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Pharmacogenetic passport

Improving the efficacy and safety of drug treatments

Medication-related iatrogenesis is a well-known public health issue among healthcare professionals. Drug produce variable reactions in different individuals, ranging from potency to inefficacy, and can lead to undesirable or even toxic effects.
It is generally accepted that physiological, pathological, environmental, and genetic factors can be the cause of iatrogenic complications.

Medication-related iatrogenesis can extend treatment duration, potentially increasing suffering for the patient. Medication-related iatrogenesis can also result in severe disease progression, poor treatment adherence, more frequent doctor visits, or hospitalisation.

With the implementation of pharmacogenetic tests, some of these situations can be limited or avoided completely.

The role of genetics in adverse drug reactions

Genetic heritage influences the enzymatic activity of enzymes involved in drug metabolism with potential to impact on drug efficacy or tolerance.

Based on genetic polymorphism, individuals within a population are categorized into 5 phenotypic groups:

- **Poor metabolizer** (greatly reduced or no enzyme activity): production of a nonfunctional enzyme.
- **Intermediate metabolizer** (slowed enzyme activity): with lead to the production of 2 enzymes, one functional and one nonfunctional.
- **Normal metabolizer** (normal enzyme activity): production of functional enzyme.
- **Rapid metabolizer** (increased enzyme activity) or **ultra-rapid metabolizer** (greatly increased enzyme activity): over production of a functional enzyme (resulting from gene duplication, and /or increased gene expression).

Currently we are aware of 20 genes that have a clinically significant impact in drug metabolism. The majority of these enzymes belong to the CYP family (CYP2D6, CYP2C9 et CYP2C19).

In addition other genetic elements are involved in drug efficacy or tolerance, including transporters (SLCO1B1, ABCG2), drug targets, or human leukocyte antigen alleles (HLA-B*57:01, HLA-A*31:01).

Individual genetic predispositions: are we all affected?

The vast majority of individuals have one or more pharmacogenetic variants. In a study involving over 1,000 patients[1], **99% of them carried at least one genetic variation** impacting medication.

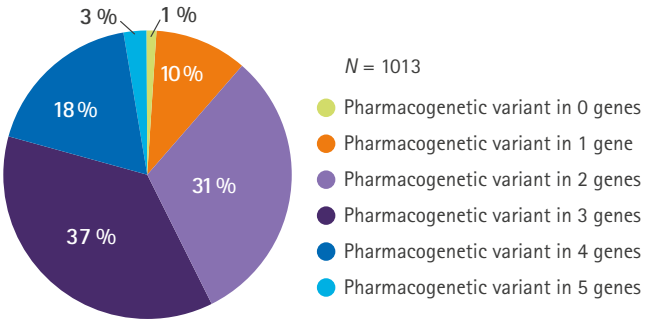

Figure: Percentage of patients in the study with actionable pharmacogenetic variants in zero to five genes

The right dose for each patient

With exome* (or genome) sequencing, it is possible to define a patient's pharmacogenetic (PGx) profile based on his genetic heritage.

This PGx allows to:

- prevent overexposure;
- explain the occurrence of adverse reactions;
- increase drug efficacy;
- guide the clinician in the choice of drug or dosage.

Pharmacogenetic Passport

John Doe

Date of birth: Jan 1, 1990

Pharmacogenetic impact on efficacy/risk of ADRs	
BCHE reduced function	mivacurium
CYP2B6 IM	efavirenz
CYP2B6 IM **CYP2C19** IM	sertraline
CYP2C9 IM*3	celecoxib, flurbiprofen, ibuprofen, lornoxicam, meloxicam, piroxicam, siponimod, tenoxicam
CYP2C9 IM*3 **CYP4F2** IM **VKORC1** normal function	warfarin
CYP2C9 IM*3 **HLA-B** normal risk (*15:02-negative)	phenytoin
CYP2C9 IM*3 **SLCO1B1** normal function	fluvastatin
CYP2C19 IM	carisoprodol, citalopram, clopidogrel, dexlansoprazole, escitalopram, lansoprazole, omeprazole, pantoprazole, sertraline, voriconazole
CYP2C19 IM **CYP2D6** IM	amitriptyline, clomipramine, doxepin, imipramine, trimipramine
CYP2D6 IM	atomoxetine, codeine, desipramine, flecainide, gefitinib, iloperidone, metoprolol, nortriptyline, paroxetine, perphenazine, pimozide, propafenone, tamoxifen, thioridazine, tramadol, venlafaxine, zuclopenthixol

For the complete list of tested genes and for further information, please refer to the detailed report | Generated on: 16/07/20 11:17 AM

Results are available within four weeks.

*Exome analysis is used to identify point variations in genes that encode for proteins (i.e., coding sequences), as well as deletions or duplications (CNV).

Indications

The prediction of individual responses to medications can be useful in most medical specialties. The use of pharmacogenetic profiling is particularly suited for the following categories of drugs:

- Anticoagulants
- Analgesics/ anti-rheumatics
- Proton pump inhibitors
- Psychotropic drugs / Antidepressants
- Cytostatic drugs
- Statins
- Antibiotics / antivirals / antifungals
- Antidiabetics
- Urological drugs
- Antihypertensives

Clinical benefits

By determining the pharmacogenetic profile of their patients, clinicians can **identify the most suitable medication** for each patient and prescribe it at the **most appropriate dose**, which allows:

- Faster treatment success;
- Less medication consumption over a shorter period of time;
- Higher probability to choose a more efficient alternative, if necessary;
- Better compliance.

Benefits of pharmacogenetics

- Reduce the incidence of adverse effects[2]
- Improve drug safety
- Better treatment outcomes and quality of care
- Avoid loss of opportunity for the Patient
- Reduce the cost of drug iatrogenesis and treatment ineffectiveness for healthcare systems
- Improve Patient's experience

A study published in « The Lancet » in 2023[2] demonstrated that conducting pharmacogenetic tests prior to treatment **reduces the incidence of adverse effects by 30%**

In practice

THE STEPS

Prescription of exome (or genome) sequencing + pharmacogenetic passport

- Blood sample (EDTA whole blood or extracted DNA)
- Test request form including consultation certificate and patient's consent form

Collection and transport of the sample

- Logistics can be organised by Eurofins Biomnis

Sequencing

- Coverage of the entire exome, i.e. approximately 22,000 genes
- Approximately 98% of bases covered beyond 30X
- >99% sensitivity

Results

- Report(s) issued within 4 weeks

Test	Exome test + pharmacogenetic passport or stand alone pharmacogenetic passport
Test code	EXOME
Turnaround time	4 weeks
Sample	Whole blood EDTA or extracted DNA
Price	Please contact us
Documents required	B110-INTGB test request form available on www.eurofins-biomnis.com > Test guide > Test code **EXOME**

Pharmacogenetics by Eurofins Biomnis

Ongoing biological support, from testing to result interpretation.

Prescription using a test request form which includes the consultation certificate and consent form.

Short turnaround time for results (4 weeks).

References

1. Ji, Y. et al. (2016) Preemptive Pharmacogenomic Testing for Precision Medicine : A Comprehensive Analysis of Five Actionable Pharmacogenomic Genes Using Next-Generation DNA Sequencing and a Customized CYP2D6 Genotyping Cascade. The Journal of molecular Diagnostics. 18(3), 438-445., 95(4), 423-432. https://doi.org/10.1016/j.jmoldx.2016.01.003

2. A 12-gene pharmacogenetic panel to prevent adverse drug reactions: an open-label, multicentre, controlled, cluster-randomised crossover implementation study; Swen J. et al. The Lancet 2023

3. French national pharmacogenetic network (Réseau national de pharmacogénétique. RNPGx)

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