

4CPS-055 PHARMACOGENETICS AND ITS APPLICATIONS IN PERSONALISED MEDICINE: A SYSTEMATIC REVIEW

L Amaro\*, J Cordero, A Martínez-Escudero, A Aguado, MÁ Calleja. Hospital Universitario Virgen Macarena, Hospital Pharmacy, Seville, Spain

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**Background and Importance** Pharmacogenetics evaluates how genetic variations influence drug responses. Nowadays, genetic tests have advanced, become more affordable, and its integration are supported by stronger clinical evidence. Guidelines such as those from CPIC and resources like PharmGKB facilitate genotype-based prescribing. Organisations like the FDA promote genetic testing before initiating certain medications. Preventive pharmacogenetic panels seems promising, but further research on biomarkers and diverse populations is needed.

**Aim and Objectives** This review examines recent evidence on the genotype-drug response relationship and its application in clinical practice.

**Material and Methods** A systematic search was conducted on PubMed to identify articles investigating the genotype-drug response relationship. The search strategy included terms such as ‘pharmacogenetics,’ ‘personalised treatment,’ ‘precision medicine,’ ‘dose adjustment,’ ‘individualised dosing,’ ‘clinical routine,’ and ‘clinical practice.’ Studies such as clinical trials, observational studies, and meta-analyses were included. The

initial search yielded a total of 136 articles published between 2013 and 2023 for analysis.

**Results** 49 articles were included for the final analysis. The characteristics of the articles are explained in table 1.

A relationship between genetic polymorphisms and drug response or toxicity was found for drugs such as opioids, GLP-1 agonists, tacrolimus, oral anticoagulants, oral antineoplastics, atypical antipsychotics, efavirenz, clopidogrel, lamotrigine, anti-TNF $\alpha$  agents, voriconazole, SSRIs, or statins, among others. However, for drugs like metformin, quetiapine, irinotecan, bisoprolol, and anti-VEGF agents, no statistically significant association between genotype and response was found.

**Conclusion and Relevance** The studies analysed in this review suggest a strong correlation between genetic variability and individual drug responses, supporting the use of pharmacogenetics for treatment optimisation. However, for certain drugs like metformin, quetiapine, etc., the influence of genotype on their response remains unclear. More studies with larger sample sizes, greater ethnic diversity, and consideration of non-genetic factors are needed. Lack of standardisation in analysis methods and accessibility to genetic testing are significant challenges in this field. In summary, pharmacogenetics shows immense potential in personalised medicine, but further research is required.

REFERENCES AND/OR ACKNOWLEDGEMENTS

Conflict of Interest No conflict of interest.

Abstract 4CPS-055 Table 1

Table 1. Characteristics of studies							
Study	Drug prescribed	Genotype(s) used	Primary outcome result	Study	Drug prescribed	Genotype(s) used	Primary outcome result
Abdelhady et al.	Efavirenz	CYP2B6*6*6	↑ QICF interval in *6/*6 carriers. CYP2B6*6*6 ↑ EFV exposure.	Lee et al. (2018)	Clopidogrel	CYP2C19	Risk for adverse CV events was ↑ in LOF carriers.
Casajus et al.	Azathioprine	TPMT NUOT15	NUOT15 PMu/IMs ↑ risk of leukopenia.	Lee et al. (2021)	Clopidogrel	CYP2C19	PMu/IMs without *17 ↑ risk of major atherosclerotic events.
Castaflo-Amores et al.	Bisoprolol	ADRB1	ADRB1 Arg389Gly affect response to bisoprolol. Not confirmed with meta-analysis.	Limphiphuvadh et al.	Gemcitabine	ABCG2 SLC29A3	ABCG2 Q141K CA/MA ↑ PFS and toxicity vs. CC. SLC29A3 S158F C/T/T ↑ OS vs. CC.
Cavallari et al. (2018)	Clopidogrel	CYP2C19	↑ risk for adverse CV events in CYP2C19 IMu/PMs.	Linares et al.	Oxycodone	CYP2D6	Oxycodone concentrations: PM > EM > UM.
Cavallari et al. (2022)	Opioids	CYP2D6	CYP2D6 PMu/IMs may attain no relief from some opioids.	Lu et al.	Antipsychotics	CYP2D6	UMs and PMs are at increased risk for tardive dyskinesia.
Danese et al.	Coumarins	CYP4F2*3	CYP4F2 T allele variation needed ↑ coumarin doses	Maagdenberg et al.	Acenocouma	VKORC1 CYP2C9 CYP4F2	VKORC1, CYP2C9*2/CYP2C9*3 and CYP3A4*22 ↓ stable dose.
Dapia et al.	Voriconazole	CYP2C19 POR CYP2C9	Contribution to interindividual variability of voriconazole AUC. CYP2C19>POR>CYP2C9.	Mirozhnichenko et al.	Olanzapine	CYP2D6 CYP1A2	Differences were found in olanzapine concentrations in CYP2D6 PMs (G/A) and EMs (G/G).
Devil et al.	Cannabidiol	AOK1 SLC15A1	↑ response: AOK1 rs6729738 CC. ↓ response: SLC15A1 rs1339067 TT	Neary et al. (2017)	Efavirenz	CYP2B6	CYP2B6 S166>T TT ↑ EFV concentration than GG.
Dawed et al.	GLP-1 agonist	ARRB1 GLP1R	GLP1R Gly168Ser and ARRB1 Thr370Met ↓ HbA1c after treatment with GLP-1 agonist.	Neary et al. (2019)	Efavirenz	CYP2B6	Efavirenz concentration ↑ in CYP2B6 983 T>C CT vs. TT.
Degortler et al.	Statins	SLCO1B1 ABCG2	Rosuvastatin concentration ↑ in SLCO1B1 c.521C and ABCG2 c.421A. Atorvastatin concentrations ↑ with SLCO1B1 c.521C, ↓ with SLCO1B1 c.388G.	Ovejero-Benito et al. (2017)	Etanercept	HLA-B MAP3K1 PTTG1	PTTG1 rs2431697 C, HLA-B/MICA rs13437088 T ↑ non-responders. MAP3K1 rs96844 C ↑ responders.
Dias et al.	Irinotecan	UGT1A1*28	Difference in OS, PFS between UGT1A1*28 genotypes was not statistically significant.	Ovejero-Benito et al. (2018)	Infliximab Adalimumab	IL-12B NFKBIA	IL-12B rs2546890 A ↑ response.
Diaz-Villamarin et al.	Anti-VEGF	ARMS2 A695	No statistically significant association between efficacy and ARMS2 A695.	Packiasabapathy et al.	Methodone	CYP2B6	CYP2B6 PMs ↓ metabolism vs. NMs. rs4803419 TT ↓ pain scores vs. CC.
Dujic et al.	Metformin	SLC22A1 SLC47A1	None of the variants were significantly associated with response.	Peña et al.	Imatinib	CYP2B6 CYP3A4	CYP2B6 GS16T ↓ imatinib concentration and t1/2. ↓ adverse effects in CYP3A4 *22/*22, *1/*20 and *1/*22 vs. *1/*1.
Ebid et al.	Tacrolimus	CYP3A4 CYP3A5	Tacrolimus levels ↑ in CYP3A4*22 and CYP3A5*3 than in CYP3A4*1 and CYP3A5*1.	Postmus et al.	Pravastatin	OO2A DNAC5B	Not significant associations between SNPs and CV event reduction by pravastatin.
El Rouby et al.	Warfarin	VKORC1 CYP2C9	CYP2C9 rs4085116 T ↓ weekly warfarin dose vs. CC.	Rusman et al.	Clopidogrel	CYP2C19	CYP2C19 IMu/PMs associated with ↓ risk of thrombotic events.
Gassó et al.	Fluoxetine	TPH2	rs11179002, rs60032326 and rs34517220, associated with ↑ clinical improvement.	Saiz-Rodríguez et al.	Clopidogrel	CYP2C19 ABCB1	CYP2C19 IMu/PMs ↑ aggregation value. ABCB1 C3435T, C1236T and G2677T/A variants had ↓.
Gullat et al.	Apixaban	ABCG2	ABCG2 c.421C > A predictor of ↑ apixaban concentration.	Shilbeyeh et al.	Quetiapine	CYP3A5 ABCB1	CYP3A5 *1/*1 ↑ clearance vs. *1/*3 y *3/*3.
Guo et al.	Warfarin	CYP2C9 VKORC1	CYP4F2*3 associated with ↑ warfarin dose requirements.	Soo et al.	Capecitabine	TSER	TSER (TYMS enhancer region) 3R/3R ↑ tolerance to capecitabine.
Haas et al. (2020)	Efavirenz	CYP2B6	CYP2B6 PMs associated with ↑ plasma efavirenz.	Talamonti et al.	Ustekinumab	HLA-C*6 b	HLA-C*06 associated with ↑ and faster response.
Haas et al. (2021)	Rifapentine Efavirenz	NAT2 CYP2B6	NAT2 PMs ↑ rifapentine concentrations. CYP2B6 PMs ↑ efavirenz concentration.	Tejpar et al.	Irinotecan	UGT1A1	UGT1A1*28 7/7 ↑ grade III-IV irinotecan-induced neutropenia.
Ham et al.	Benzodiazepines	CYP2C9*2/*3	CYP2C9 *2 or *3 ↑ fall risk and non-carriers did not.	Thekan et al.	NSAIDs	CYP2C9	CYP2C9 IMu/PMs ↑ NSAID exposure and risk of adverse effects.
Kato et al.	Fluvoxamine	S-HTTLPR FGF2	S-HTTLPR LA/S' and FGF2 rs1449683C/T associated with HAM-D change.	Thomas et al.	Metoprolol	CYP2D6	CYP2D6 AS>1 ↑ CI vs. AS 0. AS 0 HR reduction with AS 1 vs. AS 2-2.25.
Kim et al.	Sunitinib	ABCG2	ABCG2 421 AA associated with toxicity (thrombocytopenia, neutropenia, and HFS).	Wang et al.	Azathioprine	TPMT NUOT15	IMs of TPMT have increased risk of azathioprine-induced leukopenia compared with NMs.
Klarica et al.	Lamotrigine	ABCG2 421C>A	ABCG2 421C>A ↓ troughs of lamotrigine vs. wild-type.	Xia et al.	Warfarin	CYP2C9*3 VKORC1	VKORC1-1639G > A affect the most the initial dose of warfarin. The required stable dose ↑ in GG.
Zhao et al.	Tacrolimus	CYP3A5	Tacrolimus CI ↑ in CYP3A5*1 vs.				