When you swallow a pill, what actually happens next? Where does it go? How does your body decide what to do with it? And what happens when two drugs meet inside you and start competing for the same spot?

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SafePolyMed.eu

Improving Safety in Polymedication by Managing Drug-Drug-Gene Interactions

Safety in Polypharmacy training 2026

Session 2 - Video 1/2

Fundamental Concepts in Drug-Drug Interactions (DDIs)

How Drugs Work in Your Body & What Happens When They Collide

Rachel Giles, Olga Millán

LeukaNET Leukemia Advocates Network

Patvocates PATIENT ENGAGEMENT IS IN OUR DNA

Funded by the European Union

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Polypharmacy & The Risk of Drug-Drug Interactions

Multiple Conditions



→

Polypharmacy

5+ medications
at the same time

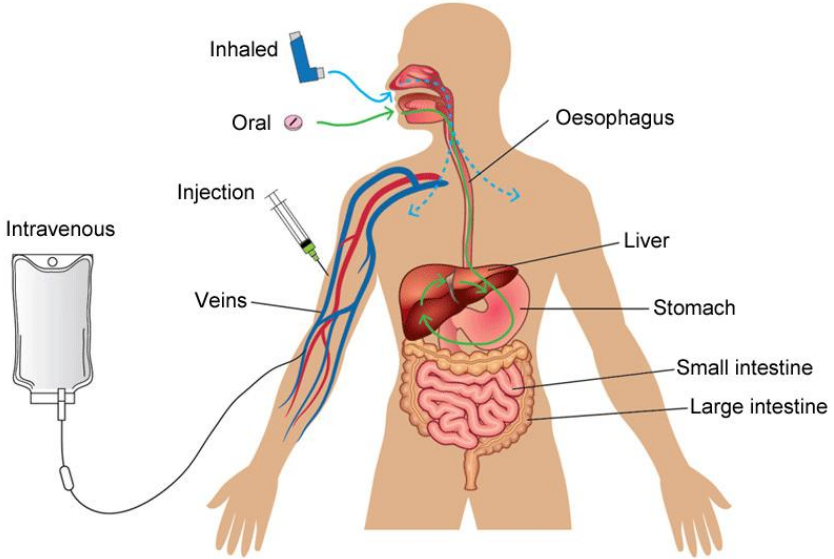
→

High Risk of:

- Drug-Drug Interactions
- Side Effects
- Adverse Drug Reactions
- Medication Errors

💡 The more medications you take → the higher the risk of harmful interactions

How Medicines Enter Your Body: Routes of Administration



Oral

- Pills & capsules
- Liquids
- Sublingual (under tongue)

Injected

- Intravenous (IV)
- Intramuscular (IM)
- Subcutaneous (SC)

Topical / Other

- Creams & patches
- Inhalers & sprays
- Suppositories

The route determines how much drug reaches your bloodstream and how fast.

Introduction to medicines - EUPATI Toolbox | https://toolbox.eupati.eu/resources/introduction-to-medicines/

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The First-Pass Effect: Your Liver as a Drug Filter

The Oral Drug Journey

1. **Swallowed**
   Tablet/capsule
2. **Gut absorption**
   Stomach → small intestine
3. **Portal vein**
   Blood flows to liver first
4. **Liver metabolism**
   Large portion broken down
5. **Systemic circulation**
   Remaining drug reaches body

Bioavailability Example

300 mg taken orally

70% absorbed by gut	**210 mg**
60% removed by liver	**–126 mg**
Bioavailability (28%)	**84 mg**

💡 Some drugs can't be taken as pills because the liver destroys too much — e.g., nitrate patches for chest pain.

See video: https://www.youtube.com/watch?v=BQQns7RAUzA

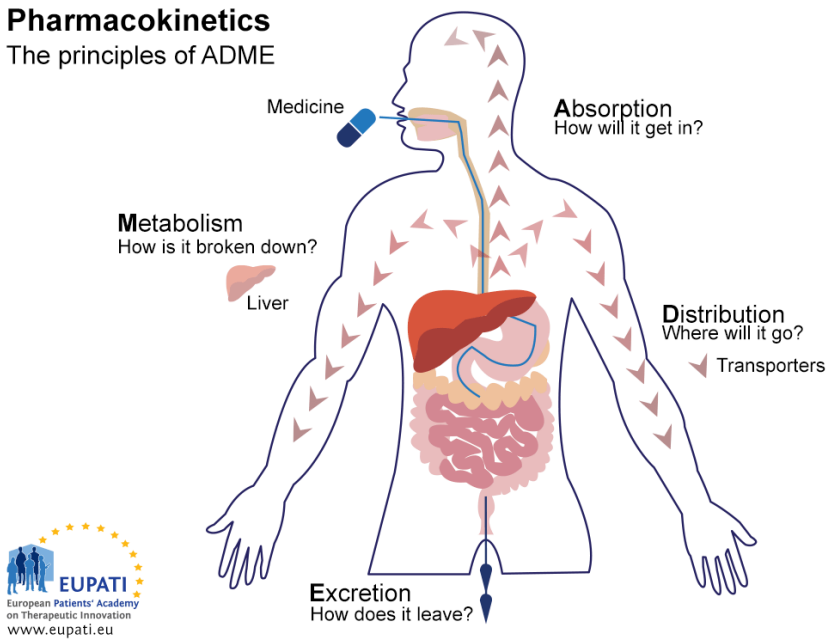
Pharmacokinetics (PK): What Your Body Does to a Drug

A **Absorption:** Drug moves from administration site into the bloodstream

D **Distribution:** Drug travels through blood to reach target organs & cells

M **Metabolism:** Liver enzymes (CYP450) break the drug down into metabolites

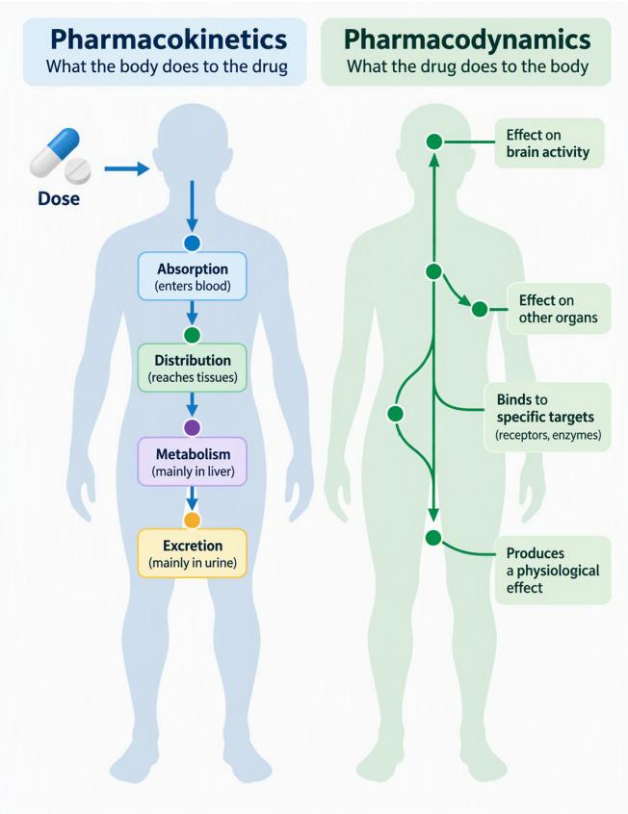
E **Elimination:** Drug or by-products leave via urine, faeces, sweat, breath



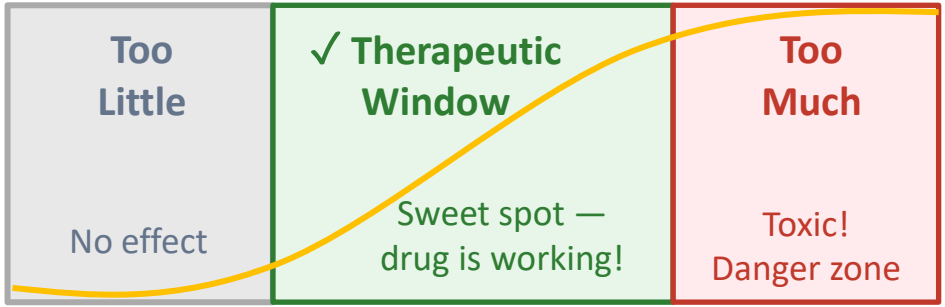
⚠ Each ADME step is a potential point where another drug can interfere and cause a DDI.

Introduction to medicines - EUPATI Toolbox | https://toolbox.eupati.eu/resources/key-principles-of-pharmacology/

Pharmacodynamics (PD) — What the Drug Does to Your Body



The Therapeutic Window



Dosing Strategies

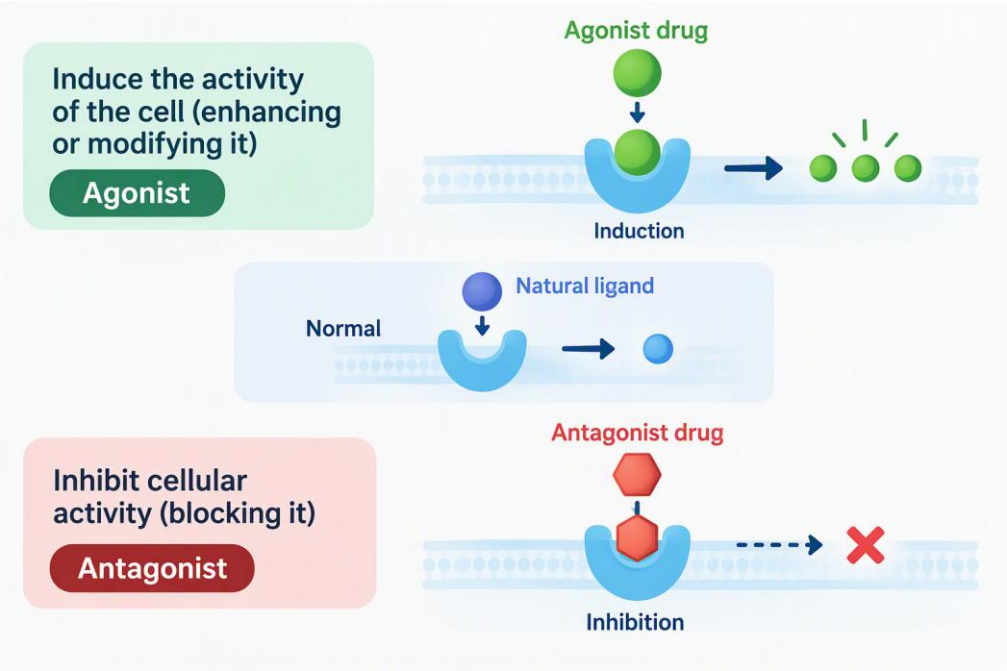
- Fixed flat dose for everyone
- Dose adjusted by body size
- Fixed dose per age group (adults vs. children)

Choice depends on the drug and the individual.

https://en.wikipedia.org/wiki/Pharmacodynamics

How Drugs Act on Cells: Receptors, Agonists & Antagonists

Most drugs work by binding to receptors on your cells



When two drugs compete for the SAME receptor → Pharmacodynamic Drug-Drug Interaction

https://www.pharmaguideline.com/2021/09/principles-and-mechanisms-of-drug-action..html

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Drug-Drug Interactions: When Medicines Collide

A DDI occurs when different compounds taken at the same time affect each other's behaviour.



Prescription Medicines



OTC Medicines

Natural Substances (e.g. grapefruit)



Supplements (vitamins, fish oil)

> 2,500

pairs of interacting drugs

⚠ DDI especially dangerous when a drug has a **narrow therapeutic window**

(small margin between effective & toxic dose)

Understanding DDIs is key to patient safety

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DDI Case Study 1

When a Heartburn Drug Undermines a Heart Drug

Patient Profile

Woman, 68 years
Arrives at ER
with a heart attack

Taking:

- Clopidogrel (anti-clot)
- ASA - Aspirin
- Omeprazole (heartburn)

The DDI Mechanism

1. Clopidogrel needs CYP enzyme to become ACTIVE
2. Omeprazole BLOCKS that CYP enzyme
3. Clopidogrel remains INACTIVE
4. Clot prevention fails

Outcome

Heart Attack (MI)

Heartburn drug silently undermined the clot-prevention drug.

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DDI Case Study 2

Example of how it goes wrong

The Case

Patient taking Methotrexate (RA drug) + NSAIDs (common anti-inflammatory painkiller)

Study of patients with rheumatoid arthritis & psoriasis showed that **NSAIDs reduce kidney function**
→ kidneys eliminate methotrexate more slowly
→ toxic methotrexate levels build up in blood

Consequences

- **Bone marrow suppression**
- **Gastrointestinal toxicity**
- **Kidney (renal) failure**

A common painkiller + a commonly used immunosupresant, yet the combination can be fatal

Svanström H, et al., Pharmacoepidemiol Drug Saf. 2018 doi: 10.1002/pds.4555. Epub 2018 May 24. PMID: 29797447.

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Key Takeaways



Every drug travels through your body via ADME — Absorption, Distribution, Metabolism, Elimination.



At every ADME step, another drug can interfere, causing a Drug-Drug Interaction.



The therapeutic window is your target: too little = no effect, too much = toxic.



Always tell your healthcare team about ALL substances — prescription, OTC, supplements.

Coming up next: Video 2 — The Patient Perspective, PROs, PROMs & Real-World DDI Cases

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Credits & Attributions

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AI disclosure

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