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Module 2: Pharmacokinetics and Pharmacodynamics

Essential for safe and effective medication administration in nursing practice.

4B. Physiological Integrity Pharmacological and Parenteral Therapies

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Pharmacokinetics

- **Absorption:** How drugs enter the bloodstream.
- Passive Diffusion: Lipid-soluble drugs move from high to low concentration.
- Active Transport: Movement against concentration gradient, requiring energy.
- Facilitated Diffusion: Movement with carrier proteins.
- **Factors Affecting Absorption:** pH, blood flow, surface area, drug formulation.

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Distribution Factors

Protein Binding:	Blood-Brain Barrier:	Tissue Binding:
• Only unbound drugs are active; protein levels affect drug action.	• Lipid-soluble drugs cross easily; polar drugs do not.	• Drugs may accumulate in specific tissues (e.g., tetracycline binds to calcium in bones).

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Volume of Distribution (Vd)

- **Definition:** Extent of drug distribution throughout body tissues.
- **Clinical Implications:** Large Vd indicates extensive distribution; small Vd suggests limited distribution.

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Metabolism

- **Liver Function:** Drugs transformed into active or inactive metabolites.
- **Phase I Reactions:** Oxidation, reduction, hydrolysis via P450 enzymes.
- **Phase II Reactions:** Conjugation with molecules like glucuronic acid for easier excretion.

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First-Pass Metabolism & Excretion

First-Pass Metabolism

- **Definition:** Metabolism of orally administered drugs by the liver before reaching systemic circulation.
- **Example:** Nitroglycerin has poor oral effectiveness due to first-pass metabolism.

Excretion

- **Renal Excretion:** Drugs filtered by the glomeruli and secreted by renal tubules.
- **Biliary Excretion:** Some drugs excreted in bile, potentially causing enterohepatic recycling.

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Pharmacodynamics

Mechanisms of Drug Action:

- Receptor Theory: Drugs bind to receptors (agonists, antagonists, partial agonists).
- Signal Transduction: Drug-receptor binding triggers cellular responses (e.g., beta-adrenergic agonists).

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Dose-Response Relationships

Threshold Phase:
- First dose causing measurable effect.

Linear Phase:
- Dose-response increases proportionally.

Plateau Phase:
- Maximum effect reached.

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Therapeutic Range & Drug Response

Therapeutic Range

- Definition: Plasma concentration range achieving desired effect without toxicity.
- Monitoring: Warfarin, lithium require therapeutic drug monitoring.

Factors Influencing Drug Response

- Patient Variability: Age, sex, genetic makeup, comorbidities, medications.
- Tolerance: Requires higher doses over time for the same effect.

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Drug Interactions

Types:

- Synergistic Effects: Combined effects are greater than individual effects.
- Antagonistic Effects: One drug reduces the effect of another.
- **Assessment:**
- Medication history to identify interactions.

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Effects &Adverse Reactions

Side Effects and Adverse Reactions

- Side Effects: Predictable, dose-dependent effects (e.g., drowsiness with antihistamines).
- Adverse Reactions: Unintended, harmful effects (e.g., hepatotoxicity with acetaminophen overdose).

Serious Adverse Reactions

- Anaphylaxis: Severe allergic reaction; needs immediate epinephrine.
- Stevens-Johnson Syndrome (SJS): Severe skin reaction requiring immediate discontinuation of the drug.

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Monitoring and Reporting

- **Documentation:** Accurate documentation of side effects and adverse reactions.
- **Communication:** Collaboration with healthcare team; utilizing reporting systems like NCC MERP.

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CONCLUSION

- Understanding pharmacokinetics and pharmacodynamics is essential for optimizing medication management.
- Nurses play a key role in patient education, assessment, and overall care.