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Pharmacokinetics, Pharmacodynamics, & THEIR CLINICAL RELEVANCE

PHARMACOKINETICS (PK)

Pharmacokinetics is the study of how the drug is processed by the body.[1] Simply put, it is *what the body does to the drug*,[1] and involves each of the following:

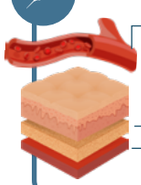
A — Absorption

The drug is transported from the site of administration to systemic circulation.[2]

Bioavailability: percentage of administered drug that reaches site of action.[3]

Administration Routes:

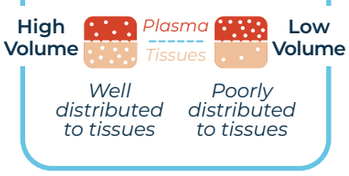
- **ORAL:** Absorbed by stomach and intestines.[2] Bioavailability can be reduced by first-pass metabolism.[3]
- **TOPICAL:** Absorbed by skin[2]
- **INHALATION:** Absorbed in lungs[2]
- **INJECTION:**[4]
  - **Intravenous:** Bypasses absorption
  - **Subcutaneous:** Slow absorption
  - **Intramuscular:** Slow absorption



D — Distribution

Volume of Distribution (VD) is the extent of distribution between plasma and tissues.[4]

VD = The amount of drug in the body divided by drug plasma concentration.[4]



Factors Impacting Drug Response

1. Genetics[2,11]
2. Age[5]
3. Sex[6]
4. Diet & lifestyle interactions[7]
5. Disease impacting organ function[8]

M — Metabolism

Drug structure is modified to facilitate elimination from the body. Occurs through liver enzymes (e.g. cytochrome P450).[2]

Phases Of Metabolism:[4]

PHASE I

- **Reactions:** oxidation, reduction, and hydrolysis
- **Possible outcomes:**
  - Inactivated drug
  - Inactive drug form (prodrug) is activated

PHASE II

- **Reactions:** conjugation and hydrolysis
- **Primary outcome:** Addition of polar group (e.g., acetylation, methylation) that enables elimination

First-Pass Metabolism: Drug metabolism that occurs before drug reaches systemic circulation

- Lowers bioavailability
- Common for oral drugs

E — Elimination

Drugs are irreversibly removed from the body,[9] both active drug and metabolites.[4]

Kidney filtration (urine) is the primary method for elimination.[2,4]

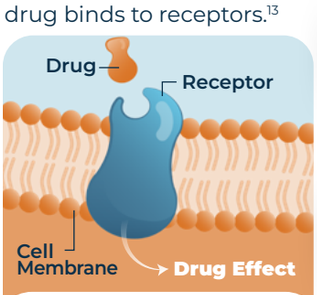
CLINICAL RELEVANCE OF PK[16]

1. Monitor Therapeutic Effect
2. Interpret drug plasma concentrations
3. Optimize Drug Therapy

PHARMACODYNAMICS (PD)

Pharmacodynamics is the study of how the drug affects the body.[3] Simply put, it is *what the drug does to the body.* It is the drug action that is responsible for therapeutic response and toxic effects.[1]

Action occurs when the drug binds to receptors.[13]



CLINICAL RELEVANCE OF PD

- **Therapeutic effect** is determined by concentration at the site of action.[14]
- Drug affinity, potency, and efficacy help determine **required dose**.[3]

Drug Action Determined By:

1. **Affinity**[3]
   Strength of drug binding to a specific receptor.
   High affinity typically requires lower dose.
2. **Efficacy** (intrinsic activity)[13]
   Effect on receptor activity, leading to cellular activity change.
   Relative measurement of ability to produce a response.
3. **Potency** (occupancy)[3]
   Relationship between drug dose & effect magnitude.
   High potency requires low dose to produce strong effect.

Connection Between PK & PD:

PK describes drug movement through the body and resulting concentration in different body compartments (ADME above).[15]

- A Absorption
- D Distribution
- M Metabolism for prodrugs
- M Metabolism
- E Elimination

Drug Dose[15] (amount of drug administered) → **Drug Concentration**[15] (that reaches the site of action) → **Drug Elimination**[4]

Drug Response[13]

PD describes the *therapeutic and adverse* effects of the drug (affinity, potency, and activity).[1,3,13,17]

SCAN TO VISIT PSYCHU TODAY:
PsychU.org/resource-library/bipolar-disorder

References:

1. Newell DR. Ann Oncol . 1994;5 Suppl 4:9 15.
2. Alavijeh MS, et al. NeuroRx. 2005;2(4):554-571.
3. Currie GM. J Nucl Med Technol. 2018;46(2):81-86.
4. Currie GM. J Nucl Med Technol. 2018;46(3):221-230.
5. Mangoni AA, et al. Br J Clin Pharmacol. 2004;57(1):6-14.
6. Alomar MJ. Saudi Pharm J. 2014;22(2):83-94.
7. Niederberger E, et al. Int J Mol Sci. 2021;22(14):7692.
8. Staudinger JL. Pharm Res. 2013;30(9):2171-2173.
9. Jambhekar SS, et al. 1st ed. Pharmaceutical Press; 2009.
10. Correll CU, et al. CNS Drugs. 2021;35(1):39-59.
11. Lynch T, et al. Am Fam Physician. 2007;76(3):391-396.
12. Berg KA, et al. Int J Neuropsychopharmacol. 2018;21(10):962-977.
13. Salahudeen MS, et al. Saudi Pharm J. 2017;25(2):165-175.
14. Rizk ML, et al. Clin Transl Sci. 2017;10(3):133-142.
15. Negus SS, et al. Curr Top Behav Neurosci . 2018;39:245 259.
16. Kang JS, et al. Korean J Intern Med . 2009;24(1):1 10.
17. Jones AW. WIREs Forensic Sci. 2019;1(5):e1340.

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March 2023 US.CORP.X.23.00113