Imagine a world where, before you take a single pill, your doctor already knows exactly how your body will process it. Not a guess based on your age or weight, but a precise prediction based on your DNA. That world isn’t science fiction anymore. It’s called pharmacogenomics, and it’s already changing medicine today.

SAFEPOLYMED

SafePolyMed.eu

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

Safety in Polypharmacy training 2026

Session 3 - Video 3/3

Drug-Gene & Drug-Drug-Gene Interactions

Pharmacogenomics, Gene Editing & the Future of Personalised Medicine

Rachel Giles, Olga Millán

LeukaNET Leukemia Advocates Network

Patvocates PATIENT ENGAGEMENT IS IN OUR DNA

Funded by the European Union

AI Disclosure: *Avatars, voices, and some visual elements in this video were generated using HeyGen & Copilot. The educational content was created by humans and subsequently edited and summarised with AI assistance.*

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The Four Metaboliser Types: Which One Are You?

Your genes determine how active your drug-metabolising enzymes are



Extensive

The "average" population. Drugs work as intended.



Intermediate

Process drugs more slowly. More side effects, reduced effectiveness.



Poor

Enzymes barely function. Drugs build up, causing toxicity.



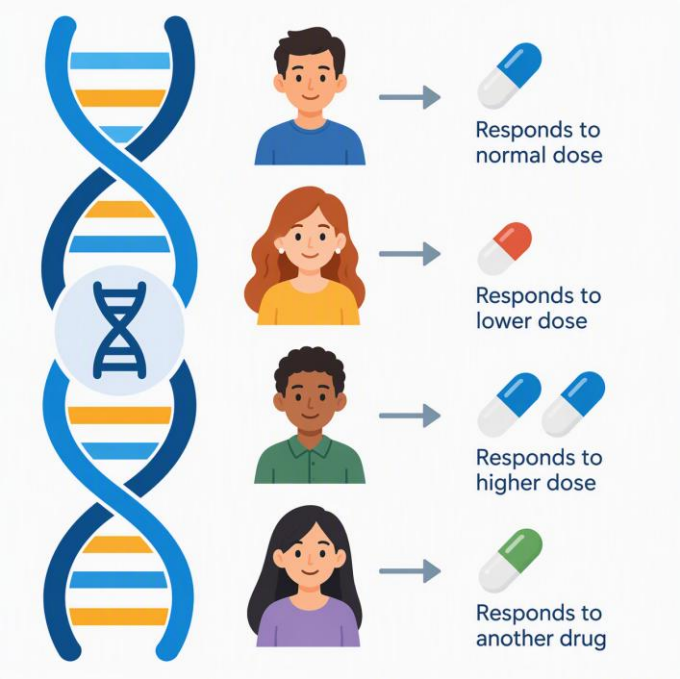
Ultra-rapid

Enzymes work so fast, drugs clear before they act.

Most people have no idea which type they are, yet it can change medication safety and effectiveness

Pharmacogenomics & DDGIs

The branch of pharmacology that studies how an individual's genetic inheritance affects the body's response to drugs



Multiple medications + ***Genetic Variant*** = **DDGIs**

Drug-drug-gene interactions occur when genes and multiple drugs interact

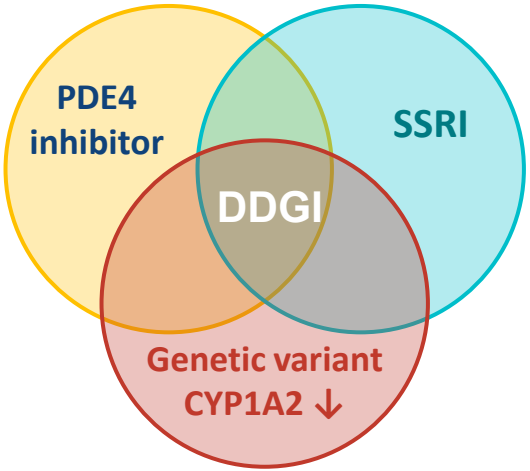
Pharmacogenomics & DDGIs

The branch of pharmacology that studies how an individual's genetic inheritance affects the body's response to drugs

Psychiatric patient with COPD

- Roflumilast (**PDE4 inhibitor**) + Fluvoxamine (**SSRI**), both processed by CYP enzymes.
- A **CYP1A2-reducing variant**
- Fluvoxamine further slows down the metabolism of Roflumilast
- Excessive drug levels
- Physical side effects and psychiatric risks

Solution: genetic testing → dose adjustment or alternative drug



https://www.sciencedirect.com/science/article/pii/S0163725813000065?via%3Dihub

Gene Editing

Gene editing allow genetic material to be added, removed, or altered at particular locations in the genome



Highlight

Locate the target DNA sequence with the mutation.



Cut

Molecular "scissors" cut the DNA at that precise point.



Repair

The cell’s repair machinery fixes the gap with a correct sequence.

CRISPR - Clustered Regularly Interspaced Short Palindromic Repeats

Goal: correct faulty genes that cause disease, add new functions, or remove harmful DNA.

MedlinePlus [Internet]. Bethesda (MD): National Library of Medicine (US); [updated Jun 24; cited 2020 Jul 1]. Available from: https://medlineplus.gov/. https://medlineplus.gov/genetics/understanding/genomicresearch/genomeediting/

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Real-World Examples: Genetic Testing Saving Lives

Three cases where a genetic variant changes how a drug should be used

Thiopurine

Gene: TPMT

Used for leukaemia & autoimmune disease. Low TPMT activity → drug buildup, bone marrow suppression.

Test before treating

Clopidogrel

Gene: CYP2C19

Antiplatelet drug. Poor CYP2C19 metabolisers can't activate it, then clot prevention fails, risk of heart attack/stroke.

Switch to alternative drug

5-Fluorouracil

Gene: DPYD / DPD

Chemotherapy drug. Reduced DPD activity → severe toxicity: Gastrointestinal, bone marrow, neurological damage.

Routine pre-testing now standard

Pharmacogenomics = Safer Polypharmacy

Clinical Pharmacology & Therapeutics, 89: 198-209 | *N Engl J Med 2009;360:354-362* | *https://pmc.ncbi.nlm.nih.gov/articles/PMC5760397/*

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The Big Takeaway

Your genes directly influence how every drug in your medicine cabinet works inside you

Ask your healthcare team - Has genetic testing been considered for my medications?

Push for routine testing - support pharmacogenomic testing in routine care.

Access & awareness - The technology and evidence exist; it's about access and awareness now.

Session 3 completed ✓

▶ **Next: Session 4 — Vulnerability factors in polypharmacy: individual, social, and systemic risks.**

Credits & Attributions

Authors

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AI disclosure

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