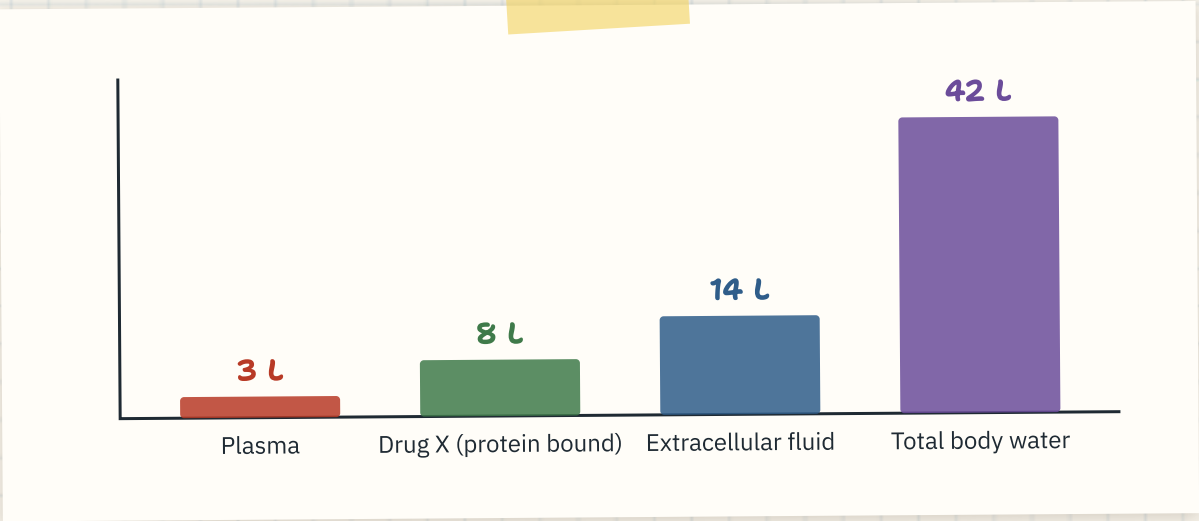
Volume of distribution

Vd = dose / plasma concentration



Step by step

1. Plasma ≈ 3 L: confined to plasma
2. Extracellular fluid ≈ 14 L
3. Total body water ≈ 42 L
4. Above 42 L: held in tissue
5. Loading dose = target concentration × Vd

VOLUME OF DISTRIBUTION

$$Vd = dose / C_0$$

IV dose; C_0 = concentration extrapolated to time zero; L or L/kg

Factor	Effect on Vd
Plasma protein binding	Lower (e.g. warfarin 8–10 L)
Tissue binding, lipid solubility	Higher (chloroquine: thousands of L)
Water-soluble drug	Small; stays in extracellular fluid
Edema, ascites, effusions	Larger for water-soluble drugs
Older age	Smaller for water-soluble drugs

What changes Vd

Rule of thumb

More drug leaves plasma: lower concentration, larger Vd

Bound in plasma: small Vd

Bound in tissue: large Vd

Exam traps

- Vd is an apparent volume, not a real one; 350 mg ÷ 0.5 mg/L = 700 L in a body of 42 L of water.
- Only unbound drug diffuses into tissue.
- Do not divide the other way round: Vd is dose over concentration.

Volume of distribution: why Vd can be bigger than the body

Video, written lesson, practice question and sources: medservatory.com/usmle-step-1/pharmacology-principles-autonomic/volume-of-distribution-vd-dose-concentration

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