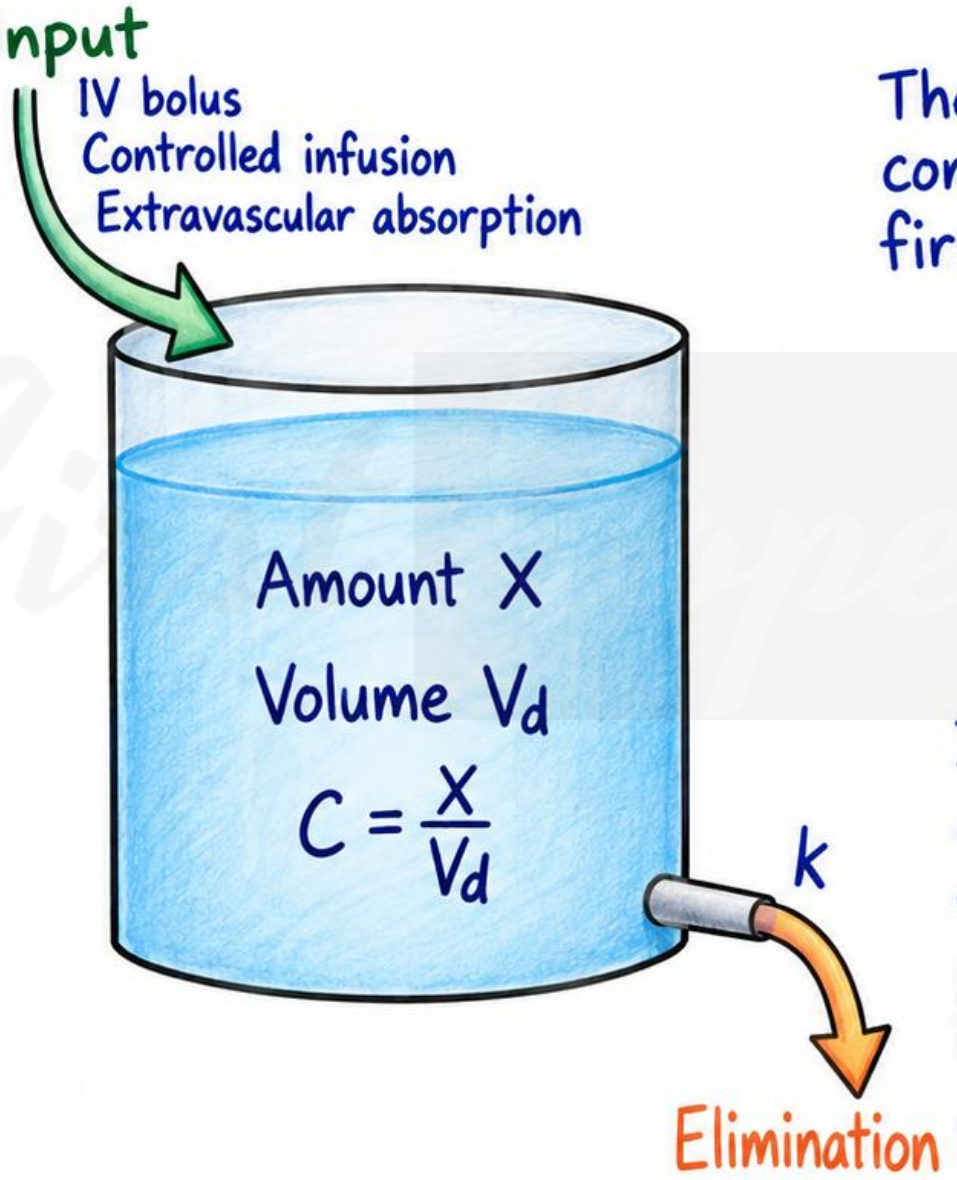
DOCTOR OF PHARMACY

One-compartment open model

The model treats the body as one well-mixed kinetic space.

Distribution is effectively instantaneous relative to the sampled elimination phase.

Open means that drug can leave the system through elimination.

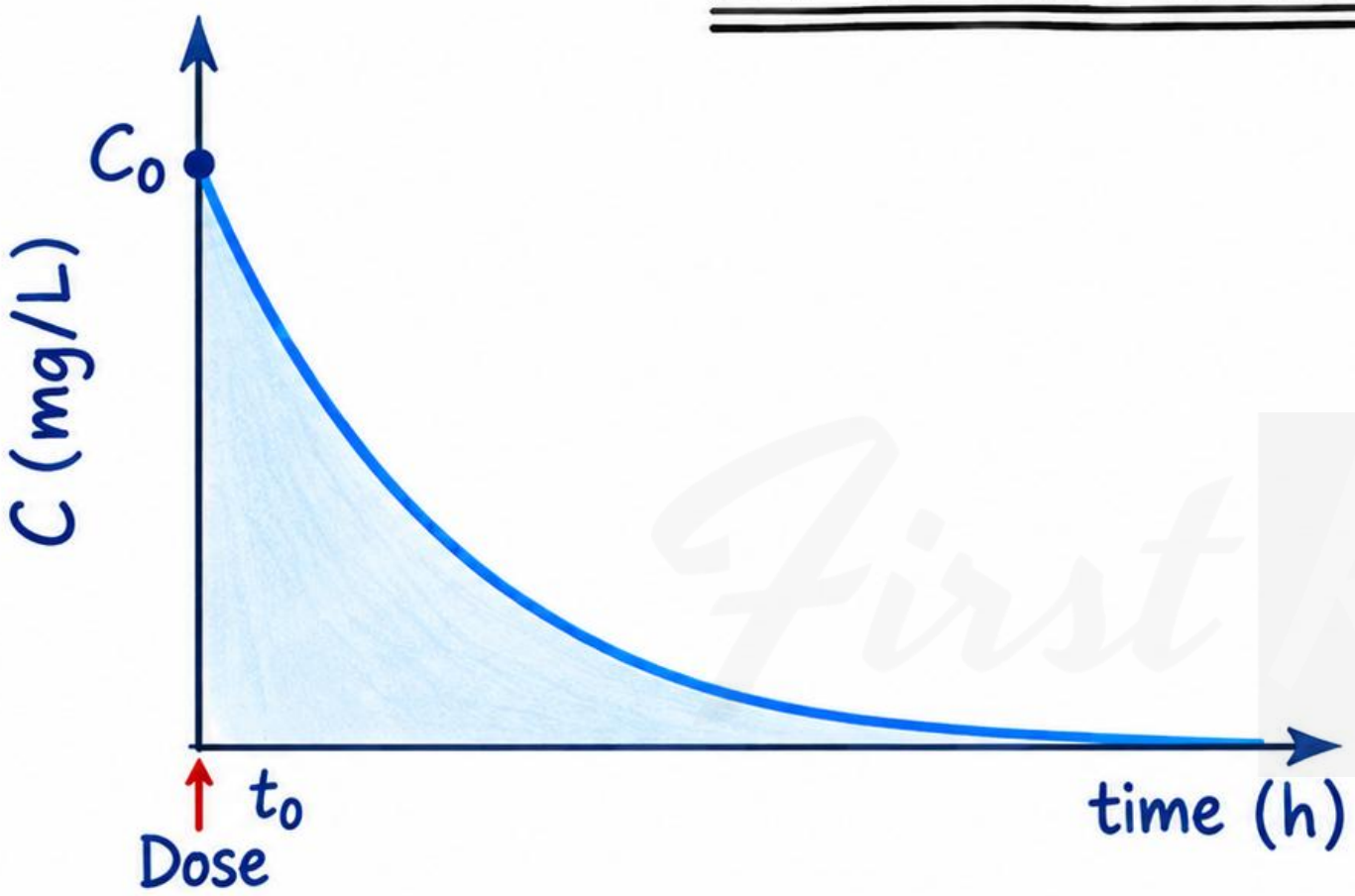


The basic model assumes constant volume and first-order elimination.

Separate tissue equilibration phases are not described.

Input may be an IV bolus, a controlled infusion or an extravascular absorption process. Each input requires its own concentration-time equation.

IV bolus concentration



$$C_0 = \frac{\text{Dose}}{Vd}$$

$$C(t) = C_0 e^{(-kt)}$$

An ideal IV bolus delivers the dose directly into systemic blood.
There is no absorption step and F = 1.

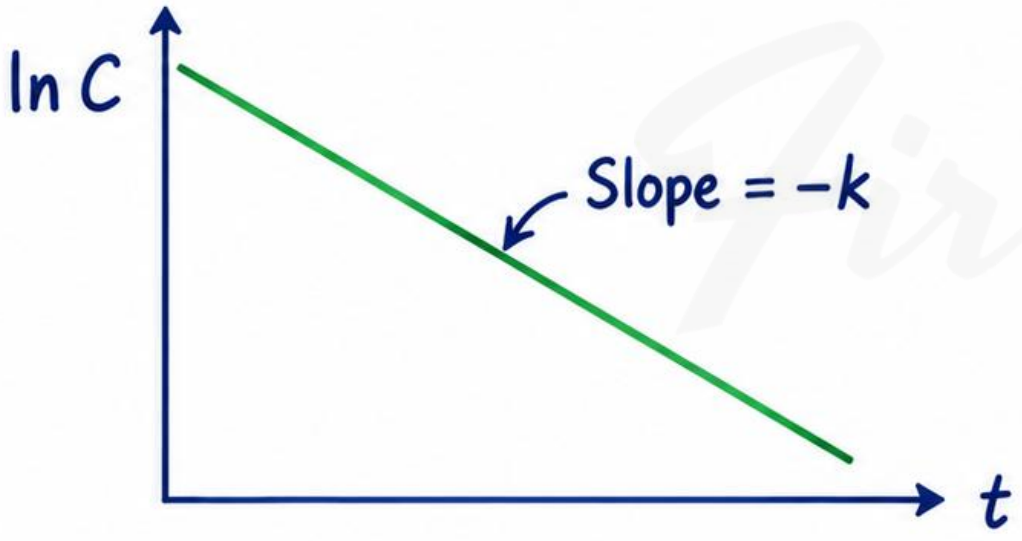
C_0 is the model-extrapolated concentration at time zero.
With constant Vd and k, concentration falls exponentially after the dose.
The model assumes mixing has effectively occurred. Actual very early samples may still reflect distribution.

Log plots and elimination rate

Natural logarithm:

$$\ln C = \ln C_0 - kt$$

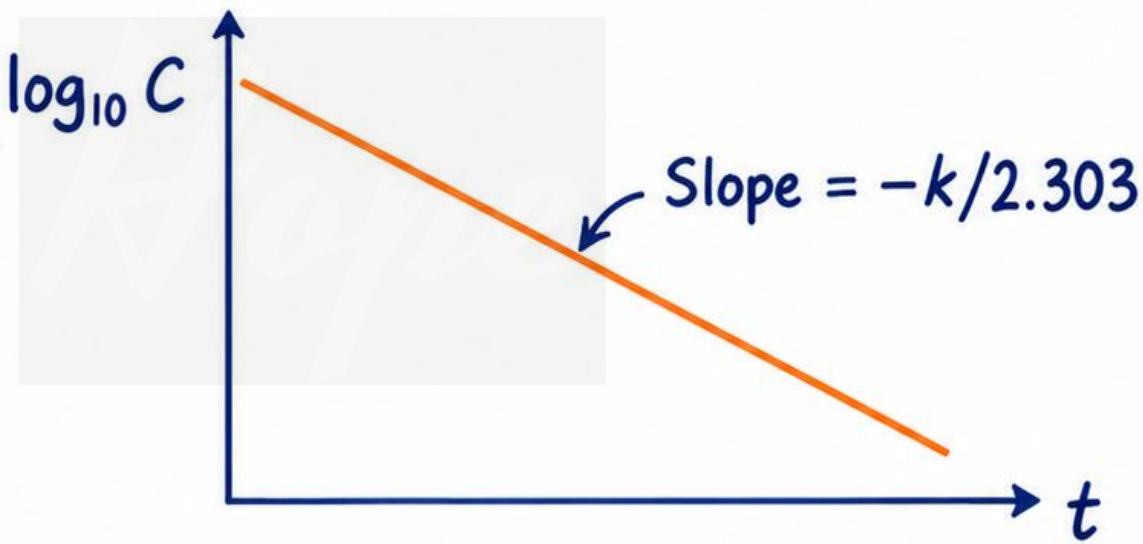
Slope of $\ln C$ against $t = -k$.



Common logarithm:

$$\log_{10} C = \log_{10} C_0 - kt/2.303$$

Slope of $\log_{10} C$ against $t = -k/2.303$.



$$t_{½} = 0.693/k$$

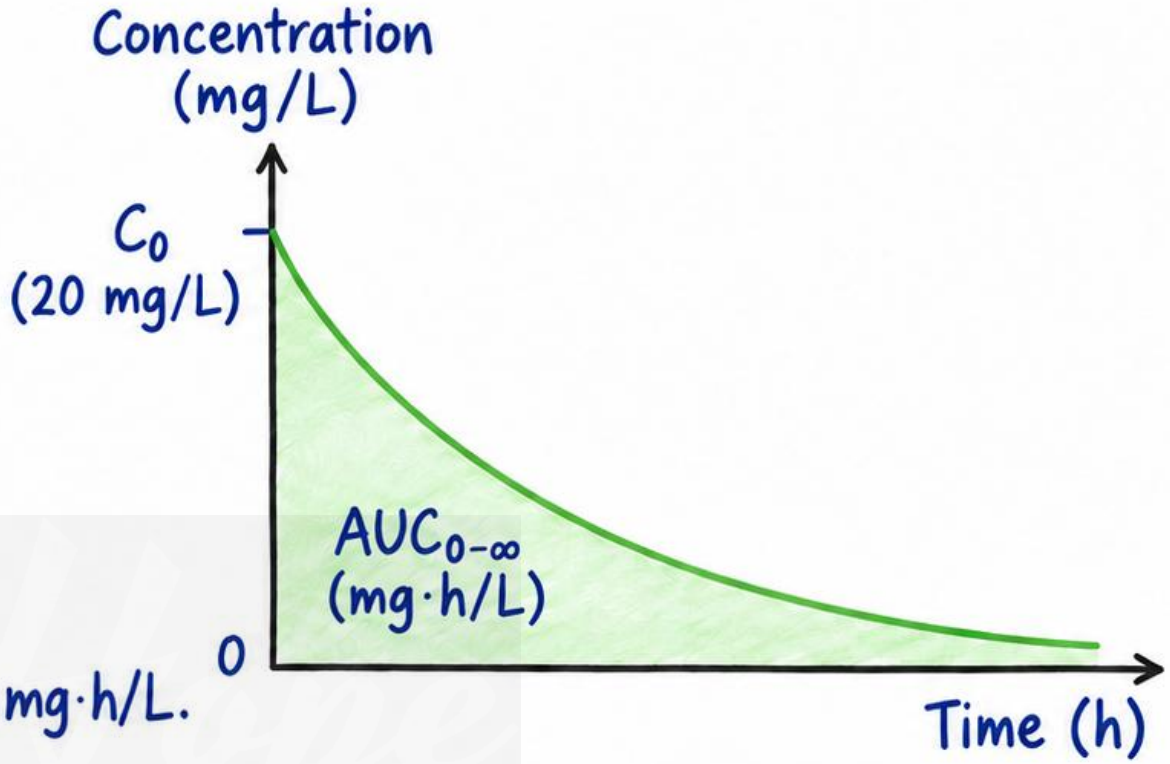
State the logarithm base before calculating k. A negative slope represents declining concentration, while k itself is positive.

IV bolus parameters and units

$$V_d = \text{Dose}/C_0$$

$$CL = k \times V_d$$

$$AUC_{0-\infty} = C_0/k = \frac{\text{Dose}}{CL}$$



V_d has units L. CL has units L/h. AUC has units mg·h/L.

Illustrative calculation:

Dose = 400 mg, C_0 = 20 mg/L, $t_{1/2}$ = 4 h.

V_d = 20 L, k = 0.1733 h^{-1}.

$$V_d = \frac{\text{Dose}}{C_0} = \frac{400\ \text{mg}}{20\ \text{mg/L}} = 20\ \text{L}$$

$$k = \frac{0.693}{t_{1/2}} = \frac{0.693}{4\ \text{h}} \approx 0.1733\ h^{-1}$$

$$CL = k \times V_d \approx 0.1733\ h^{-1} \times 20\ \text{L} \approx 3.47\ \text{L/h}$$

$$AUC_{0-\infty} = \frac{C_0}{k} = \frac{20\ \text{mg/L}}{0.1733\ h^{-1}} \approx 115.4\ \text{mg·h/L}$$

This example illustrates model arithmetic, not a prescribing recommendation.

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