

Accession ID:	XXXXX
Sample Type:	Blood
Patient's Name:	XXXXX
Gender/Age:	Female



Medical history / Current Medications:

Current Patient Medications

Clopidogrel:

The personalized pharmacogenomics profile of this patient reveals extensive CYP2C19-mediated metabolism, and extensive ABCB1-mediated function. For further details, please find supporting evidence in this report or on websites such as www.pharmgkb.org or www.fda.gov.

Examples of different levels of evidence for PGx SNPs

Gene	Marker	Level of Evidence	Drugs
TPMT	rs1142345	1A	Azathioprine, Mercaptopurine, Thioguanine
DYPD	rs3918290	1A	Fluorouracil, Capecitabine, Tegafur, Pyrimidine analogues
CYP2D6	rs16947	1A	Amitriptyline, Codeine, Nortriptyline, Paroxetine
VKORC1	rs9923231	1A	Warfarin
SLCO1B1	rs4149056	1A	Simvastatin
CYP2D6	rs16947	1B	Tramadol
VKORC1	rs9923231	1B	Acenocoumarol
UGT1A1	rs8175347	2A	Irinotecan
NAT2	rs1801280	2A	Isoniazid
CYP2D6	rs16947	2A	Flecainide, Doxepin, Desipramine, Atomoxetine, Risperidone, Clomipramine, Imipramine, Venlafaxine
SLCO1B1	rs4149056	2A	Cerivastatin, Pravastatin, Rosuvastatin
ABCB1	rs1045642	2A	Digoxin, Nevirapine, Methotrexate
UGT1A8	rs1042597	3	Cyclosporine, Mycophenolate mofetil, Sirolimus, Tacrolimus
UGT1A1	rs8175347	3	Raloxifene
SULT1A1	rs9282861	3	Conjugated estrogens
ADH1B	rs1229984	3	Ethanol
CYP2D6	rs16947	3	Timolol, Carvedilol, Haloperidol, Aripiprazole, Metoprolol, Citalopram, Escitalopram, Tamoxifen
VKORC1	rs9923231	3	Phenprocoumon
SLCO1B1	rs4149056	3	Repaglinide, Irinotecan, Mycophenolate mofetil, Atorvastatin, Methotrexate, Olmesartan
ABCB1	rs1045642	3	Paclitaxel, Phenytoin, Fluorouracil, Dicloxacillin, Capecitabine, Nortriptyline, Oxaliplatin, Verapamil, Fexofenadine, Atorvastatin, Simvastatin, Sirolimus, Talinolol, Tamoxifen, Morphine, Efavirenz, Vincristine, Imatinib, Olanzapine, Risperidone, Cyclosporine, Tacrolimus, Atazanavir, Phenobarbital, Codeine, Clopidogrel, Etoposide, Oxaliplatin
CYP2D6	rs16947	4	Methylphenidate, Bufluralol
SLCO1B1	rs4149056	4	Lopinavir, Atrazantin
ABCB1	rs1045642	4	Carbamazepine

Level 1A Annotation for a variant-drug combination in a CPIC or medical society-endorsed PGx guideline, or implemented at a PGRN site or in another major health system.

Level 1B Annotation for a variant-drug combination where the preponderance of evidence shows an association. The association must be replicated in more than one cohort with significant p-values, and preferably will have a strong effect size.

Level 2A Annotation for a variant-drug combination that qualifies for level 2A where the variant is within a VIP (Very Important Pharmacogene) as defined by PharmGKB. The variants in level 2A are in known pharmacogenes, so functional significance is more likely.

Level 2B Annotation for a variant-drug combination with moderate evidence of an association. The association must be replicated but there may be some studies that do not show statistical significance, and/or the effect size may be small.

Level 3 Annotation for a variant-drug combination based on a single significant (not yet replicated) or annotation for a variant-drug combination evaluated in multiple studies but lacking clear evidence of an association.

Level 4 Annotation based on a case report, non-significant study or in vitro, molecular or functional assay evidence only.

GENOTYPE/HAPLOTYPE/PHENOTYPE DETAIL

Gene	Genotype-Haplotype	Phenotype
CYP1A1	*1/*1	Extensive metabolizer
CYP1A2	*1A/*1A	Extensive metabolizer
CYP2A6	*1A/*1A	Extensive metabolizer
CYP2B6	Del/Dup or *1/*1	Extensive metabolizer
CYP2C8	*1/*1	Extensive metabolizer
CYP2C9	*1/*1	Extensive metabolizer
CYP2C19	*1A/*1A	Extensive metabolizer
CYP2D6	*1/*1	Extensive metabolizer
CYP2E1	*1/*1	Extensive metabolizer
CYP2J2	*1/*1	Extensive metabolizer
CYP3A4	*1A/*1A	Extensive metabolizer
CYP3A5	*1A/*1A	Extensive metabolizer
CYP4F2	*1/*1	Extensive metabolizer
VKORC1	H1/H1	Sensitive to Warfarin
SLC15A2	*1/*1	Extensive function
SLC22A1	*1/*1	Extensive function
SLC22A2	*1/*1	Extensive function
SLC22A6	*1/*1	Extensive function
SLCO1B1	*1A/*1A	Extensive function
SLCO1B3	*1/*1	Extensive function
SLCO2B1	*1/*1	Extensive function
ABCB1	*1/*1	Extensive function
ABCC2	*1/*1	Extensive function
ABCG2	*1/*1	Extensive function
ADH1B	*1/*1	Extensive metabolizer
SULT1A1	Del/Dup or *1/*1	Extensive metabolizer
EPHX1	*1/*1	Extensive metabolizer
NAT1	*1/*1	Extensive acetylator
NAT2	*4/*4	Ultrarapid acetylator
TPMT	*1/*1	Extensive metabolizer
GSTM1	*1/*1 or Del/Dup	Extensive metabolizer
GSTP1	*1A/*1A	Extensive metabolizer
GSTM1	Del/Dup or *1/*1	Extensive metabolizer
GSTM2b	Del/Dup or *1/*1	Extensive metabolizer
BCHE	*1/*1	Extensive function
UGT1A1	*1/*1	Extensive metabolizer
UGT1A3	*1/*1	Extensive metabolizer
UGT1A4	*1/*1	Extensive metabolizer
UGT1A6	*1/*1	Extensive metabolizer
UGT1A8	*1/*1	Extensive metabolizer
UGT1A9	*1/*1	Extensive metabolizer
UGT2B7	*1a/*1a	Extensive metabolizer
UGT2B15	*1/*1	Extensive metabolizer
UGT2B17	Del/Dup or *1/*1	Extensive metabolizer
DPYD	*1/*1	Extensive metabolizer
OPRM1	*1/*1	Sensitive to Opioids
NUDT15	*1/*1	Thiopurines resistance
APOE	*3/*3	
G6PD	B/B	

Disclaimer: No patient should evaluate or use the information contained herein without the advice, consultation and supervision of a licensed healthcare professional such as a pharmacist or physician. Laboratory-developed testing characteristics and protocols. Results have not been reviewed or approved by the U.S. Food & Drug Administration (FDA).

Methodology: Array based assays detect listed alleles, including all common and most rare variants with known clinical significance at analytical sensitivity and specificity >99%. Array based assays detect listed alleles, including all common and most rare variants with known clinical significance at analytical sensitivity and specificity >99%.

Limitations: Testing cannot detect all genetic mutations, inactive or altered genes. The absence of a finding of a detectable gene, polymorphism or mutation does not necessarily indicate patient possesses intermediate or high sensitivity phenotypes or that patient has an undetected polymorphism. Absence of finding may be due to drug-drug interaction.

PHARMACOGENOMICS

Genetic Markers Tested for Pharmacogenomics:

Results are arranged by drug response. Each individual report contains six sections, including: Patient's current medication (if any), Medication history, genotype/haplotype/phenotype detail, PGx report, Genomic Test Results, and Patient Information Card. Inclusion of the PGx Report indicates that the tested individual: displays decreased efficacy to the drug (light green dots), should use the drug as directed (green dots), or exhibits increased toxicity to the drug (red dots). Inclusion of Genomic Test Results indicates genotype, haplotype, phenotype, or presence of mutation.

Organization of Table:

1. Gene/Locus refers to gene or intergenic region of genetic marker location.
2. Marker refers to the tested marker's unique identifier.
3. Genotype/Haplotype refers to the particular marker's combination of nucleotides. The letter(s) on either side of the slash refer(s) to the two (2) copies of the patient DNA. Del and dashes denotes nucleotide indels in patient DNA. Empty cells indicate an absence of genotyping results.
4. Phenotype refers to the CYP specific drug metabolizing capabilities of an individual.

see risks and limitations on the last pages of this report

PGx Report - Pain Management

Type: Anti-inflammatory Agent, Analgesic, Antipyretic

Drug Class	Generic	Primary Mechanism Involved	Other Mechanisms Involved	May Have Decreased Efficacy	Used As Directed	May Have Increased Toxicity
The Nonsteroidal Antiinflammatory Drugs (NSAIDs)						
Acetic acid derivatives	Diclofenac	UGT2B7	CYP2C9, UGT1A3, UGT1A9, CYP2E1, CYP3A4		●	
	Nabumetone	CYP1A2	CYP2C19, CYP3A4		●	
	Indomethacin	CYP2C9	CYP2C19		●	
Enolic acid (Oxicam) derivatives	Meloxicam	CYP2C9	CYP1A2, CYP3A4, CYP3A5		●	
	Piroxicam	CYP2C9	CYP3A4, CYP3A5		●	
	Tenoxicam	CYP2C9			●	
	Lornoxicam	CYP2C9			●	
Selective COX-2 inhibitors (Coxibs)	Etoricoxib	CYP3A4	CYP3A5, CYP2C9, CYP2D6, CYP1A2		●	
	Parecoxib	CYP2C9	CYP3A4, CYP3A5		●	
	Celecoxib	CYP2C9	CYP2C19		●	
Propionic acid derivatives	Ibuprofen	CYP2C9	CYP2C19, CYP2C8, UGT1A3, UGT1A9, UGT2B7		●	
	Flurbiprofen	CYP2C9			●	
	Ketoprofen	CYP3A4	CYP2C9, CYP3A5, UGT1A6, UGT1A9, UGT2B7		●	
	Fenoprofen	CYP2C9	UGT2B7		●	
	<u>Vicoprofen</u>	CYP2D6	CYP3A4		●	
Anthranilic acid derivatives (Fenamates)	Naproxen	CYP2C9	CYP1A2, CYP2C8, UGT2B7, SULT1A1, UGT1A3, UGT1A6, UGT1A9		●	
	Mefenamic acid	CYP2C9			●	
The Non-NSAIDs Analgesic	Acetaminophen	UGT1A1, UGT1A6, UGT1A9, SULT1A1, GSHs	CYP2E1, CYP3A4, CYP3A5, CYP2D6, CYP1A2, ABCG2		●	

PGx Report - Pain Management

Type: Opioid

Drug Class	Generic	Primary Mechanism Involved	Other Mechanisms Involved	May Have Decreased Efficacy	Used As Directed	May Have Increased Toxicity
Opioid Analgesics						
Opium alkaloids	Morphine	UGT2B7	ABCB1, ABCC3, UGT1A1, UGT1A8, OPRM1, COMT		●	
	Codeine	CYP2D6	CYP3A4, UGT2B7, UGT2B4, FMO3, CYP3A5, OPRM1		●	
Esters of morphine	DiAcetylmorphine (Heroin)	CES1	CES2, BCHE, OPRM1		●	
Ethers of morphine	Dihydrocodeine	CYP3A4	CYP2D6, CYP3A5		●	
	Ethylmorphine	CYP2D6	CYP3A4, CYP3A5		●	
Semi-synthetic alkaloid derivatives	Hydrocodone	CYP2D6	CYP3A4, CYP3A5, OPRM1		●	
	Hydromorphone	UGT2B7			●	
	Oxycodone	CYP3A4	CYP3A5, CYP2D6, ABCB1, UGT2B7, COMT		●	
	Oxymorphone	UGT2B7			●	
Synthetic opioids						
Anilidopiperidine derivatives	Alfentanyl	CYP3A4	CYP3A5, ABCB1, OPRM1		●	
	Fentanyl	CYP3A4	CYP3A5, ABCB1, OPRM1		●	
	Sufentanil	CYP3A4	CYP3A5, OPRM1		●	
Phenylpiperidine derivatives	Meperidine	CYP2B6	CYP3A4, CYP2C19, CYP3A5, UGT1A4		●	
	Ketobemidone	CYP2C9	CYP3A4, CYP3A5		●	
Diphenylpropylamine derivatives	Dextropropoxyphene	CYP3A4	CYP3A5, Renal Excretion		●	
	Levacetylmethadol	CYP3A4	CYP3A5		●	
	Loperamide	CYP3A4	CYP2C8, CYP3A5		●	
	Methadone	CYP3A4	CYP2B6, CYP2D6, CYP3A5, ABCB1, UGT2B7, COMT		●	
Oripavine derivatives	Buprenorphine	CYP3A4	CYP3A5, CYP2C8, UGT1A1, UGT1A3, UGT2B7		●	
Morphinan derivatives	Dextromethorphan	CYP2D6	CYP3A4, CYP3A5		●	
Others	Tramadol	CYP2D6	CYP3A4, CYP2B6, CYP3A5, OPRM1, SLC22A1, COMT		●	
	Tapentadol	CYP2C9	CYP2C19, CYP2D6		●	
	<u>Tilidine</u>	CYP3A4	CYP2C19, CYP3A5		●	
Anti-opioid	Methylnaltrexone	CYP2D6	CYP3A4, CYP3A5		●	
	Naloxone	UGT2B7	UGT1A3		●	
	Naltrexone	UGT2B7	UGT1A1, UGT1A3, OPRM1		●	

PGx Report - Pain Management

Type: Drugs Prescribed for the Treatment of Gout, Antirheumatic

Drug Class	Generic	Primary Mechanism Involved	Other Mechanisms Involved	May Have Decreased Efficacy	Used As Directed	May Have Increased Toxicity
Drugs Prescribed for Gout						
Uricosurics	Sulfinpyrazone	CYP2C9	CYP3A4, CYP3A5		✓	
Mitotic inhibitors	Colchicine	CYP3A4	CYP3A5		✓	
Xanthine oxidase inhibitors	Febuxostat	CYP1A2, CYP2C8	CYP2C9, UGT1A1, UGT1A3, UGT1A9, UGT2B7		✓	
	Allopurinol	AOX1	Renal Excretion, HLA-B*5801		✓	
	Oxypurinol	Renal Excretion			✓	
Recombinant urate oxidase	Rasburicase		G6PD, CYB5R1, CYB5R2, CYB5R3, CYB5R4		✓	
DMARDs	Leflunomide	CYP1A2			✓	
Anti-inflammatory	Tofacitinib	CYP3A4	CYP2C19, CYP3A5		✓	

Abbreviations: DMARDs, Disease-modifying antirheumatic drugs; RE, renal excretion (unchanged drug).

Additional SNPs of Importance for Pain Management

Gene	Marker	Genotype	Drug	Level of Evidence	Results
OPRM1	rs1799971	A/A	Naloxone	2B	Patients may have lower cortisol response
OPRM1	rs1799971	A/A	Morphine	2B	Pain patients may experience increased efficacy of opioids and may be less susceptible to opioid addiction, and may require a decreased dose of opioids
OPRM1	rs1799971	A/A	Alfentanil	2B	Pain patients may experience increased efficacy of opioids and may be less susceptible to opioid addiction, and may require a decreased dose of opioids
OPRM1	rs1799971	A/A	Fentanyl	2B	Pain patients may experience increased efficacy of opioids and may be less susceptible to opioid addiction, and may require a decreased dose of opioids
OPRM1	rs1799971	A/A	Tramadol	2B	Pain patients may experience increased efficacy of opioids and may be less susceptible to opioid addiction, and may require a decreased dose of opioids
OPRM1	rs1799971	A/A	Hydrocodone	3	Patients may have a decreased risk for experiencing side effects, including constipation, dry mouth or respiratory depression
COMT	rs4680	G/G	Paroxetine	3	Patients may require a higher dose

PGx Report - Modulation of Cardiovascular Function

Type: Antiarrhythmic

Drug Class	Generic	Primary Mechanism Involved	Other Mechanisms Involved	May Have Decreased Efficacy	Used As Directed	May Have Increased Toxicity
Antiarrhythmic class Ia	Quinidine	CYP3A4, CYP2D6	CYP2E1, CYP3A5, CYP2C9, CYP2C8		✓	
	Procainamide	CYP2D6	NAT2		✓	
	Sparteine	CYP2D6			✓	
	Disopyramide	CYP3A4	CYP3A5, CYP1A2, CYP2C19		✓	
Antiarrhythmic class Ib	Phenytoin	CYP2C19	CYP2C9, CYP3A4, CYP3A5, CYP2D6, ABCB1, EPHX1, HLA-B*1502		✓	
	<u>Tocainide</u>	UGTs			✓	
	Lidocaine	CYP1A2	CYP3A4, CYP3A5		✓	
Antiarrhythmic class Ic	Mexiletine	CYP2D6	CYP1A2		✓	
	Propafenone	CYP2D6	CYP3A4, CYP1A2, CYP3A5		✓	
	Flecainide	CYP2D6			✓	
Antiarrhythmic class II	Encainide	CYP2D6			✓	
	Carvediol	CYP2D6	UGT1A1, UGT2B4, CYP2C9		✓	
	Bisoprolol	CYP2D6	CYP3A4, CYP3A5		✓	
	Metoprolol	CYP2D6	CYP3A4, CYP3A5		✓	
Antiarrhythmic class III	Propranolol	CYP2D6	CYP1A2, CYP2C19, CYP3A4, CYP3A5, UGT1A9		✓	
	Amiodarone	CYP3A4	CYP2C8, CYP3A5		✓	
	Dronedarone	CYP3A4	CYP3A5		✓	
Antiarrhythmic class IV	Dofetilide	Renal Excretion	CYP3A4, CYP3A5		✓	
	Diltiazem	CYP3A4	CYP2C19, CYP3A5		✓	
	Verapamil	CYP3A4	CYP2C8, CYP3A5, ABCB1		✓	

PGx Report - Modulation of Cardiovascular Function

Type: Antihypertensive I

Drug Class	Generic	Primary Mechanism Involved	Other Mechanisms Involved	May Have Decreased Efficacy	Used As Directed	May Have Increased Toxicity
Antihypertensives						
Angiotensin II receptor antagonist	Losartan	CYP2C9	CYP3A4, CYP3A5, UGT1A1, UGT1A3			
	Azilsartan	CYP2C9				
	Irbesartan	CYP2C9				
	Telmisartan	Biliary Excretion	UGT1A1			
	Olmesartan	Hydrolysis	Renal Excretion, SLCO1B1			
	Valsartan	CYP2C9				
Angiotensin-Converting Enzyme Inhibitors	Captopril	Renal Excretion	CYP2D6			
	Enalapril	CES1, Renal Excretion	CYP3A4, CYP3A5			
	Trandolapril	CES1	CYP2D6, CYP2C9, Renal Excretion			
Renin inhibitors	A lisuren	CYP3A4	CYP3A5, ABCB1			
Aldosterone Antagonists	Eplerenone	CYP3A4	CYP3A5			
Loop diuretic	Torasemide	CYP2C9	CYP2C8, Renal Excretion			
	Furosemide	Renal Excretion	UGT1A9, UGT1A10			
Potassium-sparing diuretic	Triamterene	CYP1A2				
Vasopressin receptor antagonists	Tolvaptan	CYP3A4	CYP3A5			
Adrenergic release inhibitors	Debrisoquine	CYP2D6				
Peripheral Adrenergic Inhibitors	Reserpine	CYP2D6				
Beta-1 cardioselective beta-blockers	Metoprolol	CYP2D6	CYP3A4, CYP3A5			
	Bisoprolol	CYP2D6	CYP3A4, CYP3A5			
	Nebivolol	CYP2D6				

PGx Report - Modulation of Cardiovascular Function

Type: Antihypertensive II

Drug Class	Generic	Primary Mechanism Involved	Other Mechanisms Involved	May Have Decreased Efficacy	Used As Directed	May Have Increased Toxicity
Antihypertensives						
Nonselective beta-blockers	Timolol	CYP2D6				
	Propranolol	CYP2D6	CYP1A2, CYP2C19, CYP3A4, CYP3A5, UGT1A9			
Beta-blockers with alpha activity	Carvedilol	CYP2D6	UGT1A1, UGT2B4, CYP2C9			
	Labetalol	CYP2D6	CYP2C19, ABCB1, UGT1A1, UGT1A9, UGT2B7			
Alpha blockers	Terazosin	CYP3A4	CYP3A5			
	Doxazosin	CYP2D6	CYP2C19, CYP3A4, CYP3A5			
α-2 adrenergic agonist	Clonidine	CYP2D6	CYP1A2, CYP3A4, CYP3A5			
	Tizanidine	CYP1A2				
Antihypertensives Calcium channel blockers						
Dihydropyridine	Amlodipine	CYP3A4	CYP3A5			
	Nifedipine	CYP3A4	CYP1A2, CYP2A6, CYP3A5			
	Nimodipine	CYP3A4	CYP3A5			
	Nicardipine	CYP2C8	CYP2D6, CYP3A4, CYP3A5			
Benzothiazepine	Diltiazem	CYP3A4	CYP2C19, CYP3A5			
Phenylalkylamine	Verapamil	CYP3A4	CYP2C8, CYP3A5, ABCB1			
Nonselective	Bepridil	CYP3A4	CYP3A5			
Anti-pulmonary arterial hypertension						
ERA-Dual antagonists	Bosentan	CYP2C9	CYP3A4, CYP3A5, SLCO1B3			
	Macitentan	CYP3A4	CYP2C19, CYP3A5			
Phosphodiesterase inhibitors	Sildenafil	CYP3A4	CYP2C9, CYP3A5			
	Tadalafil	CYP3A4	CYP3A5			

Abbreviations: ERA, endothelin receptor antagonist.

PGx Report - Modulation of Cardiovascular Function

Type: Cardiac stimulant, Vasodilator, Drugs Prescribed for the Treatment of Angina

Drug Class	Generic	Primary Mechanism Involved	Other Mechanisms Involved	May Have Decreased Efficacy	Used As Directed	May Have Increased Toxicity
Cardiac stimulants						
Digitalis glycosides	Digoxin	Renal Excretion	ABCB1, SLCO1B3, ABCB4		●	
	Epinephrine	MAO	COMT		●	
	Phenylephrine	MAO	SULTs, UGTs		●	
	Dopamine	ALDH1A1, ALDH2	DBH, MAOA, MAOB, SULT1A3, SULT1A4, COMT		●	
	Synephrine	MAO			●	
Vasodilators used in cardiac diseases						
Organic nitrates	Isosorbide dinitrate	NAT2	NAT1	●●		
Other Vasodilators	Hydralazine	NAT2	NAT1, CYP1A2, CYP3A4, CYP3A5	●●		
Other Drugs Used in Angina						
Other cardiac preparations	Ranolazine	CYP3A4	CYP2D6, CYP3A5		●	
	Ivabradine	CYP3A4	CYP3A5		●	

PGx Report - Modulation of Cardiovascular Function

Type: Dyslipidemia

Drug Class	Generic	Primary Mechanism Involved	Other Mechanisms Involved	May Have Decreased Efficacy	Used As Directed	May Have Increased Toxicity
Drug Therapy for Hypercholesterolemia and Dyslipidemia (Liver)						
	Atorvastatin	CYP3A4, HMGCR	HMGCR, ABCG2, CYP3A5, ABCB1, ABCG8, UGT1A1, UGT1A3, UGT2B7, KIF6		●	
	Fluvastatin	CYP2C9, SLCO1B1	HMGCR, ABCG2, CYP3A4, CYP2C8, UGT1A1, UGT1A3, UGT2B7		●	
	Lovastatin	CYP3A4, SLCO1B1	CYP3A5, HMGCR, UGT1A1, UGT1A3		●	
	Cerivastatin	CYP3A4, SLCO1B1	HMGCR, CYP2C8, CYP3A5		●	
	Pitavastatin	UGT1A3, UGT2B7	CYP2C9, CYP2C8, ABCB1, HMGCR		●	
	Pravastatin	SLCO1B1, HMGCR	KIF6, APOE, ABCA1		●	
	Simvastatin	CYP3A4, SLCO1B1	ABCG2, HMGCR, CYP3A5, ABCB1, SLCO2B1, UGT1A1, UGT1A3, UGT2B7, KIF6		●	
	Rosuvastatin	UGT1A1	UGT1A3, ABCG2, HMGCR		●	
MTTP inhibitors	Lomitapide	CYP3A4	CYP3A5, LDLR		●	
Drug Therapy for Hypercholesterolemia and Dyslipidemia (GI)						
Cholesterol absorption inhibitors	Ezetimibe	UGT1A1	UGT1A3, UGT2B15		●	
Drug Therapy for Hypercholesterolemia and Dyslipidemia (Blood vessels)						
	Gemfibrozil	CYP3A4	CYP3A5, UGT2B7, UGT1A1, UGT1A3, UGT1A9, UGT2B15		●	
Fibrates	Clofibrate	UGT2B7			●	
	Fenofibrate	UGT1A9	UGT2B7, PPARA, ABCA1		●	
Drug Therapy for familial hypercholesterolemia						
Cholesterol-reducing drug (antisense oligonucleotide)	Mipomersen	Nuclease, Renal Excretion	LDLR		●	

Abbreviations: MTTP, microsomal triglyceride transfer protein; GI, gastrointestinal tract. Rosuvastatin and Pravastatin are considered alternative Statins since are not extensively metabolized by the CYPs.

Additional SNPs of Importance for Treatment Using Statins

Gene	Marker	Genotype	Drug	Level of Evidence	Results
HMGCR	rs17244841	A/A	Fluvastatin	2A	Adequate response to Statin treatment
HMGCR	rs17244841	A/A	Pravastatin	2A	Adequate response to Statin treatment
HMGCR	rs17244841	A/A	Simvastatin	2A	Adequate response to Statin treatment
HMGCR	rs17238540	T/T	Pravastatin	3	Adequate response to Statin treatment
HMGCR	rs17238540	T/T	Simvastatin	3	Adequate response to Statin treatment
HMGCR	rs17238540	T/T	Atorvastatin	3	Adequate response to Statin treatment
HMGCR	rs17238540	T/T	Fluvastatin	3	Adequate response to Statin treatment
HMGCR	rs17238540	T/T	Lovastatin	3	Adequate response to Statin treatment
HMGCR	rs3846662	A/A	Simvastatin	4	Adequate response to Statin treatment
KIF6	rs20455	T/T	Atorvastatin	3	Decreased risk for adverse cardiovascular events
KIF6	rs20455	T/T	Pravastatin	3	Decreased risk for adverse cardiovascular events
APOE	rs7412	C/C	Atorvastatin	2A	Less responsive to Statin treatment
APOE	rs7412	C/C	Pravastatin	3	Less responsive to Statin treatment
APOE	rs7412	C/C	Simvastatin	3	Less responsive to Statin treatment
ABCA1	rs12003906	C/C	Atorvastatin	3	Less responsive to Statin treatment
ABCA1	rs12003906	C/C	Pravastatin	3	Less responsive to Statin treatment
ABCA1	rs12003906	C/C	Simvastatin	3	Less responsive to Statin treatment
LEPR	rs1137101	A/A	Simvastatin	3	Patients with coronary heart disease may have a reduced response to treatment
CETP	rs5882	G/G	Simvastatin	3	Less responsive to Statin treatment
ITGB3	rs5918	T/T	Clopidogrel	3	Patients may have an increased antiplatelet effect to a 300 or 600 mg loading dose of Clopidogrel

PGx Report - Modulation of Cardiovascular Function

Type: Anticoagulant, Antiplatelet

Drug Class	Generic	Primary Mechanism Involved	Other Mechanisms Involved	May Have Decreased Efficacy	Used As Directed	May Have Increased Toxicity
Blood Coagulation and Anticoagulant, and Antiplatelet Drugs						
Vitamin K antagonist	Warfarin	CYP2C9, VKORC1	CYP4F2, CYP2C19, CYP1A2, CYP3A4, EPHX1, PROC, PROS1			⚠️
	Acenocoumarol	CYP2C9, VKORC1	CYP4F2, CYP2C19, CYP1A2			⚠️
	Phenprocoumon	CYP2C9, VKORC1	CYP4F2, CYP3A4, CYP2C8, EPHX1			⚠️
Direct factor Xa inhibitors	Rivaroxaban	CYP3A4	CYP2J2, CYP3A5		🟢	
	Apixaban	CYP3A4	CYP3A5		🟢	
Antiplatelet Drugs						
ADP receptor (P2Y12) inhibitors Nucleotide/nucleoside analogs	Ticagrelor	CYP3A4	CYP3A5		🟢	
ADP receptor (P2Y12) inhibitors Thienopyridines	Clopidogrel	CYP2C19	ABCB1, ABCC3		🟢	
	Prasugrel	BCHE, CYP3A4	CYP2B6, CYP2C9, CYP2C19, CYP3A5, CYP2D6		🟢	
Irreversible cyclooxygenase inhibitors	Aspirin	GLYAT, UGTs, Renal Excretion	CYP2C9, CYP3A4, CYP3A5		🟢	
Phosphodiesterase inhibitors	Cilostazol	CYP3A4	CYP2C19, CYP3A5		🟢	
Protease-activated receptor-1 (PAR-1) antagonists	Vorapaxar	CYP3A4	CYP2J2, CYP3A5		🟢	

Abbreviations: P2Y12, purinergic receptor P2Y12.

SNPs of Importance for Venous Thromboembolism Risk

Gene	Protein change	Nucleotide change	Marker	Genotype	Results
F5	Arg534Gln	1601G>A	rs6025	G/G	Normal risk
F5	His1327Arg	3980A>G	rs1800595	A/A	Normal risk
F2		*97G>A	rs1799963	G/G	Normal risk
SELE	Ser128Arg	445A>C	rs5361	A/A	Normal risk
LPL	Asn291Ser	953A>G	rs268	A/A	Normal risk
ADRB2	Gln27Glu	79C>G	rs1042714	C/C	Normal risk
VKORC1		1173C>T	rs9923231	A/A	High warfarin sensitivity; low warfarin dosage
VKORC1		-1639G>A	rs9934438	T/T	High warfarin sensitivity; low warfarin dosage
MTHFR	Ala222Val	665C>T	rs1801133	C/C	Normal MTHFR enzyme function.
MTHFR	Glu429Ala	1286A>C	rs1801131	A/A	Normal MTHFR enzyme function.
MTHFR	Ala222Val	665C>T	rs1801133	C/C	Normal risk
MTHFR	Glu429Ala	1286A>C	rs1801131	A/A	Normal risk

Additional SNPs of Importance for Cardiovascular Treatment I

Gene	Marker	Genotype	Drug	Level of Evidence	Results
ADRB1	rs1801252	A/A	Atenolol, Bisoprolol, Metoprolol, Verapamil	3	Patients may 1) experience more benefit from beta blocking agents (such as atenolol) than verapamil 2) require additional heart failure medications (such as diuretics)
ADRB1	rs1801252	A/A	Timolol	3	Patients may have increased systolic (SAP) and diastolic (DAP) arterial pressure responses
ADRB1	rs1801253	G/G	Metoprolol	3	Patients may have weaker response to treatment
ADRB1	rs1801253	G/G	Verapamil	3	Patients with Atrial Fibrillation may have an increased response to treatment
ADRB1	rs1801253	G/G	Dobutamine	3	Healthy males may have smaller increases in fractional shortening and systolic blood pressure when given Dobutamine
ADRB2	rs1042713	A/A	Benazepril	3	Patients with hypertension may have a smaller decrease in diastolic blood pressure
ADRB2	rs1042714	A/A	Isoproterenol	3	Patients may have increased isoproterenol-mediated desensitization in the vasculature

Additional SNPs of Importance for Cardiovascular Treatment II

Gene	Marker	Genotype	Drug	Level of Evidence	Results
GRK4	rs1024323	C/C	Metoprolol	3	In male patients with hypertensive nephrosclerosis may have a reduced response
GRK4	rs1024323	C/C	Atenolol or Verapamil	3	Patients with hypertension and coronary artery disease may have decreased, but not absent, risk for adverse cardiovascular outcomes when treated with Atenolol or Verapamil
ACE	rs1799752	-/ATAC	Captopril	2A	Patients with conditions such as heart failure, chronic obstructive pulmonary disease and Type 2 diabetes may have an increased response
ACE	rs1799752	-/ATAC	Hydrochlorothiazide	3	Patients with essential hypertension may have a decreased reduction in blood pressure
ACE	rs1799752	-/ATAC	Enalapril	3	Patients with conditions such as heart failure, chronic obstructive pulmonary disease and Type 2 diabetes may have an increased response
ACE	rs1799752	-/ATAC	Benazepril/Perindopril	3	Patients with diabetes or hypertension may have a poorer response
ACE	rs1799752	-/ATAC	Irbesartan	3	Hypertensive patients may have a greater reduction in diastolic blood pressure
ACE	rs1799752	-/ATAC	Pravastatin	3	Patients may be less likely to benefit from treatment

PGx Report - Internal Medicine

Type: Drugs Prescribed for the Modulation of Respiratory Function

Drug Class	Generic	Primary Mechanism Involved	Other Mechanisms Involved	May Have Decreased Efficacy	Used As Directed	May Have Increased Toxicity
Respiratory						
Anticholinergic	Umeclidinium	CYP2D6				
	Aclidinium	CYP2D6	CYP3A4, CYP3A5			
Beta2-adrenergic agonist	Arformoterol	CYP2D6 .UGT1A1	CYP2C19			
	Indacaterol	UGT1A1, CYP3A4	CYP3A5, CYP1A2, CYP2D6			
	Formoterol	CYP2D6	CYP2C19, CYP2C9, CYP2A6			
	Salmeterol	CYP3A4	CYP3A5			
Corticosteroid	Vilanterol	CYP3A4	CYP3A5			
	Budesonide	CYP3A4	CYP3A5			
	Fluticasone	CYP3A4	CYP3A5			
Phosphodiesterase inhibitor	Mometasone	CYP3A4	CYP3A5			
	Roflumilast	CYP3A4	CYP1A2, CYP3A5			
	Theophylline	CYP1A2	CYP2E1			
5-lipoxygenase inhibitor	Zileuton	CYP1A2	CYP2C9, CYP3A4, CYP3A5			
Leukotriene receptor-1 antagonist	Montelukast	CYP3A4	CYP2C9, CYP3A5, SLCO2B1, ABCC1			
	Pranlukast	CYP3A4	CYP3A5			
	Zafirlukast	CYP2C9	CYP3A4, CYP3A5			
Treatment of cystic fibrosis (specifics mutations in the CFTR gene)	Ivacaftor	CYP3A4	CYP3A5, CFTR			

Abbreviations: CFTR, Cystic fibrosis transmembrane conductance regulator.

PGx Report - Internal Medicine

Type: Antiemetic

Drug Class	Generic	Primary Mechanism Involved	Other Mechanisms Involved	May Have Decreased Efficacy	Used As Directed	May Have Increased Toxicity
Antiemetic						
Antiemetic, 5-HT3 receptor antagonist Indole derivative	Dolasetron	CYP3A4	CYP2D6, CYP3A5			
	Tropisetron	CYP3A4	CYP2D6, CYP3A5			
Antiemetic, 5-HT3 receptor antagonist Isoquinoline derivative	Palonosetron	CYP1A2	CYP2D6, CYP3A4, CYP3A5			
	Granisetron	CYP3A4	CYP3A5			
Antiemetic, 5-HT3 receptor antagonist Indazole derivative	Ondansetron	CYP2B6	CYP1A2, CYP2D6, CYP3A4, ABCB1			
	Domperidone	CYP3A4	CYP3A5			
Antiemetic, dopamine-receptor antagonist	Prochlorperazine	CYP2D6	CYP3A4, CYP3A5			
	Metoclopramide	CYP2D6	CYP1A2, CYB5R1, CYB5R2, CYB5R3, CYB5R4			
	Aprepitant	CYP3A4	CYP3A5, CYP1A2, CYP2C19			
Antiemetic, H1 histamine receptor antagonist	Diphenhydramine	CYP2D6	CYP3A4, CYP3A5, UGT1A3, UGT1A4			
	Hydroxyzine	ADHs	CYP3A4, CYP3A5			
	Promethazine	CYP2D6	UGT1A3, UGT1A4, SULTs			
Cannabinoids	Dronabinol	CYP2C9	CYP2C19, CYP3A4, CYP3A5			
Benzodiazepines	Lorazepam	UGT2B15	UGT2B7			
	Midazolam	CYP3A4	CYP3A5			
Anticholinergics	Scopolamine	CYP3A4	CYP3A5			
Steroids	Dexamethasone	CYP3A4	CYP17A1, CYP3A5			

Abbreviations: 5-HT, Serotonin; NK1, neurokinin 1.

PGx Report - Internal Medicine

Type: Drugs Prescribed for the Treatment of Peptic Ulcers and/or Gastro-Esophageal Reflux Disease

Drug Class	Generic	Primary Mechanism Involved	Other Mechanisms Involved	May Have Decreased Efficacy	Used As Directed	May Have Increased Toxicity
Histamine H2-receptor antagonists	Ranitidine	Renal Excretion	CYP1A2, CYP2C19, FMO3, CYP3A4, CYP3A5		●	
Proton-pump inhibitor	Omeprazole	CYP2C19	CYP3A4, CYP2C9, CYP3A5		●	
	Dexlansoprazole	CYP2C19	CYP3A4, CYP3A5		●	
	Esomeprazole	CYP2C19	CYP3A4, CYP3A5		●	
	Lansoprazole	CYP3A4	CYP2C19, CYP3A5		●	
	Rabeprazole	Non Enz	CYP2C19, CYP3A4, CYP3A5		●	
	Ilaprazole	CYP3A4	CYP3A5		●	
	Pantoprazole	CYP2C19	CYP3A4, CYP2D6, CYP2C9, CYP3A5		●	

Abbreviations: Non Enz, non-enzymatic metabolism.

PGx Report - Internal Medicine

Type: Drugs Prescribed for the Treatment of Functional Gastrointestinal Disorders, Obesity

Drug Class	Generic	Primary Mechanism Involved	Other Mechanisms Involved	May Have Decreased Efficacy	Used As Directed	May Have Increased Toxicity
Drugs for functional gastrointestinal disorders						
Acting on serotonin receptors 5-HT3 antagonists	Alosetron	CYP2C9	CYP3A4, CYP1A2		●	
	Cilansetron	CYP3A4	CYP2D6, CYP1A2, CYP2C19, CYP3A5		●	
Gastroprolinetic						
Serotonin 5-HT ₁ receptor agonist	Cisapride	CYP3A4	CYP3A5		●	
	Cinatapride	CYP3A4	CYP2C8, CYP3A5		●	
Parasympathetic mimetic	<u>Itriptreptide</u>	FMO3			●	
Dopamine antagonists	Metoclopramide	CYP2D6	CYP1A2, CYB5R1, CYB5R2, CYB5R3, CYB5R4		●	
	<u>Clebopride</u>	CYP3A4	CYP3A5		●	
	Domperidone	CYP3A4	CYP3A5		●	
Antipropulsives						
Opioids	Loperamide	CYP3A4	CYP2C8, CYP3A5		●	
	Morphine	UGT2B7	ABCB1, ABCC3, UGT1A1, UGT1A8, OPRM1, COMT		●	
Centrally acting anti-obesity drugs						
Stimulant/ Amphetamine/ Appetite suppressant agent	Sibutramine	CYP3A4	CYP3A5		●	
	Phentermine	Renal Excretion	CYP3A4, CYP3A5		●	
Anorectic	Lorcaserin	CYP2D6	CYP3A4, CYP3A5		●	

PGx Report - Internal Medicine

Type: Diabetes

Drug Class	Generic	Primary Mechanism Involved	Other Mechanisms Involved	May Have Decreased Efficacy	Used As Directed	May Have Increased Toxicity
Antidiabetic Secretagogues						
Meglitinides	Repaglinide	CYP2C8	SLCO1B1, CYP3A4, CYP3A5, ABCC8		●	
	Nateglinide	CYP2C9	CYP3A4, CYP3A5		●	
Sulfonylurea 1st generation						
Sulfonylurea 2nd generation	Chlorpropamide	Renal Excretion	CYP2D6, G6PD		●	
	Tolazamide	CYP2C9			●	
	Tolbutamide	CYP2C9	CYP2C19, CYP2C8		●	
Glipizide						
Sulfonylurea 2nd generation	Glyburide	CYP2C9	G6PD		●	
	Gliquidone	CYP3A4	CYP2C19, CYP2C8, CYP3A5, G6PD		●	
	Gliclazide	CYP2C9	CYP2C19		●	
	Glimepiride	CYP2C9	G6PD		●	
	Saxagliptin	CYP3A4	CYP3A5		●	
DPP-IV inhibitor	Alogliptin	Renal Excretion	CYP2D6, CYP3A4, CYP3A5		●	
	Linagliptin	Renal Excretion	CYP3A4, CYP3A5		●	
	Sitagliptin	CYP3A4	CYP2C8, CYP3A5		●	
Antidiabetic Sensitizers						
Thiazolidinediones	Pioglitazone	CYP2C8	CYP3A4, CYP3A5		●	
	Rosiglitazone	CYP2C8	CYP2C9		●	
Antidiabetic Other						
SGLT2 inhibitors	Canagliflozin	UGT1A9, UGT2B4	CYP3A4, CYP3A5		●	
	Dapagliflozin	UGT1A9			●	

Abbreviations: DPP-IV, Dipeptidyl peptidase-4; SGLT2, sodium/glucose cotransporter 2 or gliflozins.

PGx Report - Internal Medicine

Type: Migraine, Antihistamine, Abortifacient, Drugs Prescribed for the Treatment of Hyperparathyroidism, Dermatology

Drug Class	Generic	Primary Mechanism Involved	Other Mechanisms Involved	May Have Decreased Efficacy	Used As Directed	May Have Increased Toxicity
Anti-migraine						
Selective serotonin (5-HT1) agonists	Almotriptan	CYP3A4	CYP2D6, CYP3A5		●	
	Eletriptan	CYP3A4	CYP3A5		●	
	Frovatriptan	CYP1A2			●	
	Naratriptan	CYP1A2	CYP2C8, CYP2C9, CYP2D6		●	
	Sumatriptan	MAO	UGTs, HTR2A		●	
	Zolmitriptan	CYP1A2			●	
Ergot alkaloids	Dihydroergotamine	CYP3A4	CYP3A5		●	
	Ergotamine	CYP3A4	CYP3A5		●	
Antihistamines						
Aminoalkyl ethers	Diphenhydramine	CYP2D6	CYP3A4, CYP3A5, UGT1A3, UGT1A4		●	
Substituted alkylamines	Chlorpheniramine	CYP3A4	CYP3A5		●	
Phenothiazine derivatives	Promethazine	CYP2D6	UGT1A3, UGT1A4, SULTs		●	
Piperazine derivatives	Hydroxyzine	ADHs	CYP3A4, CYP3A5		●	
	Cyclizine	CYP2D6			●	
	Cetirizine	Renal Excretion			●	
Other antihistamines	Terfenadine	CYP3A4	CYP3A5		●	
	Loratadine	CYP3A4, CYP2D6	CYP3A5, CYP2C8, CYP2C9		●	
	Fexofenadine	Biliary Excretion	Renal Excretion, CYP3A4, CYP3A5, SLCO2B1		●	
	Desloratadine	CYP2C8	UGT2B10		●	
	Astemizole	CYP3A4	CYP3A5		●	
Treatment of secondary hyperparathyroidism						
Calcimimetic	Cinacalcet	CYP3A4	CYP2D6, CYP3A5, CYP1A2		●	
Abortifacient						
Progestin Antagonist	Mifepristone	CYP3A4	CYP3A5		●	
Dermatology Antipsoriasis						
Retinoids	Eretretinate	CYP26A1			●	
	Acitretin	CYP26A1			●	
Dermatology Anti-acne						
Retinoid	Isotretinoin	CYP2C8	CYP2C9, CYP3A4, CYP2B6, CYP3A5		●	

Abbreviations: BE, biliary excretion.

PGx Report - Psychiatry

Type: Antidepressant I

Drug Class	Generic	Primary Mechanism Involved	Other Mechanisms Involved	May Have Decreased Efficacy	Used As Directed	May Have Increased Toxicity
Antidepressants						
SSRIs	Citalopram	CYP2C19, CYP2D6	CYP3A4, CYP3A5, SLC6A4, HTR2A		●	
	Escitalopram	CYP3A4, CYP2C19	CYP2D6, CYP3A5, SLC6A4, HTR2C		●	
	Dapoxetine	CYP2D6	CYP3A4, CYP3A5, FMO1		●	
	Fluoxetine	CYP2D6	CYP3A4, CYP2C9, CYP3A5, CYP2C19, SLC6A4, HTR2A		●	
	Paroxetine	CYP2D6	CYP3A4, CYP1A2, CYP3A5, CYP2C9, SLC6A4, HTR2A, DRD3		●	
	Sertraline	CYP2B6	CYP2C19, CYP2C9, CYP3A4, CYP2D6, SLC6A4		●	
	Fluvoxamine	CYP2D6	CYP1A2, SLC6A4, HTR2A		●	
SMSs	Vilazodone	CYP3A4	CYP3A5, CYP2C19, CYP2D6		●	
SNRIs	Levomilnacipran	CYP3A4	CYP2C8, CYP3A5, CYP2C19, CYP2D6		●	
	Milnacipran	UGTs	Renal Excretion		●	
	Venlafaxine	CYP2D6	CYP2C19, CYP3A4, CYP2C9, CYP3A5, SLC6A3, SLC6A4, HTR2A		●	
	Duloxetine	CYP2D6	CYP1A2, HTR2A		●	
NRIs	Atomoxetine	CYP2D6	CYP2C19, CYP3A4, CYP3A5, SLC6A2		●	
	Reboxetine	CYP3A4	CYP3A5		●	
	Maprotiline	CYP2D6	CYP1A2		●	
TCAs that preferentially inhibit the reuptake of serotonin	Clomipramine	CYP2D6	CYP3A4, CYP2C19, CYP1A2, CYP2C9, SLC6A4, HTR2A		●	
	Imipramine	CYP1A2, CYP2D6	CYP2C19, CYP3A4, CYP3A5, UGT1A3, UGT1A4		●	
TCAs that preferentially inhibit the reuptake of norepinephrine	Desipramine	CYP2D6	CYP1A2, CYP2C19		●	
	Nortriptiline	CYP2D6	CYP1A2, CYP2C19, ABCB1, SLC6A4		●	
	Protriptyline	CYP2D6			●	

PGx Report - Psychiatry

Type: Antidepressant II

Drug Class	Generic	Primary Mechanism Involved	Other Mechanisms Involved	May Have Decreased Efficacy	Used As Directed	May Have Increased Toxicity
Antidepressants						
TCAs that fairly balanced serotonin-norepinephrine reuptake inhibitors	Amitriptyline	CYP2D6	CYP3A4, CYP2C19, CYP2C9, CYP1A2, CYP2B6, UGT1A3, UGT1A4		●	
	Doxepin	CYP2D6, CYP2C19	CYP1A2, CYP3A4, CYP3A5, UGT1A3, UGT1A4		●	
	Dosulepin	CYP2D6, CYP2C9	CYP3A4, CYP1A2, CYP3A5, CYP2C19		●	
TeCAs	Mianserin	CYP2D6	CYP3A4, CYP1A2, CYP2B6, CYP3A5		●	
	Amoxapine	CYP2D6	CYP3A4, CYP3A5		●	
TCA with antipsychotic and sedative properties	Trimipramine	CYP2D6	CYP2C19, CYP2C9		●	
MAOI	Tranylcypromine	MAO	CYP3A4, CYP2A6, CYP3A5, CYP2C19, CYP2D6		●	
	Moclobemide	CYP2C19	CYP2D6, CYP1A2, HTR2A		●	
Atypical antidepressants						
SMSs	Vortioxetine	CYP2D6	CYP2C9, CYP3A4, CYP3A5, UGTs, CYP2A6, CYP2C8, CYP2C19, CYP2B6		●	
NaSSAs	Mirtazapine	CYP1A2	CYP2D6, CYP3A4, CYP3A5, SLC6A4, HTR2A		●	
SARIs	Trazodone	CYP3A4	CYP2D6, CYP3A5		●	
	Nefazodone	CYP2D6, CYP3A4	CYP3A5, UGT1A6		●	
Antidepressant and smoking cessation aid	Bupropion	CYP2B6	CYP2E1, CYP3A4, CYP2C9, CYP2D6, CYP1A2, CYP3A5		●	
Antidepressant and anti-anxiety	Buspirone	CYP3A4	CYP3A5		●	

Abbreviations: SSRI, serotonin selective reuptake inhibitor; SMS, Serotonin modulator and stimulator; SNRI, serotonin-norepinephrine reuptake inhibitor; NRI, norepinephrine reuptake inhibitor; TCA, tricyclic antidepressant; TeCA, tetracyclic antidepressant; MAOI, monoamine oxidase inhibitor; NaSSA, noradrenergic and specific serotonergic antidepressant; SARI, serotonin antagonist and reuptake inhibitor.

Additional SNPs of Importance for Treatment Using Antidepressants

Gene	Marker	Genotype	Drug	Level of Evidence	Results
SLC6A4	HTTLPR form	L/L	Escitalopram	2A	Caucasian depressive patients may have an increased response or increased improvement
SLC6A4	HTTLPR form	L/L	Citalopram	2A	Depressive patients may have an increased response or increased improvement
SLC6A4	HTTLPR form	L/L	Clomipramine	3	Female patients may have increased clomipramine-induced prolactin release
SLC6A4	HTTLPR form	L/L	Escitalopram	3	Asian depressive patients may have a decreased response or decreased improvement
SLC6A4	HTTLPR form	L/L	Paroxetine	3	Asian depressive patients may have a decreased response or decreased improvement
SLC6A4	HTTLPR form	L/L	Paroxetine	3	Caucasian depressive patients may have an increased response or increased improvement
SLC6A4	HTTLPR form	L/L	Fluoxetine	3	Depressive patients may have an increased response or increased improvement
SLC6A4	HTTLPR form	L/L	Sertraline	3	Caucasian depressive patients may have an increased response or increased improvement
SLC6A4	HTTLPR form	L/L	Sertraline	3	Asian depressive patients may have a decreased response or decreased improvement
SLC6A4	HTTLPR form	L/L	Fluvoxamine	3	Depressive patients may have an increased response or increased improvement
SLC6A4	HTTLPR form	L/L	Mirtazapine	3	Depressive patients may have an increased risk of side effects
SLC6A4	rs25531	A/A	Citalopram	3	Depressive patients may have a decreased risk of side effects
SLC6A4	rs25531	A/A	Fluoxetine	4	Depressive patients may have an increased response or increased improvement
GRIK4	rs1954787	T/T	Citalopram	1B	Patients may have a decreased chance of response to Citalopram treatment
GRIK4	rs1954787	T/T	Antidepressants	2B	Patients with Depressive Disorder or Depression may be less likely to respond to antidepressant treatment
ADRA2A	rs1800544	G/G	SSRIs	3	Patients with major depressive disorder may have decreased response to selective serotonin reuptake inhibitors
GABRP	rs10036156	T/T	SSRIs	3	Patients with Depressive Disorder or Depression may be less likely to respond to antidepressant treatment
GABRP	rs10036156	T/T	Venlafaxine	3	Patients with Depressive Disorder or Depression may be less likely to respond to antidepressant treatment
HTR2A	rs6313	C/C	Paroxetine	3	Patients with depression may have an increased risk of adverse medication reactions

Additional SNPs of Importance for the Treatment of Depression and Psychosis, and the Treatment of Alcohol and Tobacco Use Disorders

Gene	Marker	Genotype	Drug	Level of Evidence	Results
HTR2A	rs6311	G/G	Escitalopram	3	Patients with anxiety disorder may have a decreased risk of adverse cognitive effects
HTR2A	rs6311	G/G	Fluvoxamine	3	Depressive patients may have an increased risk of gastrointestinal side effects and increased response
COMT	rs4680	G/G	Fluvoxamine	3	Schizophrenia patients may have a decreased risk for developing extrapyramidal symptoms
COMT	rs4680	G/G	Venlafaxine	3	Patients with Depressive Disorder may have increased response but patients with Anxiety Disorders may have a decreased response
COMT	rs4680	G/G	Paroxetine	3	Depressive patients may have a decreased response or decreased improvement
ANKK1/DRD2	rs1800497	G/G	Bupropion	1B	Patients may be more likely to quit smoking
ANKK1/DRD2	rs1800497	G/G	Antipsychotics	2A	Schizophrenia patients may have an increased risk for tardive dyskinesia
ANKK1/DRD2	rs1800497	G/G	Ethanol	2B	Patients may have a decreased, but not absent, risk for Alcoholism
ANKK1/DRD2	rs1800497	G/G	Clozapine Olanzapine Risperidone	2B	Patients may have decreased but not non-existent risk of side effects including hyperprolactinemia and weight gain
ANKK1/DRD2	rs1800497	G/G	Nicotine	3	Patients may have a decreased likelihood of smoking cessation when treated with nicotine replacement
ANKK1/DRD2	rs1800497	G/G	Risperidone	3	Schizophrenia patients may have less improvement in symptoms
HTR2A	rs7997012	A/A	Antidepressants	3	Reduced risk of having no response to treatment (higher improvement) with antidepressants

PGx Report - Psychiatry

Type: Typical Antipsychotic

Drug Class	Generic	Primary Mechanism Involved	Other Mechanisms Involved	May Have Decreased Efficacy	Used As Directed	May Have Increased Toxicity
Typical antipsychotic						
Butyrophenones	Bromperidol	CYP3A4	CYP3A5		●	
	Droperidol	CYP3A4	CYP3A5		●	
	Haloperidol	UGTs, CYP3A4	CYP1A2, CYP2D6, CYP3A5, SLC6A4, HTR2C		●	
Phenothiazines with aliphatic side-chain	Chlorpromazine	CYP2D6	CYP1A2, UGT1A3, UGT1A4, CYP3A4, CYP3A5		●	
	Levomepromazine	CYP3A4	CYP1A2, CYP3A5		●	
	Promazine	CYP1A2	CYP3A4, CYP2C19, CYP2C9, CYP3A5		●	
	Cyamemazine	CYP1A2	CYP3A4, CYP2C9, CYP2C8, CYP3A5		●	
Phenothiazines with piperazine structure	Fluphenazine	CYP2D6			●	
	Perphenazine	CYP2D6			●	
	Prochlorperazine	CYP2D6	CYP3A4, CYP3A5		●	
	Trifluoperazine	CYP1A2	UGT1A4		●	
Phenothiazines with piperidine structure	Thioridazine	CYP2D6	CYP1A2, CYP3A4, CYP2C19, CYP3A5		●	
Phenothiazines used as an anti-histamine, sedative, and antiemetic	Promethazine	CYP2D6	UGT1A3, UGT1A4, SULTs		●	
Diphenyl-butylpiperidine	Pimozide	CYP3A4, CYP2D6	CYP1A2, CYP3A5		●	
Thioxanthene derivative	Thiothixene	CYP1A2	CYP3A4, CYP3A5		●	
	Zuclopentixol	CYP2D6	CYP3A4, CYP3A5		●	
Tricyclics	Loxapine	CYP1A2	CYP3A4, CYP2D6, UGT1A3, UGT1A4, CYP3A5		●	

PGx Report - Psychiatry

Type: Atypical antipsychotic

Drug Class	Generic	Primary Mechanism Involved	Other Mechanisms Involved	May Have Decreased Efficacy	Used As Directed	May Have Increased Toxicity
Atypical antipsychotic						
Diazepines, Oxazepines, Thiazepines and Oxepines	Olanzapine	UGT1A4	CYP1A2, CYP2D6, FMO3, FMO1, SLC6A4, SLC1A1, HTR2A, HTR2C, DRD3		●	
	Quetiapine	CYP3A4, CYP2D6	CYP3A5, CYP1A2, CYP2C9, CYP2C19, SLC6A4		●	
	Asenapine	CYP1A2, UGT1A4	CYP2D6, CYP3A4, CYP3A5		●	
	Clozapine	CYP1A2, CYP2D6	CYP3A4, FMO3, CYP2C9, CYP2C19, CYP3A5, CYP2A6, UGT1A3, UGT1A4, SLC6A3, SLC1A1, HTR2C, DRD3		●	
Indole derivatives	Sertindole	CYP2D6	CYP3A4, CYP3A5		●	
	Ziprasidone	CYP3A4	AOX1, CYP3A5		●	
	Lurasidone	CYP3A4	CYP3A5		●	
Benzamides	Sulpiride	Renal Excretion			●	
	Amisulpride	Renal Excretion			●	
Other antipsychotics	Aripiprazole	CYP2D6	CYP3A4, CYP3A5, DRD3		●	
	<u>Risperidone</u>	CYP2D6	CYP3A4, CYP3A5, ABCB1, SLC6A4, SLC1A1, HTR2A, HTR2C, DRD3		●	
	Iloperidone	CYP2D6	CYP3A4, CYP3A5		●	
	Paliperidone	CYP2D6	CYP3A4, CYP3A5		●	
	Zotepine	CYP3A4	CYP1A2, CYP3A5, CYP2D6		●	

Additional SNPs of Importance in Treatment that Includes the Use of Antipsychotics and for the Treatment of Autism

Gene	Marker	Genotype	Drug	Level of Evidence	Results
SLC6A4	HTTLPR form	L/L	Olanzapine	3	Depressive patients may have an increased risk of side effects
SLC6A4	HTTLPR form	L/L	Quetiapine	3	Depressive patients may have an increased risk of side effects
SLC6A4	HTTLPR form	L/L	Risperidone	3	Depressive patients may have an increased risk of side effects
HTR2A	rs6311	G/G	Risperidone	3	Children with autism may have poorer response to treatment
HTR2C	rs3813929	C/C	Olanzapine	3	Patients with psychiatric disorders or schizophrenia may have an increased risk of weight gain
HTR2C	rs6318	G/G	Olanzapine	3	Schizophrenia patients may have a decreased risk of weight gain
COMT	rs4680	G/G	Haloperidol	3	Schizophrenia patients may have a decreased risk for developing extrapyramidal symptoms
DRD3	rs6280	G/G	Olanzapine	3	Schizophrenia patients may have greater positive symptom improvement and positive symptom remission
DRD3	rs4680	G/G	Clozapine	3	Schizophrenia patients may have a poorer response to treatment
DRD3	rs6280	G/G	Risperidone	3	Children with Autism may have better response to treatment
DRD1	rs4532	G/G	Methylphenidate or Dextroamphetamine	3	Patients with attention deficit hyperactivity disorder (ADHD) may have an increased severity of social withdrawal or nausea

Other genetic and clinical factors may also influence a patient's response to medications.

PGx Report - Neurology

Type: Drugs Prescribed for the Treatment of ADHD, Related Drugs

Drug Class	Generic	Primary Mechanism Involved	Other Mechanisms Involved	May Have Decreased Efficacy	Used As Directed	May Have Increased Toxicity
Anti ADHD Stimulants						
Amphetamine	Dextroamphetamine	Renal Excretion, CYP2D6	DBH, FMO3, GLYAT		●	
	<u>Levoamphetamine</u>	Renal Excretion, CYP2D6	FMO3		●	
NDRI	Dexmethylphenidate	CYP2D6	Renal Excretion		●	
	Lisdexamfetamine	Hydrolysis	CYP2D6, Renal Excretion		●	
Psychostimulant	Methylphenidate	CYP2D6	Renal Excretion, SLC6A2, SLC6A3, SLC6A4, DRD3		●	
	Anti ADHD Non-stimulants					
NERI	Atomoxetine	CYP2D6	CYP2C19, CYP3A4, CYP3A5, SLC6A2		●	
Central alpha-2 Adrenergic Agonist	Clonidine	CYP2D6	CYP1A2, CYP3A4, CYP3A5		●	
Antidepressants	Bupropion	CYP2B6	CYP2E1, CYP3A4, CYP2C9, CYP2D6, CYP1A2, CYP3A5		●	
	Imipramine	CYP1A2, CYP2D6	CYP2C19, CYP3A4, CYP3A5, UGT1A3, UGT1A4		●	
	Desipramine	CYP2D6	CYP1A2, CYP2C19		●	
	Milnacipran	UGTs	Renal Excretion		●	
	Reboxetine	CYP3A4	CYP3A5		●	
Wakefulness-promoting agent	Modafinil	Hydrolysis, CYP2D6	CYP1A2, CYP3A4, CYP2B6, CYP3A5		●	
	Armodafinil	CYP3A4	CYP3A5		●	
Anti-insomnia						
Melatonin Receptor Agonist	Ramelteon	CYP1A2	CYP2C19, CYP3A4, CYP3A5		●	

Abbreviations: ADHD, Attention deficit hyperactivity disorder; NERI; norepinephrine reuptake inhibitor, NDRI, norepinephrine-dopamine reuptake inhibitor.

PGx Report - Neurology

Type: Drugs Prescribed for the Treatment of Epilepsy

Drug Class	Generic	Primary Mechanism Involved	Other Mechanisms Involved	May Have Decreased Efficacy	Used As Directed	May Have Increased Toxicity
Antiepileptic						
Barbiturates	Phenobarbital	CYP2C19	ABCB1		●	
Carbamates	Felbamate	CYP3A4	CYP2E1, CYP3A5		●	
Carboxamides	Carbamazepine	CYP3A4, EPHX1	CYP2C8, CYP2B6, UGT2B7, CYP1A2, CYP3A5, ABCB1, HLA-B*1502, HLA-A*3101, ABCC2		●	
Fatty acids	Tiagabine	CYP3A4	CYP3A5, CYP1A2, CYP2D6, CYP2C19		●	
	<u>Valproic acid</u>	UGT1A3, UGT1A4, UGT1A6, UGT1A8, UGT1A9, UGT1A10,	UGT2B7, CYP2C9, CYP2A6, CYP2B6		●	
Fructose derivatives	Topiramate	Renal Excretion	CYPs, UGTs		●	
GABA analogs	Gabapentin	Renal Excretion			●	
	Pregabalin	Renal Excretion			●	
Hydantoin	Phenytoin	CYP2C19	CYP2C9, CYP3A4, CYP3A5, CYP2D6, ABCB1, EPHX1, HLA-B*1502		●	
	Mephenytoin	CYP2C19	CYP2C8, CYP2C9, CYP2B6, CYP1A2, CYP2D6		●	
Oxazolidinediones	Trimethadione	CYP2C9	CYP2E1, CYP3A4, CYP3A5		●	
	Paramethadione	CYP2C9			●	
Pyrimidinedione	Primidone	CYP2C9	CYP2C19		●	
Pyrrolidines	Brivaracetam	CYP2C19, CYP2C9	CYP3A4, CYP3A5, CYP2C8, CYP2B6		●	
	Levetiracetam	Renal Excretion			●	
Succinimides	Seletracetam	Renal Excretion			●	
	Ethosuximide	CYP3A4	CYP3A5, CYP2E1		●	
Sulfonamides	Zonisamide	CYP3A4	CYP2C19, CYP3A5		●	
Triazines	Lamotrigine	UGT1A4	UGT2B7, HLA-B*1502		●	
	Lacosamide	CYP2C9	CY2C19, CYP3A4		●	
Other	Perampanel	CYP3A4	CYP3A5		●	
	Retigabine	UGT1A4	NAT2	●		

Abbreviations: GABA, gamma-aminobutyric acid.

PGx Report - Neurology

Type: Anxiolytic, Hypnotic, Sedative, Anticonvulsant, Muscle Relaxants

Drug Class	Generic	Primary Mechanism Involved	Other Mechanisms Involved	May Have Decreased Efficacy	Used As Directed	May Have Increased Toxicity	
Anxiolytic, Hypnotic, Sedative, Anticonvulsant, and Muscle Relaxant							
Benzodiazepine acting	Short-	Midazolam	CYP3A4	CYP3A5			
		Triazolam	CYP3A4	CYP3A5			
		Brotizolam	CYP3A4	CYP3A5			
Benzodiazepine Intermediate-acting		Alprazolam	CYP3A4	CYP3A5			
		Bromazepam	CYP1A2	CYP2D6			
		Clobazam	CYP2C19	CYP3A4, CYP3A5, CYP2B6			
		Flunitrazepam	CYP2C19	CYP2C9, CYP3A4, CYP3A5, NAT2			
		Estazolam	CYP3A4	CYP3A5			
		Clonazepam	CYP3A4	CYP2C19, CYP3A5, NAT2			
		Oxazepam-r	UGT2B7	UGT1A9			
		Oxazepam-s	UGT2B15				
		Quazepam	CYP3A4	CYP2C19, CYP3A5			
		Lormetazepam	CYP3A4	CYP3A5			
		<u>Lorazepam-r</u>	UGT2B7				
		<u>Lorazepam-s</u>	UGT2B15				
Benzodiazepine acting	Long-	Nitrazepam	CYP3A4	CYP3A5, NAT2			
		Temazepam	CYP2C19	CYP3A4, CYP3A5, UGT2B7			
		Diazepam	CYP2C19, CYP3A4	CYP3A5, CYP2B6, CYP1A2			
		Clorazepate	CYP3A4	CYP3A5			
		Chlordiazepoxide	CYP3A4	CYP3A5			
Nonbenzodiazepine hypnotic	hypnotic	Flurazepam	CYP3A4	CYP3A5			
		<u>Nordazepam</u>	CYP3A4	CYP3A5			
		Zolpidem	CYP3A4	CYP3A5, CYP1A2, CYP2D6			
		Zaleplon	AOX1, CYP3A4	CYP3A5			
Nonbenzodiazepine hypnotic		Zopiclone	CYP3A4	CYP2C8, CYP2C9, CYP3A5			
		Eszopiclone	CYP3A4	CYP2E1, CYP3A5			

PGx Report - Neurology

Type: Drugs Prescribed for the Treatment of Alzheimer's and Parkinson's, Related Drugs

Drug Class	Generic	Primary Mechanism Involved	Other Mechanisms Involved	May Have Decreased Efficacy	Used As Directed	May Have Increased Toxicity
Anti-Alzheimer disease						
Acetylcholinesterase inhibitor	Tacrine	CYP1A2	CYP2D6			
	Donepezil	CYP2D6	CYP3A4, CYP3A5			
	Rivastigmine	ACHE	BCHE, ChAT			
	Galantamine	CYP2D6	CYP3A4, CYP3A5			
NMDA receptor antagonist	Memantine	Renal Excretion	UGTs			
Anti-Parkinson disease						
Inhibitor of MAO-B	Selegiline	CYP2B6	CYP2C9, CYP3A4, CYP3A5, CYP2A6, FMO3			
	Rasagiline	CYP1A2				
COMT inhibitors	Entacapone	UGT1A9, CYP3A4	CYP2A6, CYP3A5, UGT1A6, UGT2B7, UGT2B15			
	<u>Tolcapone</u>	UGT1A9	UGT2B15			
Dopamine receptor agonists	Bromocriptine	CYP3A4	CYP3A5			
	Pramipexole	Renal Excretion	DRD3			
	Ropinirole	CYP1A2	UGTs, Renal Excretion			
Anticholinergics - Antimuscarinics	Diphenhydramine	CYP2D6	CYP3A4, CYP3A5, UGT1A3, UGT1A4			
Anti-hyperkinetic movement	Tetrabenazine	CYP2D6	CYP1A2			
Anti-amyotrophic lateral sclerosis drug	Riluzole	CYP1A2				
Anti-multiple sclerosis						
Sphingosine 1-phosphate Receptor Modulator	Fingolimod	CYP4F2				
Anthracenedione	Mitoxantrone	CYP2E1				
Dihydroorotate dehydrogenase inhibitor	<u>Teriflunomide</u>	Hydrolysis	NATs, SULTs			
Improvement of walking in patients with multiple sclerosis						
Selective blocker of members of voltage-activated K+ channels	Dalfampridine	Renal Excretion	CYP2E1			

Abbreviations: NMDA, N-methyl-D-aspartate; COMT, Catechol-O-methyltransferase.

Additional SNP of Importance for different Medical Condition and personality

Gene	Marker	Genotype	Results
APOE	rs429358	T/T	Normal risk for Alzheimer's disease
GABRA6	rs3219151	C/C	Normal risk for schizophrenia
DRD4	rs1800955	T/T	Normal novelty seeking personality
ABCG2	rs2231142	C/C	Increased risk for Gout
BDNF	rs6265	G/G	Normal risk for ADHD or depression
DRD2	rs6277	C/C	Higher risk for schizophrenia

Additional SNP of Importance for hypersensitivity

Gene	Marker	Genotype	HLA	Drug	Results
HLA-A	rs1061235	A/A	HLA-A*3101	Carbamazepine	Normal Carbamazepine sensitivity
FLOT1	rs3909184	WT/WT	HLA-B*1502	Carbamazepine	Normal risk for medication-induced hypersensitivity
HCP5	rs2395029	WT/WT	HLA-B*5701	Lamotrigine, Phenytoin, Abacavir	Normal risk for medication-induced hypersensitivity

The variant allele for rs1061235(T) serves as a proxy for the HLA-A*3101 allele, the variant allele for rs3909184(C) serves as a proxy for the HLA-B*1502 allele, the variant allele for rs2395029(G) serves as a proxy for the HLA-B*5701 allele.

PGx Report - Infectology

Type: Antibiotics

Drug Class	Generic	Primary Mechanism Involved	Other Mechanisms Involved	May Have Decreased Efficacy	Used As Directed	May Have Increased Toxicity
Antibacterials: protein synthesis inhibitors 50S						
Amphenicols	Chloramphenicol	CYP2C9	UGT2B7		●	
Lincosamides	Clindamycin	CYP3A4	CYP3A5		●	
Antibiotic						
Macrolides	Clarithromycin	CYP3A4	CYP3A5		●	
	Erythromycin	CYP3A4			●	
	Telithromycin	CYP3A4	CYP3A5		●	
Antibacterials: nucleic acid inhibitors						
DHPS inhibitor Short-acting sulfonamides	Sulfadimidine	NAT2	Renal Excretion	●●		
	Sulfapyridine	NAT2	Renal Excretion	●●		
DHPS inhibitor Intermediate-acting sulfonamides	Sulfamethoxazole	Renal Excretion	NAT2, CYP2C9		●	
Anaerobic DNA inhibitors/ Nitroimidazole	Tinidazole	CYP3A4	CYP3A5		●	
	Ornidazole	CYP3A4	CYP3A5		●	
DNA-dependent RNA polymerase inhibitors	Rifampicin	CYP3A4	CYP2C8, CYP3A5, CYP2C19, CYP2A6, RE		●	
	Rifabutin	CYP3A4	CYP1A2, CYP3A5		●	
Other drugs against mycobacteria	Dapsone	CYP2E1	NAT2, CYP3A4, CYP2C9, CYP3A5, CYP2D6, UGT1A9, G6PD		●	
	Bedaquiline	CYP3A4	CYP2C8, CYP2C19, CYP3A5		●	
	Isoniazid	NAT2	CYP2E1, Renal Excretion	●●		
	Pyrazinamide	AOX1, XDH	CYP1A2, CYP3A4, CYP3A5, RE		●	

Abbreviations: DHPS, Dihydropteroate synthase.

PGx Report - Infectology

Type: Antimalarial, Anthelmintic, Antifungal

Drug Class	Generic	Primary Mechanism Involved	Other Mechanisms Involved	May Have Decreased Efficacy	Used As Directed	May Have Increased Toxicity
Antimalarial						
Aminoquinolines	Chloroquine	CYP2C8	CYP3A4, CYP3A5, G6PD			
	Hydroxychloroquine	CYP2D6	CYP2C8, CYP3A4, CYP3A5			
	Amodiaquine	CYP2C8				
	Primaquine	CYP2D6	G6PD			
Methanolquinolines	Quinine	CYP3A4, CYP2D6	CYP2C19, CYP3A5, G6PD			
	Mefloquine	CYP3A4	CYP3A5			
Artemisinin and derivatives	Artemisinin	CYP3A4	CYP2B6, CYP3A5			
	Artemether	CYP3A4	CYP3A5			
	Artesunate	CYP2A6				
	<u>Arteether</u>	CYP3A4	CYP2B6, CYP3A5			
Biguanides	Proguanil	CYP2C19				
Other antimalarials	Halofantrine	CYP3A4	CYP3A5			
	Pentamidine	CYP2C19	CYP1A2, CYP2D6			
Anthelmintic						
Benzimidazoles	Albendazole	CYP3A4	CYP1A2, CYP3A5			
Antifungals						
Imidazoles	Ketoconazole	CYP3A4	UGT1A1, FMO3, CYP26A1			
	Itraconazole	CYP3A4				
Triazoles	Voriconazole	CYP2C19	CYP2C9, CYP3A4, CYP3A5			
	Fluconazole	Renal Excretion				
Allylamines	Terbinafine	CYP2C9	CYP1A2, CYP3A4, CYP2C8, CYP2C19			

PGx Report - Infectology

Type: Antiretroviral, Antiviral

Drug Class	Generic	Primary Mechanism Involved	Other Mechanisms Involved	May Have Decreased Efficacy	Used As Directed	May Have Increased Toxicity
Antiretroviral						
Protease inhibitor generation 1st	Lopinavir	CYP3A4	SLCO1B1, CYP3A5, ABCC1, ABCC2			
	Ritonavir	CYP3A4	CYP2D6, CYP3A5, ABCC1			
	Saquinavir	CYP3A4	CYP3A5			
	Indinavir	CYP3A4	CYP2D6, CYP3A5, ABCC4			
	Nelfinavir	CYP2C19	CYP3A4, CYP3A5			
	Fosamprenavir	CYP3A4	CYP3A5			
Protease inhibitor generation 2nd	Atazanavir	CYP3A4	CYP3A5, ABCB1			
	Darunavir	CYP3A4	CYP3A5, SLCO3A1			
	Tipranavir	CYP3A4	CYP3A5			
NNRTI generation 1st	Delavirdine	CYP3A4	CYP2D6, CYP3A5			
	Efavirenz	CYP2B6	CYP2A6, ABCB1, SLCO3A1, ABCG2			
NNRTI 2nd generation	Nevirapine	CYP3A4	CYP2B6, CYP3A5, ABCB1, SLCO3A1			
	Etravirine	CYP3A4	CYP2C9, CYP2C19, CYP3A5			
	Rilpivirine	CYP3A4	CYP3A5			
Nucleoside reverse transcriptase inhibitor (NRTI)	Zidovudine	UGT2B7	Renal Excretion, UGT1A9, SLCO3A1, ABCC1, ABCC4			
	Abacavir	ADH6	UGT1A1, ADK, HLA-B*5701			
Neuraminidase inhibitors/release phase	Zanamivir	Renal Excretion				
	Peramivir	Renal Excretion				
	Oseltamivir	BCHE, ACHE	Renal Excretion			
CCR5 Co-receptor Antagonist	Maraviroc	CYP3A4	CYP3A5			
Hepatitis C Virus NS3/4A Protease Inhibitor	Boceprevir	CYP3A4	IFNL3, CYP3A5			
	Telaprevir	CYP3A4	CYP3A5, IFNL3			
	Paritaprevir	CYP3A4	CYP3A5			
	Simeprevir	CYP3A4	CYP2C8, CYP2C19, CYP3A5, IFNL3			
Other antivirals	Enfuvirtide	CYP2C19	CYP2E1, CYP1A2			
	Raltegravir	UGT1A1	SLCO1A2			
	Elvitegravir	CYP3A4	CYP3A5			
	Dolutegravir	UGT1A1, CYP3A4	CYP3A5			

Abbreviations: NNRTI, Non-Nucleoside Reverse Transcriptase Inhibitors; CCR5, C-C chemokine receptor type 5.

PGx Report - Oncology, Hematology

Type: Antineoplastic I

Drug Class	Generic	Primary Mechanism Involved	Other Mechanisms Involved	May Have Decreased Efficacy	Used As Directed	May Have Increased Toxicity
Alkylation agents						
Nitrogen mustard analogues	Cyclophosphamide	CYP2B6	CYP2C19, CYP3A4, CYP2C9, CYP3A5, EPHX1, ALDH1A1, ABCC3		●	
	Iphosphamide	CYP2B6	CYP3A4, CYP3A5		●	
Nitrosoureas	Carmustine	CYP1A2	Renal Excretion		●	
Antimetabolites						
Folic acid analogues	Methotrexate	Renal Excretion	AOX1, SLC01B1, SLC19A1, ABCC1, ABCC2, ABCC3, ABCG2		●	
	Pemetrexed	Renal Excretion	SLC19A1		●	
Purine analogues	Mercaptopurine	XO	TPMT, NUDT15, AOX1, SLC19A1		●	
	Tioguanine	HPRT1	TPMT, NUDT15		●	
	Cladribine	DCK	Renal Excretion		●	
	Clofarabine	DCK	Renal Excretion		●	
	Nelarabine	ADA	DCK, Renal Excretion, XO		●	
Pyrimidine analogues	Fluorouracil	DPYD, TYMS, MTHFR	NQO1, GSTP1, UMPs, TYMP, SLC19A1, ABCG2		●	
	Cytarabine	CES1, CES2, CDA	TYMP, DPYD, TYMS, SLC01B1, SLC29A1		●	
	Tegafur	CYP2A6	DPYD, TYMS		●	

PGx Report - Oncology, Hematology

Type: Antineoplastic II

Drug Class	Generic	Primary Mechanism Involved	Other Mechanisms Involved	May Have Decreased Efficacy	Used As Directed	May Have Increased Toxicity
Plant alkaloids and other natural products						
Vinca alkaloids and analogues	Vincristine	CYP3A4	CYP3A5, ABCC3		●	
	Vinblastine	CYP3A4	CYP3A5		●	
Podophyllotoxin derivatives	Etoposide	CYP3A4	CYP3A5, CYP1A2, CYP2E1, ABCB1, UGT1A1		●	
	Teniposide	CYP2C19	CYP3A4, CYP3A5, ABCB1		●	
Taxanes	Paclitaxel	CYP2C8	CYP3A4, CYP3A5, ABCB1, SLC29A1		●	
	Docetaxel	CYP3A4	CYP3A5, EPHX1, SLC01B3, ABCC6		●	
Cytotoxic antibiotics and related substances						
Anthracyclines and related substances	Doxorubicin	ALDH1A1, ABCB1, GSTP1, NQO1	CYP3A4, CYP2B6, CYP3A5, CYP2C8, CYP2D6, ABCC2, ABCC3		●	
	Mitoxantrone	CYP2E1			●	
Other antineoplastic agents						
Platinum compounds	Cisplatin	Renal Excretion, NQO1, GSTP1	EPHX1, GSTM1, ABCB1, XPC, LRP2, SLC19A1, ABCC2, ABCC3		●	
Derivative of camptothecin	Irinotecan	UGT1A1, CYP3A4, CES1, CES2	CYP3A5, CYP2B6, UGT1A4, SLC01B1, BCHE, UGT1A9, UGT1A10, SLC19A1, SLC01B3, ABCG2		●	

PGx Report - Oncology, Hematology

Type: Antineoplastic Targeted Therapy I

Drug Class	Generic	Primary Mechanism Involved	Other Mechanisms Involved	May Have Decreased Efficacy	Used As Directed	May Have Increased Toxicity
Protein kinase inhibitor (receptor)						
Epidermal growth factor receptor (EGFR)	Erlotinib	CYP3A4	CYP1A2, CYP3A5		●	
	Gefitinib	CYP3A4	CYP2D6, CYP3A5, ABCG2		●	
	Vandetanib	CYP3A4	FMO3, FMO1, CYP3A5		●	
EGFR and epidermal growth factor receptor (HER2)	Lapatinib	CYP3A4, CYP2C19	CYP2C8, CYP3A5, HLA-DQA1*0201, HLA-DRB1*0701		●	
	Neratinib	CYP3A4	CYP3A5		●	
C-KIT and PDGFR FLT3	<u>Masitinib</u>	CYP3A4	CYP3A5		●	
	<u>Lestaurtinib</u>	CYP3A4	CYP3A5		●	
RET, VEGFR and EGFR	Vandetanib	CYP3A4	FMO3, FMO1, CYP3A5		●	
c-MET and VEGFR2	Cabozantinib	CYP3A4	CYP2C8, CYP3A5		●	
Multiple targets (c-KIT, FGFR, PDGFR and VEGFR)	Axitinib	CYP3A4	CYP1A2, CYP2C19, CYP3A5, UGT1A1		●	
	Nintedanib	CYP1A2	CYP2C9, CYP2C19, CYP2D6, CYP2E1		●	
	Pazopanib	CYP3A4, UGT1A1	CYP1A2, CYP2C8, CYP3A5		●	
	Ponatinib	CYP3A4	CYP2C8, CYP2D6, CYP3A5		●	
	Regorafenib	CYP3A4	UGT1A9, CYP3A5		●	
	Sorafenib	CYP3A4	UGT1A9, CYP3A5		●	
	Sunitinib	CYP3A4	CYP3A5, ABCG2		●	
	<u>Toceranib</u>	CYP3A4	CYP3A5		●	
	Protein kinase inhibitor (non-receptor)					
BCR-ABL	Imatinib	CYP3A4	CYP3A5, ABCB1, SLC01A2, SLC22A4, ABCG2		●	
	Nilotinib	CYP3A4, UGT1A1	CYP1A2, CYP2C9, CYP2C19, CYP2D6, CYP3A5, ABCG2		●	
	Dasatinib	CYP3A4	CYP3A5, ABCG2		●	
	Ponatinib	CYP3A4	CYP2C8, CYP2D6, CYP3A5		●	
Src	Bosutinib	CYP3A4	CYP3A5		●	
Janus kinase	<u>Lestaurtinib</u>	CYP3A4	CYP3A5		●	
	Ruxolitinib	CYP3A4	CYP3A5		●	
	Pacritinib	CYP3A4	CYP3A5		●	
	Tofacitinib	CYP3A4	CYP2C19, CYP3A5		●	

PGx Report - Oncology, Hematology

Type: Antineoplastic Targeted Therapy II

Drug Class	Generic	Primary Mechanism Involved	Other Mechanisms Involved	May Have Decreased Efficacy	Used As Directed	May Have Increased Toxicity
Protein kinase inhibitor (non-receptor)						
EML4-ALK	Ceritinib	CYP3A4	CYP2C9, CYP3A5		●	
	Crizotinib	CYP3A4	CYP3A5		●	
Bruton tyrosine kinase	Ibrutinib	CYP3A4	CYP2D6, CYP3A5		●	
BRAF inhibitor (V600E mutation-positive)	Dabrafenib	CYP2C8	CYP3A4, CYP3A5, G6PD		●	
Other Targeted therapy						
mTOR Inhibitors	Sirolimus	CYP3A4	CYP3A5		●	
	Everolimus	CYP3A4	CYP2C8, CYP3A5	●		
Hedgehog pathway inhibitor	Vismodegib	CYP2C9	CYP3A4, CYP3A5		●	
Hormone antagonists and related agents						
Selective estrogen receptor modulators (SERM)	Toremifene	CYP3A4	CYP2D6, CYP3A5		●	
	Tamoxifen	CYP3A4, CYP2D6, CYP2C9	CYP3A5, CYP2B6, FMO1, FMO3, CYP2C19, CYP1A2, UGT1A3, UGT1A4, SULT1A1, F2, F5, ABCC2		●	
SERD	Fulvestrant	CYP3A4	CYP3A5		●	
Anti-androgens	Flutamide	CYP1A2	CYP3A4, CYP3A5		●	
	Nilutamide	CYP2C19	FMO3		●	
	Bicalutamide	CYP3A4	CYP3A5		●	
Aromatase inhibitors	Enzalutamide	CYP2C8	CYP3A4, CYP3A5		●	
	Anastrozole	CYP3A4	CYP3A5, UGT1A4		●	
	Letrozole	CYP3A4	CYP2A6, CYP3A5		●	
Other hormone antagonists and related agents	Exemestane	CYP3A4	CYP3A5		●	
Abiraterone	CYP3A4	CYP3A5, SULT2A1			●	
Hematologic						
Thrombopoiesis Stimulating Agent	Eltrombopag	CYP1A2	CYP2C8, F5, SERPINC1		●	

Abbreviations: C-KIT, tyrosine-protein kinase Kit; PDGFR, Platelet-derived growth factor receptor; FLT3, FMS-like tyrosine kinase-3; RET, RET proto-oncogene; VEGFR, Vascular endothelial growth factor receptor; Src, Proto-oncogene tyrosine-protein kinase Src; EML4-ALK, echinoderm microtubule associated protein like 4 – anaplastic lymphoma kinase; BRAF, proto-oncogene B-Raf; mTOR, mammalian target of rapamycin; SERD, selective estrogen receptor down-regulator.

PGx Report - Organ Transplantation

Type: Immunosuppressive, Immunomodulation

Drug Class	Generic	Primary Mechanism Involved	Other Mechanisms Involved	May Have Decreased Efficacy	Used As Directed	May Have Increased Toxicity
Immunosuppressive						
Antimetabolite	Mycophenolate mofetil	CYP3A4	CYP3A5, CYP2C8, UGT2B7, UGT1A8, UGT1A9, SLC01B1, SLC01B3, ABCC2, HPRT1		●	
	Azathioprine	XO	TPMT, NUDT15, AOX1		●	
Calcineurin Inhibitors	Pimecrolimus	CYP3A4	CYP3A5	●●		
	Tacrolimus	CYP3A4	CYP3A5, ABCB1, UGT2B7	●●		
	Cyclosporine	CYP3A4	CYP3A5, ABCB1, UGT2B7, ABCC2	●●		
mTOR Inhibitors	Temsirolimus	CYP3A4	CYP3A5	●●		
	Everolimus	CYP3A4	CYP2C8, CYP3A5	●●		
Immunomodulation						
Immunomodulator and anti-angiogenic	Pomalidomide	CYP1A2	CYP3A4, CYP2C19, CYP2D6, CYP3A5		●	

PGx Report - Anesthesiology

Type: Anesthetic, Muscle Relaxant

Drug Class	Generic	Primary Mechanism Involved	Other Mechanisms Involved	May Have Decreased Efficacy	Used As Directed	May Have Increased Toxicity
Inhaled Anesthetics						
Inhaled Agents	Enflurane	CYP2E1			●	
	Halothane	CYP2E1	CYP3A4, CYP2A6, CYP3A5		●	
	Isoflurane	CYP2E1	CYP2B6		●	
	Methoxyflurane	CYP2E1	CYP1A2, CYP2C9, CYP2D6		●	
	Sevoflurane	CYP2E1			●	
Intravenous agents (non-opioid)						
Barbiturates	Hexobarbital	CYP2C19	CYP2C9, CYP2E1, CYP1A2		●	
	Thiameylal	CYP2C9			●	
Benzodiazepines	Diazepam	CYP2C19, CYP3A4	CYP3A5, CYP2B6, CYP1A2		●	
	Lorazepam	UGT2B15	UGT2B7		●	
	Midazolam	CYP3A4	CYP3A5		●	
Other Anesthetics	<u>Propofol</u>	UGT1A9	CYP2B6, CYP2C9, SULT1A1, NQO1		●	
	Ketamine	CYP3A4	CYP2B6, CYP2C9, CYP3A5		●	
Skeletal muscle relaxants						
Muscle Relaxants	Succinylcholine	BCHE			●	
	Carisoprodol	CYP2C19			●	
	Cyclobenzaprine	CYP1A2	CYP2D6, CYP3A4, CYP3A5, UGT1A4		●	
	Tizanidine	CYP1A2			●	

PGx Report - Urology

Type: Drugs Prescribed for the Treatment of Incontinence, Erectile Dysfunction, Benign Prostatic Hypertrophy

Drug Class	Generic	Primary Mechanism Involved	Other Mechanisms Involved	May Have Decreased Efficacy	Used As Directed	May Have Increased Toxicity
Drugs for urinary frequency and incontinence						
Anticholinergic	Oxybutynin	CYP3A4	CYP3A5		●	
	Tolterodine	CYP2D6, CYP3A4	CYP2C9, CYP3A5, CYP2C19		●	
	Solifenacin	CYP3A4	CYP3A5		●	
	Darifenacin	CYP2D6	CYP3A4, CYP3A5		●	
Drugs used in erectile dysfunction						
Phosphodiesterase inhibitors	Sildenafil	CYP3A4	CYP2C9, CYP3A5		●	
	Tadalafil	CYP3A4	CYP3A5		●	
	Vardenafil	CYP3A4	CYP2C9, CYP3A5		●	
	Avanafil	CYP3A4	CYP3A5		●	
	Udenafil	CYP3A4	CYP3A5		●	
Drugs used in benign prostatic hypertrophy						
Alpha-adrenoreceptor antagonists	Alfuzosin	CYP3A4	CYP3A5, Renal Excretion		●	
	Tamsulosin	CYP3A4	CYP2D6, CYP3A5, Renal Excretion		●	
	Silodosin	CYP3A4	UGT2B7, CYP3A5		●	
Testosterone-5-alpha reductase inhibitors	Finasteride	CYP3A4	CYP3A5		●	
	Dutasteride	CYP3A4	CYP3A5		●	

PGx Report - Endocrinology

Type: Contraceptives, Androgens, Antiandrogens, Glucocorticoid, Thyroid

Drug Class	Generic	Primary Mechanism Involved	Other Mechanisms Involved	May Have Decreased Efficacy	Used As Directed	May Have Increased Toxicity
Hormonal contraceptives						
Estrogens	Ethinylestradiol	CYP3A4, CYP2C9	CYP3A5, CYP2C19, CYP1A2, UGT1A1		●	
	Estradiol	CYP1A2	CYP3A4, CYP3A5, CYP2C8, UGT1A1, UGT1A9		●	
Progestogens	Desogestrel	CYP3A4, HSD3B1	CYP3A5, CYP2C9, CYP2C19, UGT1A1		●	
	Dienogest	CYP3A4	CYP3A5		●	
	Mestranol	CYP2C9			●	
Emergency contraceptives	Levonorgestrel	CYP3A4	CYP3A5		●	
	Ulipristal	CYP3A4	CYP1A2, CYP2D6, CYP3A5		●	
Androgens						
3-oxoandrosten-(4)-derivatives	Testosterone	CYP3A4, CYP19A1	HSD3B2, CYP3A5, UGT2B15, SULTs		●	
Antiandrogens						
Antiandrogens	Cyproterone	CYP3A4	CYP3A5		●	
Other sex hormones and modulators of the genital system						
Selective estrogen receptor modulators (SERMs)	Raloxifene	UGT1A1	UGT1A8, UGT1A10		●	
	Bazedoxifene	UGT1A1	UGT1A8, UGT1A10		●	
	Ospemifene	CYP3A4	CYP2C9, CYP3A5, CYP2C19, CYP2B6		●	
Steroid hormone						
Glucocorticoids	Dexamethasone	CYP3A4	CYP17A1, CYP3A5		●	
	Cortisol (hydrocortisone)	CYP3A4	CYP3A5		●	
	Prednisone	HSD11B2	CYP3A4, CYP3A5, SLC19A1, SULTs, UGTs		●	
Thyroid hormone						
Thyroid hormones	Levothyroxine	DIO2	UGT1A1, SULTs		●	
	Liothyronine	DIO2	UGT1A1, UGT1A9, SULTs		●	

There are additional SERMs (Tamoxifen and Toremifene) described under antineoplastics

PGx Report - Recreational Drugs

Type: Alcohol, Barbiturates, Benzodiazepines, Cannabinoids, Synthetic Cannabis, Dissociative Drugs, Tobacco

Drug Class	Generic	Primary Mechanism Involved	Other Mechanisms Involved	May Have Decreased Efficacy	Used As Directed	May Have Increased Toxicity
Alcohol	Ethanol	ADH1B	ALDH2, ADH1A, CYP2E1		●	
Amphetamines	3,4-methylenedioxymethamphetamine (MDMA)	Renal Excretion, CYP2D6	CYP1A2, CYP3A4, CYP3A5, FMO3		●	
	Methamphetamine	CYP2D6, Renal Excretion	DBH, FMO3, ACSM1, GLYAT, DRD3		●	
Barbiturates	Amobarbital	CYP3A4	CYP3A5, CYP2B6, CYP2C9, CYP2A6		●	
	Phenobarbital	CYP2C19	ABCB1		●	
Benzodiazepines	Alprazolam	CYP3A4	CYP3A5		●	
	Clonazepam	CYP3A4	CYP2C19, CYP3A5, NAT2		●	
	Lorazepam	UGT2B15	UGT2B7		●	
	Diazepam	CYP2C19, CYP3A4	CYP3A5, CYP2B6, CYP1A2		●	
Cannabinoids & Related Drugs	Cannabidiol (CBD)	CYP3A4	CYP2C19, CYP3A5		●	
	Delta 9-tetrahydrocannabinol (Δ 9 THC)	CYP2C9	CYP2C19, CYP3A4, CYP3A5		●	
	Cannabinol (CBN)	CYP2C9	CYP2C19, CYP3A4, CYP3A5		●	
Synthetic Cannabis	JWH-018	CYP1A2	CYP2C9		●	
	AM2201	CYP1A2	CYP2C9		●	
Dissociative Drugs	Ketamine	CYP3A4	CYP2B6, CYP2C9, CYP3A5		●	
	Phencyclidine (PCP)	CYP3A4	CYP3A5, CYP2A6, CYP1A2		●	
Ergoline derivative	Cocaine	BCHE, CES2	CYP3A4, CYP3A5, SLC6A3		●	
Ergoline derivatives	Lysergic acid diethylamide (LSD)	CYP3A4	CYP3A5		●	
Tobacco	Nicotine	CYP2A6, FMO3	UGT1A9, UGT1A4, UGT2B7, CYP2B6, SLC6A3		●	

Additional SNPs of Importance for Recreational Drugs

Gene	Marker	Genotype	Drug	Level of Evidence	Results
OPRD1	rs2236857	T/T	Heroin		Patients may have a lower tendency for heroin addiction
OPRK1	rs702764	A/A	Opioids		Neonates may display reduced abstinence syndrome due to in-utero opioid exposure
OPRK1	rs1051660	G/G	Opioids		Patients may have a lower tendency for Opioids addiction
DBH	rs1611115	T/T	Analgesics	3	Patients with substance withdrawal syndrome may have a decreased likelihood of headache when discontinuing the use of analgesics (such as opioids, NSAIDs, triptans, ergot)

*This report is automatically generated by CliSeq Interpret.

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Genomic Test Results

Genotype/Haplotype Details

CYP1A1

Allele Tested: *1,*2,*3,*4,*5,*6,*7,*8.

Genetic results: CYP1A1 *1/*1

Phenotype: Extensive metabolizer

Gene	Protein change	Nucleotide change	Allele	Marker	Genotype
CYP1A1	Ile462Val	1384A>G	*2	rs1048943	A/A
CYP1A1		*595T>C	*3	rs1800031	T/T
CYP1A1	Thr461Asn	1382C>A	*4	rs1799814	C/C
CYP1A1	Arg464Ser	1390C>A	*5	rs41279188	C/C
CYP1A1	Met331Ile	993G>A	*6	rs56313657	G/G
CYP1A1	Glu426Terfs	1275_1276insT	*7	rs72547510	-/-
CYP1A1	Ile448Asn	1343T>A	*8	rs72547509	T/T

CYP1A1 contribute in the metabolism of several drugs including: Amodiaquine, Estrogens, Erlotinib, Gefitinib, Warfarin.

Genotype/Haplotype Details

CYP2A6

Allele Tested: *1A,*1D,*2,*4,*5,*6,*7,*8,*9,*11,*17,*18,*20,*21,*23,*35,*39,*41,*44CNVs.

Genetic results: CYP2A6 *1A/*1A

Phenotype: Extensive metabolizer

Gene	Protein change	Nucleotide change	Allele	Marker	Genotype
CYP2A6		-1013A>G	*1D	rs4803381	A/A
CYP2A6	Leu160His	479T>A	*2	rs1801272	T/T
CYP2A6	Gly479Val	1283G>T	*5	rs5031017	G/G
CYP2A6	Arg128Gln	383G>A	*6	rs4986891	G/G
CYP2A6	Ile471Thr	1412T>C	*7	rs5031016	T/T
CYP2A6	Arg485Leu	1454G>T	*8	rs28399468	G/G
CYP2A6		-48T>G	*9	rs28399433	T/T
CYP2A6	Ser224Pro	670T>C	*11	rs28399447	T/T
CYP2A6	Val365Met	1093G>A	*17	rs28399454	G/G
CYP2A6	Tyr392Phe	1175A>T	*18	rs1809810	A/A
CYP2A6	196fs	587_588delAA	*20	rs28399444	AA/AA
CYP2A6	Lys476Arg	1427A>G	*21	rs6413474	A/A
CYP2A6	Arg203Ser	607C>T	*23	rs56256500	C/C
CYP2A6	Asn438Tyr	1312A>T	*35	rs143731390	A/A
CYP2A6	Val68Met	202G>A	*39	rs143690364	G/G
CYP2A6	Arg265Gln	794G>A	*41	rs140471703	G/G
CYP2A6	Glu390Lys	1168G>A	*44	rs376817657	G/G
CYP2A6	CNV assay		*4/XN	CYP2A6_CNVs	2

CYP2A6 is the most important gene in the metabolism of: Artesunate, Nicotine, Tegafur.

Drugs and substances known to induce CYP2A6 activity include: Pentobarbital, Phenobarbital, Rifampicin.

Drugs and substances known to inhibit CYP2A6 activity include: Grapefruit juice flavonoids, Ketoconazole, Methoxsalen, Pilocarpine, Tranylcypromine.

Genotype/Haplotype Details

CYP1A2

Allele Tested: *1A,*1B,*1C,*1D,*1E,*1F,*1G,*1J,*1K,*1L,*3,*4,*5,*6,*7,*8,*11,*15,*16.

Genetic results: CYP1A2 *1A/*1A

Phenotype: Extensive metabolizer

Gene	Protein change	Nucleotide change	Allele	Marker	Genotype
CYP1A2	Asn516Asn	1548T>C	*1B	rs2470890	T/T
CYP1A2		-3860G>A	*1C	rs2069514	G/G
CYP1A2		-2467delT	*1D	rs35694136	T/T
CYP1A2		-739T>G	*1E	rs2069526	T/T
CYP1A2		-729C>T	*1K	rs12720461	C/C
CYP1A2		-163C>A	*1F	rs762551	C/C
CYP1A2	Asp348Asn	1042G>A	*3	rs56276455	G/G
CYP1A2	Ile386Phe	1156A>T	*4	rs72547516	A/A
CYP1A2	Cys406Tyr	1217G>A	*5	rs55889066	G/G
CYP1A2	Arg431Trp	1291C>T	*6	rs28399424	C/C
CYP1A2	Splicing defect	1253+1G>A	*7	rs56107638	G/G
CYP1A2	Arg456His	1367G>A	*8	rs72547517	G/G
CYP1A2	Phe186Leu	558C>A	*11	rs72547513	C/C
CYP1A2	Pro42Arg	125C>G	*15	rs72547511	C/C
CYP1A2	Arg377Gln	1130G>A	*16	rs72547515	G/G

CYP1A2 is the most important gene in the metabolism of: Asenapine, Bromazepam, Carmustine, Clozapine, Cyamemazine, Cyclobenzaprine, Eltrombopag, Estradiol, Febuxostat, Flutamide, Frovatriptan, Imipramine, Leflunomide, Lidocaine, Loxapine, Mirtazapine, Nabumetone, Naratriptan, Nintedanib, Palonosetron, Pomalidomide, Promazine, Pyrazinamide, Ramelteon, Rasagiline, Riluzole, Ropinirole, Tacrine, Theophylline, Thiotixene, Tizanidine, Triamterene, Trifluoperazine, Zileuton, Zolmitriptan.

Drugs and substances known to induce CYP1A2 activity include: beta-naphthoflavone, char-grilled meat, Marijuana, Modafinil, Omeprazole, Tobacco.

Drugs and substances known to inhibit CYP1A2 activity include: Amiodarone, Efavirenz, Fluoroquinolones, Fluvoxamine, Ticlopidine, Verapamil.

CYP1A2 activity is dependent upon hepatic and renal function status as well as age.

Genotype/Haplotype Details

CYP2B6

Allele Tested: *1,*4,*5,*6,*7,*8,*9,*10,*11,*12,*13,*14,*15,*18,*16,*19,*20,*21,*22,*26,*27,*28, and Gene Del/Dup.

Genetic results: CYP2B6 Del/Dup or *1/*1

Phenotype: Extensive metabolizer

Gene	Protein change	Nucleotide change	Allele	Marker	Genotype
CYP2B6	Lys262Arg	785A>G	*4	rs2279343	A/A
CYP2B6	Arg487Cys	1459C>T	*5/*7	rs3211371	C/C
CYP2B6	Gln172His	516G>T	*6/*9	rs3745274	G/G
CYP2B6	Lys139Glu	415A>G	*8/*13	rs12721655	A/A
CYP2B6	Arg22Cys	64C>T	*10	rs8192709	C/C
CYP2B6	Met46Leu	136A>G	*11	rs35303484	A/A
CYP2B6	Gly99Glu	296G>A	*12	rs36060847	G/G
CYP2B6	Arg140Gln	419G>A	*14	rs35773040	G/G
CYP2B6	Ile391Asn	1172T>A	*15	rs35979566	T/T
CYP2B6	Ile328Thr	983T>C	*16	rs28399499	T/T
CYP2B6	Arg336Cys	1006C>T	*19	rs34826503	C/C
CYP2B6	Thr168Ile	503C>T	*20	rs36056539	C/C
CYP2B6	Pro428Thr	1282C>A	*21	rs35010098	C/C
CYP2B6		-82T>C	*22	rs34223104	T/T
CYP2B6	Pro167Ala	499C>G	*26	rs3826711	C/C
CYP2B6	Met198Thr	593T>C	*27	rs36079186	T/T
CYP2B6	Arg378Ter	1132C>T	*28	rs34097093	C/C

CYP2B6 is the most important gene in the metabolism of: Bupropion, Cyclophosphamide, Efavirenz, Iphosphamide, Meperidine, Ondansetron, Selegiline, Sertraline.

Drugs and substances known to induce CYP2B6 activity include: Artemisinin, Carbamazepine, Efavirenz, Nevirapine, Phenobarbital, Phenytoin, Rifampicin.

Drugs and substances known to inhibit CYP2B6 activity include: Clopidogrel, Orphenadrine, Thioteipa, Ticlopidine, Voriconazole.

Genotype/Haplotype Details

CYP2C8

Allele Tested: *1,*2,*3,*4,*5,*6,*7,*8,*11,*14.

Genetic results: CYP2C8 *1/*1

Phenotype: Extensive metabolizer

Gene	Protein change	Nucleotide change	Allele	Marker	Genotype
CYP2C8	Ile269Phe	805A>T	*2	rs11572103	A/A
CYP2C8	Arg139Lys	416G>A	*3	rs11572080	G/G
CYP2C8	Lys399Arg	1196A>G	*3	rs10509681	A/A
CYP2C8	Ile264Met	792C>G	*4	rs1058930	C/C
CYP2C8	Thr159Profs	475delA	*5	rs72558196	A/A
CYP2C8	Arg186Ter/Gly	556C>T/G	*7/*8	rs72558195	C/C
CYP2C8	Glu274Ter	820G>T	*11	rs78637571	G/G
CYP2C8	Ala238Pro	712G>C	*14	rs188934928	G/G

CYP2C8 is the most important gene in the metabolism of: Amodiaquine, Chloroquine, Dabrafenib, Desloratadine, Enzalutamide, Isotretinoin, Nicardipine, Paclitaxel, Pioglitazone, Repaglinide, Rosiglitazone.

Drugs and substances known to induce CYP2C8 activity include: Rifampicin.

Drugs and substances known to inhibit CYP2C8 activity include: Gemfibrozil, Montelukast, Trimethoprim.

Genotype/Haplotype Details

CYP2C9

Allele Tested: *1,*2,*3,*4,*5,*6,*7,*8,*9,*10,*11,*12,*13,*14,*15,*16,*18,*24,*25,*27,*31,*33.

Genetic results: CYP2C9 *1/*1

Phenotype: Extensive metabolizer

Gene	Protein change	Nucleotide change	Allele	Marker	Genotype
CYP2C9	Arg144Cys	430C>T	*2	rs1799853	C/C
CYP2C9	Ile359Leu	1075A>C	*3	rs1057910	A/A
CYP2C9	Ile359Asn	1076T>C	*4	rs56165452	T/T
CYP2C9	Asp360Glu	1080C>G	*5	rs28371686	C/C
CYP2C9	Lys273Argfs	817delA	*6	rs9332131	A/A
CYP2C9	Leu191Ile	55C>A	*7	rs67807361	C/C
CYP2C9	Arg150His/Leu	449G>A/T	*8/*27	rs7900194	G/G
CYP2C9	His251Arg	752A>G	*9	rs2256871	A/A
CYP2C9	Glu272Gly	815A>G	*10	rs9332130	A/A
CYP2C9	Arg335Trp	1003C>T	*11	rs28371685	C/C
CYP2C9	Pro489Ser	1465C>T	*12	rs9332239	C/C
CYP2C9	Leu90Pro	269T>C	*13	rs72558187	T/T
CYP2C9	Arg125His	374G>A	*14	rs72558189	G/G
CYP2C9	Ser162Ter	485C>A	*15	rs72558190	C/C
CYP2C9	Thr299Ala	895A>G	*16	rs72558192	A/A
CYP2C9	Asp397Ala	1190A>C	*18	rs72558193	A/A
CYP2C9	Glu354Lys	1060G>A	*24	rs749060448	G/G
CYP2C9	118fs	353_362delAGAAATGGAA	*25	rs72558188	I/I
CYP2C9	Ile327Thr	980T>C	*31	rs57505750	T/T
CYP2C9	Arg132Gln	395G>A	*33	rs200183364	G/G

CYP2C9 is the most important gene in the metabolism of: Acenocoumarol, Alosetron, Azilsartan, Bosentan, Cannabinol (CBN), Celecoxib, Chloramphenicol, Delta 9-tetra hydrocannabinol (Δ 9 THC), Dronabinol, Fenoprofen, Flurbiprofen, Fluvastatin, Gliclazide, Glimepiride, Glipizide, Clqiduone, Ibuprofen, Indomethacin, Irbesartan, Ketobemidone, Lacosamide, Lornoxicam, Losartan, Mefenamic acid, Meloxicam, Mestranol, Naproxen, Nateglinide, Paramethadione, Parecoxib, Phenprocoumon, Piroxicam, Primidone, Sulfinpyrazone, Tapentadol, Tenoxicam, Terbinafine, Thiamylal, Tolazamide, Tolbutamide, Torasemide, Trimethadione, Valsartan, Vismodegib, Warfarin, Zafirlukast.

Drugs and substances known to induce CYP2C9 activity include: Carbamazepine, Nevirapine, Phenobarbital, Rifampicin, Secobarbital.

Drugs and substances known to inhibit CYP2C9 activity include: Amentoflavone, Amiodarone, Apigenin, Isoniazid, Fluconazole, Miconazole, Sulfaphenazole, Valproic acid.

Genotype/Haplotype Details
CYP2C19
Allele Tested: *1A,*1B,*2A,*2B,*3,*4,*5A,*5B,*6,*7,*8,*9,*10,*12,*16,*17,*19,*22,*24,*25,*26,*27,*35.
Genetic results: CYP2C19 *1A/*1A
Phenotype: Extensive metabolizer

Gene	Protein change	Nucleotide change	Allele	Marker	Genotype
CYP2C19	Ile331Val	991A>G	*1B	rs3758581	A/A
CYP2C19	Splicing defect	681G>A	*2	rs4244285	G/G
CYP2C19	Glut92Asp	276G>C	*2B	rs17878459	G/G
CYP2C19	Trp212Ter	636G>A	*3	rs4986893	G/G
CYP2C19	Met1Val	1A>G	*4	rs28399504	A/A
CYP2C19	Arg433Trp	1297C>T	*5	rs56337013	C/C
CYP2C19	Arg132Gln	395G>A	*6	rs72552267	G/G
CYP2C19	Splicing defect	819+2T>A	*7	rs72558186	T/T
CYP2C19	Trp120Arg	358T>C	*8	rs41291556	T/T
CYP2C19	Arg144His	431G>A	*9	rs17884712	G/G
CYP2C19	Pro227Leu	690C>T	*10	rs6413438	C/C
CYP2C19	Ter491Cys	1473A>C	*12	rs55640102	A/A
CYP2C19	Arg1442Cys	1324C>T	*16	rs192154563	C/C
CYP2C19		-806C>T	*17	rs12248560	C/C
CYP2C19	Ser51Gly	151A>G	*19	151A>G-Ser51Gly	A/A
CYP2C19	Arg186Pro	557G>C	*22	rs140278421	G/G
CYP2C19	Arg335Gln	1004G>A	*24	rs118203757	G/G
CYP2C19	Phe448Leu	1344C>G	*25	rs118203759	C/C
CYP2C19	Asp256Asn	766G>A	*26	766G>A-Asp256Asn	G/G
CYP2C19		-1041G>A	*27	rs7902257	G/G
CYP2C19		332-23A>G	*35	rs12769205	A/A

CYP2C19 is the most important gene in the metabolism of: Barbiturates, Carbamazepine, Clotrimazole, Clobazam, Clopidogrel, Dextansoprazole, Diazepam, Enfuvirtide, Esomeprazole, Flunitrazepam, Hexobarbital, Mephénytoin, Moclobemide, Nelfinavir, Nilutamide, Omeprazole, Pantoprazole, Pentamidine, Phenobarbital, Phenytoin, Proguanil, Rabeprazole, Temazepam, Teniposide, Voriconazole.

Drugs and substances known to induce CYP2C19 activity include: Artemisinin, Carbamazepine, Efavirenz, Norethisterone, Rifampicin, Ritonavir, St. John's Wort.

Drugs and substances known to inhibit CYP2C19 activity include: Chloramphenicol, Esomeprazole, Felbamate, Fluvoxamine, Isoniazid, Lansoprazole, Moclobemide, Omeprazole.

Genotype/Haplotype Details
CYP2D6
Allele

*1,*2A,*2B,*2D,*3,*4A,*4B,*4K,*4M,*4N,*5,*6A,*6C,*7,*8,*9,*10,*11,*12,*13,*14A,*14B,*15,*16,*17,*18,*19,*20,*21,*29,*30,*31,*34,*35,*36,*38,*39,*40,*41,*42,*44,*45,*47,*49,*50,*51,*53,*54,*56A,*56B,*60,*61,*62,*63,*68,*69,*70,*72,*81,*96,*100,*101 and CNVs.

Genetic results: CYP2D6 *1/*1
Phenotype: Extensive metabolizer

Gene	Protein change	Nucleotide change	Allele	Marker	Genotype
CYP2D6	Arg296Cys	886C>T	*2	rs16947	C/C
CYP2D6	Ser486Thr	1457G>C	*2	rs1135840	G/G
CYP2D6	Val136Val	408G>C	*2A	rs1058164	G/G
CYP2D6		-1584C>G	*2A	rs1080985	C/C
CYP2D6	Arg259Glyfs	775delA	*3	rs35742686	A/A
CYP2D6	Splicing defect	506-1G>A	*4	rs3892097	G/G
CYP2D6	CNV assay		*5/XN	CYP2D6_CNVs	2
CYP2D6	Trp152Glyfs	454delT	*6	rs5030655	T/T
CYP2D6	His324Pro	971A>C	*7	rs5030867	A/A
CYP2D6	Gly169Ter/Arg	505G>T/A	*8/*14	rs5030865	G/G
CYP2D6	Lys281del	841_843delAAG	*9	rs5030656	AAG/AAG
CYP2D6	Pro34Ser	100C>T	*10	rs1065852	C/C
CYP2D6	Splicing defect	181-1G>C	*11	rs201377835	G/G
CYP2D6	Gly42Arg	124G>A	*12	rs5030862	G/G
CYP2D6			*13	CYP2D7/2D6 hybrid *13	0
CYP2D6	46fs	137-138insT	*15	rs774671100	-/-
CYP2D6	Thr107Ile	320C>T	*17	rs28371706	C/C
CYP2D6	468_470dupVPT	4125_4133dupGTGCCCACT	*18	rs765776661	-/-
CYP2D6	255fs	2539_2542delAACT	*19	rs72549353	AACT/AACT
CYP2D6	211fs	1973_1974insG	*20	rs72549354	-/-
CYP2D6	Arg269Profs	805_806insC	*21	rs72549352	-/-
CYP2D6	Val338Met	1012G>A	*29	rs59421388	G/G
CYP2D6	Val136Met	406G>A	*29/*70	rs61736512	G/G
CYP2D6	Arg440His	1319G>A	*31	rs267608319	G/G
CYP2D6	Val11Met	31G>A	*35	rs769258	G/G
CYP2D6	(sing-dup)		*36	CYP2D7/2D6 hybrid *36	#/NA
CYP2D6	Thr272Argfs	813_816delGACT	*38	rs72549351	GACT/GACT
CYP2D6	Pro174_Asn175insSphArgPro*2	522_523insTTTCGCCCCCTTCGCCCC	*40	rs72549356	-/-
CYP2D6	Splicing defect	985+39G>A	*41	rs28371725	G/G
CYP2D6	Gln364Cysfs	1088_1089insGT	*42	rs72549346	-/-
CYP2D6	Splicing defect	985+1G>C	*44	rs72549349	G/G
CYP2D6	Glu155Lys	463G>A	*45	rs28371710	G/G
CYP2D6	Arg257Trp	73C>T	*47	rs267608313	C/C
CYP2D6	Phe120Ile	358T>A	*49	rs1135822	T/T
CYP2D6	Glu155Ala	464A>C	*50	rs267608302	A/A
CYP2D6	Glu334Ala	1001A>C	*51	rs72549348	A/A
CYP2D6	Ala122Ser	364G>T	*53	rs1135823	G/G
CYP2D6	Thr261Ile	782C>T	*54	rs267608297	C/C
CYP2D6	Arg344Ter	1030C>T	*56A	rs147960066	C/C
CYP2D6	Ser183Ter	546_547insTA	*60	546_547insTA-Ser183Ter	-/-
CYP2D6			*61	CYP2D7/2D6 hybrid *61	0
CYP2D6	Arg441Cys	1168C>T	*62	rs730882251	C/C
CYP2D6			*63	CYP2D7/2D6 hybrid *63	0
CYP2D6			*68	CYP2D7/2D6 hybrid *68	WT/WT
CYP2D6	Glu383Lys	1147G>A	*72	rs75386357	G/G
CYP2D6	Arg269Ter	805C>T	*81	rs367543000	C/C
CYP2D6	Gln424Ter	1270C>T	*96	rs763964554	C/C
CYP2D6	Ser288Argfs	864delC	*100	rs267608279	C/C
CYP2D6	Met321Ilefs	810_828del19	*101	rs730882170	WT/WT
WBP2NL				rs5758550	G/G

CYP2D6 is the most important gene in the metabolism of: Aciclovir, Amitriptyline, Amoxapine, Arformoterol, Aripiprazole, Atomoxetine, Bisoprolol, Carvedilol, Chlorpromazine, Clomipramine, Clonidine, Codeine, Cyclizine, Dapoxetine, Darifenacin, Debrisoquine, Desipramine, Dexmethylphenidate, Dextromethorphan, Diphenhydramine, Donepezil, Dosulepin, Doxepin, Duloxetine, Encainide, Ethylmorphine, Flecainide, Fluoxetine, Fluphenazine, Fluvoxamine, Formoterol, Galantamine, Hydrocodone, Hydroxychloroquine, Iloperidone, Labetalol, Lisdexamfetamine, Loracaserin, Maprotiline, Methamphetamine, Methylnaltrexone, Methylphenidate, Metoclopramide, Metoprolol, Mexiletine, Mianserin, Modafinil, Nebivolol, Nefazodone, Nortriptyline, Paliperidone, Paroxetine, Perphenazine, Primaquine, Procainamide, Prochlorperazine, Promethazine, Propafenone, Propranolol, Protriptyline, Reserpine, Risperidone, Sertindole, Sparteine, Tetrabenazine, Thioridazine, Timolol, Tolterodine, Tramadol, Trimipramine, Umeclidinium, Venlafaxine, Vicoprofen, Vortioxetine, Zuclopentixol.

In Caucasians, approximately 6-10% are CYP2D6 poor metabolizers and up to 7% are ultrarapid drug metabolizers.

Drugs and substances known to induce CYP2D6 activity include: Dexmethylasone, Glutethimide, Rifampicin.

Drugs and substances known to inhibit CYP2D6 activity include: Bupropion, Fluoxetine, Paroxetine, Quinidine, Ritonavir.

Genotype/Haplotype Details**CYP2E1**

Allele Tested: *1,*2,*4,*7.

Genetic results: CYP2E1 *1/*1

Phenotype: Extensive metabolizer

Gene	Protein change	Nucleotide change	Allele	Marker	Genotype
CYP2E1	Arg76His	227G>A	*2	rs72559710	G/G
CYP2E1	Val179Ile	535G>A	*4	rs6413419	G/G
CYP2E1		-333T>A	*7	rs2070673	T/T

CYP2E1 is the most important gene in the metabolism of: Dalfampridine, Dapsone, Enflurane, Halothane, Isoflurane, Methoxyflurane, Mitoxantrone, Sevoflurane.

Drugs and substances known to induce CYP2E1 activity include: Ethanol, Isoniazid.

Drugs and substances known to inhibit CYP2E1 activity include: Disulfiram

Genotype/Haplotype Details**CYP2J2**

Allele Tested: *1,*7.

Genetic results: CYP2J2 *1/*1

Phenotype: Extensive metabolizer

Gene	Protein change	Nucleotide change	Allele	Marker	Genotype
CYP2J2		-76G>T	*7	rs890293	G/G

Genotype/Haplotype Details**CYP3A4**

Allele Tested: *1A,*1B,*2,*3,*6,*7,*8,*9,*10,*11,*12,*13,*15,*16,*17,*18,*20,*22,*26.

Genetic results: CYP3A4 *1A/*1A

Phenotype: Extensive metabolizer

Gene	Protein change	Nucleotide change	Allele	Marker	Genotype
CYP3A4		-392A>G	*1B	rs2740574	A/A
CYP3A4	Ser222Pro	664T>C	*2	rs55785340	T/T
CYP3A4	Met445Thr	1334T>C	*3	rs4986910	T/T
CYP3A4	Asp277Glufs	830_831insA	*6	rs4646438	-/-
CYP3A4	Gly56Asp	167G>A	*7	rs56324128	G/G
CYP3A4	Arg130Gln	389G>A	*8	rs72552799	G/G
CYP3A4	Val170Ile	508G>A	*9	rs72552798	G/G
CYP3A4	Asp174His	520G>C	*10	rs4986908	G/G
CYP3A4	Thr362Met	1088C>T	*11	rs67784355	C/C
CYP3A4	Leu373Phe	1117C>T	*12	rs12721629	C/C
CYP3A4	Pro416Leu	1247C>T	*13	rs4986909	C/C
CYP3A4	Arg162Gln	485G>A	*15	rs4986907	G/G
CYP3A4	Thr185Ser	554C>G	*16	rs12721627	C/C
CYP3A4	Phe189Ser	566T>C	*17	rs4987161	T/T
CYP3A4	Leu293Pro	878T>C	*18	rs28371759	T/T
CYP3A4	Lys487_Pro488delinsLysThrArgfs	1461_1462insA	*20	rs67666821	-/-
CYP3A4		522-191C>T	*22	rs35599367	C/C
CYP3A4	Arg268Ter	802C>T	*26	rs138105638	C/C

Genotype/Haplotype Details

CYP3A5

Allele Tested: *1A,*1D,*2,*3A,*3B,*3K,*3L,*4,*5,*6,*7,*8,*9.

Genetic results: CYP3A5 *1A/*1A

Gene	Protein change	Nucleotide change	Allele	Marker	Genotype
CYP3A5	Thr398Asn	1193C>A	*2	rs28365083	C/C
CYP3A5	Splicing defect	689-1A>G	*3	rs776746	A/A
CYP3A5	His30Tyr	58C>T	*3B	rs28383468	C/C
CYP3A5	Leu327Thrfs	92_93insG	*3B	rs200579169	-/-
CYP3A5		*14C>T	*1D/*3	rs15524	C/C
CYP3A5	Gln200Arg	599A>G	*4	rs56411402	A/A
CYP3A5	Splicing defect	T>C	*5	rs55965422	T/T
CYP3A5	Splicing defect	624G>A	*6	rs10264272	G/G
CYP3A5	Thr346Tyrfs	1035_1036insT	*7	rs41303343	-/-
CYP3A5	Arg28Cys	82C>T	*8	rs55817950	C/C
CYP3A5	Ala337Thr	1009G>A	*9	rs28383479	G/G
CYP3A5	Phe446Ser	1337T>C	*3K	rs41279854	T/T

Drugs and substances known to inhibit CYP3A4/5 activity include: Chloramphenicol, Clarithromycin, Grapefruit juice flavonoids, Indinavir, Itraconazole, Ketoconazole, Nefazodone, Nelfinavir, Ritonavir

Genotype/Haplotype Details

CYP4F2

Allele Tested: *1,*2,*3.

Genetic results: CYP4F2 *1/*1

Gene	Protein change	Nucleotide change	Allele	Marker	Genotype
CYP4F2	Trp12Gly	34T>G	*2	rs3093105	T/T
CYP4F2	Val433Met	1297G>A	*3	rs2108622	G/G

CYP4F2 is the most important gene in the metabolism of: Eingolimod

Genotype/Haplotype Details

Genotype

Allele Tested: H1 H2 H3 H4 H5 H6 H7 H8 H9

Allele Tested: H1,H2,H3,H4,H5,H
Genetic results: VKORC1 H1/H1

Genetic results: VKORC1 H1/H1
Phenotype: Sensitive to Warfarin

Gene	Protein change	Nucleotide change	Allele	Marker	Genotype
VKORC1		497T>G	H2	rs2884737	T/T
VKORC1		2255T>C	H3	rs2359612	T/T
VKORC1		1542C>G	H3	rs8050894	C/C
VKORC1		1173T>C	H4	rs9934438	T/T
VKORC1		-1639A>G	H4	rs9923231	A/A
VKORC1		296C>T	H5	rs7196161	C/C
VKORC1		3730G>A	H7	rs7294	G/G
VKORC1		776C>A	H8	rs17880887	C/C
VKORC1		173+525C>T	H9	rs17708472	C/C
VKORC1		2568G>C	H9	rs17881535	G/G

The VKORC1 gene encodes the vitamin K epoxide reductase enzyme, the drug target of Warfarin.

Genotype/Haplotype Details**SLC15A2**

Allele Tested: *1,*509K,*284A,*350F,*409S.

Genetic results: SLC15A2 *1/*1

Phenotype: Extensive function

Gene	Protein change	Nucleotide change	Allele	Marker	Genotype
SLC15A2	Arg509Lys	1526G>A	*509K	rs1143672	G/G
SLC15A2	A284A	852G>A	*284A	rs2293616	G/G
SLC15A2	Leu350Phe	1048C>T	*350F	rs2257212	C/C
SLC15A2	Pro409Ser	1225C>T	*409S	rs1143671	C/C

SLC15A2 is an important pharmacokinetic gene affecting drug disposition. Pharmaceutical agents affected include: Sorafenib.

Genotype/Haplotype Details**SLC22A1**

Allele Tested: *1,*61C,*88R,*220V,*283L,*287G,*341L,*401S,*408V,*420Del,*465R.

Genetic results: SLC22A1 *1/*1

Phenotype: Extensive function

Gene	Protein change	Nucleotide change	Allele	Marker	Genotype
SLC22A1	Arg61Cys	181C>T	*61C	rs12208357	C/C
SLC22A1	Cys88Arg	262T>C	*88R	rs55918055	T/T
SLC22A1	Gly220Val	659G>T	*220V	rs36103319	G/G
SLC22A1	Pro283Leu	848C>T	*283L	rs4646277	C/C
SLC22A1	Arg287Gly	859C>G	*287G	rs4646278	C/C
SLC22A1	Pro341Leu	1022C>T	*341L	rs2282143	C/C
SLC22A1	Gly401Ser	1201G>A	*401S	rs34130495	G/G
SLC22A1	Met408Val	1222A>G	*408V	rs628031	A/A
SLC22A1	Met420del	1260_1262delGAT	*420Del	rs72552763	GAT/GAT
SLC22A1	Met420del	AAGTTGGT	*420Del	rs4646281	AAGTTGGT/AAGTTGGT
SLC22A1	Met420Argfs	1259delT	*420Del	rs34305973	T/T
SLC22A1	Met420Terfs	1258delA	*420Del	rs35167514	A/A
SLC22A1	Gly465Arg	1393G>A	*465R	rs34059508	G/G

SLC22A1 is an important pharmacokinetic gene affecting drug disposition. Pharmaceutical agents affected include: Anthracyclines, Cisplatin, Dalfampridine, Lamivudine, Metformin, Pazopanib.

Genotype/Haplotype Details**SLC22A2**

Allele Tested: *1,*2,*3,*4and Gene Del/Dup.

Genetic results: SULT1A1 Del/Dup or *1/*1

Phenotype: Extensive metabolizer

Gene	Protein change	Nucleotide change	Allele	Marker	Genotype
SLC22A2	Pro54Ser	160C>T	*54S	rs8177504	C/C
SLC22A2	Met165Val	493A>G	*165V	rs8177508	A/A
SLC22A2	Ser270Ala	808T>G	*270A	rs316019	T/T
SLC22A2	Arg400Cys	1198C>T	*400C	rs8177516	C/C
SLC22A2	Lys432Gln	1294A>C	*432N	rs8177517	A/A

SLC22A2 is an important pharmacokinetic gene affecting drug disposition. Pharmaceutical agents affected include: Sorafenib.

Genotype/Haplotype Details**SLC22A6**

Allele Tested: *1,*50H.

Genetic results: SLC22A6 *1/*1

Phenotype: Extensive function

Gene	Protein change	Nucleotide change	Allele	Marker	Genotype
SLC22A6	Arg50His	149G>A	*50H	rs11568626	G/G

Genotype/Haplotype Details**SLCO1B1**

Allele Tested: *1A,*1B,*2,*3,*4,*5,*6,*9,*10,*11,*12,*13,*14,*15,*17,*19,*21,*22,*23.

Genetic results: SLCO1B1 *1A/*1A

Phenotype: Extensive function

Gene	Protein change	Nucleotide change	Allele	Marker	Genotype
SLCO1B1	Asn130Asp	388A>G	*1B	rs2306283	A/A
SLCO1B1	Phe73Leu	217T>C	*2	rs56101265	T/T
SLCO1B1	Val82Ala	245T>C	*3	rs56061388	T/T
SLCO1B1	Glu156Gly	467A>G	*3/*13	rs72559745	A/A
SLCO1B1	Pro155Thr	463C>A	*4/*14	rs11045819	C/C
SLCO1B1	Val174Ala	521T>C	*5	rs4149056	T/T
SLCO1B1	Ile353Thr	1058T>C	*6	rs55901008	T/T
SLCO1B1	Gly488Ala	1463G>C	*9	rs59502379	G/G
SLCO1B1	Asp655Gly	1964A>G	*10/*12	rs56199088	A/A
SLCO1B1	Glu667Gly	2000A>G	*11	rs55737008	A/A
SLCO1B1	-910G>A		*17	rs4149015	G/G
SLCO1B1	Leu643Phe	1929A>C	*19	rs34671512	A/A
SLCO1B1	Gly71Arg	211G>A	*23	rs373327528	G/G

SLCO1B1 is an important pharmacokinetic gene affecting drug disposition. Pharmaceutical agents affected include: Atorvastatin, Cerivastatin, Cytarabine, Fluvastatin, Irinotecan, Lopinavir, Lovastatin, Methotrexate, Mycophenolate mofetil, Olmesartan, Pravastatin, Repaglinide, Simvastatin.

Genotype/Haplotype Details**SLCO1B3**

Allele Tested: *1A,*1B,*2,*3,*4,*5,*6,*9,*10,*11,*12,*13,*14,*15,*17,*19,*21,*22,*23.

Genetic results: SLCO1B3 *1/*1

Phenotype: Extensive function

Gene	Protein change	Nucleotide change	Allele	Marker	Genotype
SLCO1B3	Ser112Ala	334T>G	*112A	rs4149117	T/T
SLCO1B3	Met233Ile	699G>A	*233I	rs7311358	G/G

SLCO1B3 is an important pharmacokinetic gene affecting drug disposition. Pharmaceutical agents affected include: Carboplatin, Docetaxel, Mycophenolate mofetil, Paclitaxel.

Genotype/Haplotype Details**SLCO2B1**

Allele Tested: *1,*3.

Genetic results: SLCO2B1 *1/*1

Phenotype: Extensive function

Gene	Protein change	Nucleotide change	Allele	Marker	Genotype
SLCO2B1	Ser486Phe	1457C>T	*3	rs2306168	C/C

SLCO1B3 is an important pharmacokinetic gene affecting drug disposition. Pharmaceutical agents affected include: SLCO2B1 is an important pharmacokinetic gene affecting drug disposition. Pharmaceutical agents affected include: Fexofenadine, Montelukast.

Genotype/Haplotype Details**ABCB1**

Allele Tested: *1,*2.

Genetic results: ABCB1 *1/*1

Phenotype: Extensive function

Gene	Protein change	Nucleotide change	Allele	Marker	Genotype
ABCB1	Ile1145Ile	3435C>T	*6	rs1045642	C/C
ABCB1	Ser893Ala	2677G>T/A	*7	rs2032582	G/G
ABCB1	Gly412Gly	1236C>T	*8	rs1128503	C/C

ABCB1 is an important pharmacokinetic gene modifying drug disposition. Pharmaceutical agents affected include: Alfentanyl, Aliskiren, Atazanavir, Atorvastatin, Carbamazepine, Cisplatin, Clopidogrel, Cyclosporine, Digoxin, Doxorubicin, Efavirenz, Etoposide, Fentanyl, Imatinib, Labetalol, Methadone, Morphine, Nevirapine, Nortriptyline, Ondansetron, Oxycodone, Paclitaxel, Phenobarbital, Phenytoin, Pitavastatin, Pravastatin, Risperidone, Simvastatin, Tacrolimus, Verapamil.

Genotype/Haplotype Details**ABCC2**

Allele Tested: *1,*417I,*789F,*768W,*1324I,*1450S.

Genetic results: ABCC2 *1/*1

Phenotype: Extensive function

Gene	Protein change	Nucleotide change	Allele	Marker	Genotype
ABCC2	Val417Ile	1249G>A	*417I	rs2273697	G/G
ABCC2	Ser789Phe	2366C>T	*789F	rs56220353	C/C
ABCC2	Arg768Trp	2302C>T	*768W	rs56199535	C/C
ABCC2	Ile1324=	3972C>T	*1324I	rs3740066	C/C
ABCC2	Ala1450Ser/Thr	4348G>A/T	*1450S/T	rs56296335	G/G

ABCC2 is an important pharmacokinetic gene affecting drug disposition. Pharmaceutical agents affected include: Acetaminophen, Atorvastatin, Carbamazepine, Codeine, Docetaxel, Doxorubicin, Gemtuzumab ozogamicin, Ibuprofen, Irinotecan, Lovastatin, Lamivudine, Methotrexate, Morphine, Mycophenolic acid, Paclitaxel, Pravastatin, Simvastatin, Tramadol, Vincristine.

Genotype/Haplotype Details**ABCG2**

Allele Tested: *1,*141K,*126Ter.

Genetic results: ABCG2 *1/*1

Phenotype: Extensive function

Gene	Protein change	Nucleotide change	Allele	Marker	Genotype
ABCG2	Gln141Lys	421C>A	*141K	rs2231142	C/C
ABCG2	Gln126Ter	376C>T	*126Ter	rs72552713	C/C

ABCG2 is an important pharmacokinetic gene affecting drug disposition. Pharmaceutical agents affected include: Acetaminophen, Atorvastatin, Docetaxel, Doxorubicin, Erlotinib, Fluoropyrimidines, Gefitinib, Imatinib, Irinotecan, Lovastatin, Lamivudine, Methotrexate, Pazopanib, Paclitaxel, Pravastatin, Simvastatin, Uricosurics, Zidovudine.

Genotype/Haplotype Details**ADH1B**

Allele Tested: *1,*2,*3.

Genetic results: ADH1B *1/*1

Phenotype: Extensive metabolizer

Gene	Protein change	Nucleotide change	Allele	Marker	Genotype
ADH1B	His48Arg	143A>G	*2	rs1229984	A/A
ADH1B	Arg370Cys	1108C>T	*3	rs2066702	C/C

ADH1B, also frequently known as ADH2 or ADH beta, is a Class I alcohol dehydrogenase gene. Alcohol dehydrogenases metabolize ethanol to acetaldehyde, which is successively metabolized by aldehyde dehydrogenases (ALDH1A, ALDH2 genes) to acetate.

Genotype/Haplotype Details

ALDH2

Gene	Protein change	Nucleotide change	Allele	Marker	Genotype
ALDH2	Glu504Lys	1510G>A	rs671	G/G	Alcohol flush worse hangovers. Disulfiram probably not effective for alcoholism

ALDH2 metabolize acetaldehyde. Individuals heterozygous or homozygous for the Lys504 ALDH2 gene metabolize acetaldehyde poorly and are consequently susceptible to certain adverse effects of acetaldehyde. These effects include: facial flushing, systemic dermatitis, urticaria, and alcohol-induced respiratory reactions such as exacerbation of asthma bronchoconstriction and rhinitis.

Genotype/Haplotype Details

SULT1A1

Allele Tested: *1,*2,*3,*4 and Gene Del/Dup.

Genetic results: SULT1A1 Del/Dup or *1/*1

Phenotype: Extensive metabolizer

Gene	Protein change	Nucleotide change	Allele	Marker	Genotype
SULT1A1	Arg213His	638G>A	*2	rs9282861	G/G
SULT1A1	Val223Met	667G>A	*3	rs1801030	G/G
SULT1A1	Arg37Gln	110G>A	*4	rs72547527	G/G

SULT1A1 contribute in the metabolism of several drugs including: Acetaminophen, Naproxen, Propofol, Tamoxifen.

Genotype/Haplotype Details

EPHX1

Allele Tested: *1,*113His,*139Arg.

Genetic results: EPHX1 *1/*1

Phenotype: Extensive metabolizer

Gene	Protein change	Nucleotide change	Allele	Marker	Genotype
EPHX1	Tyr113His	337T>C	*113His	rs1051740	T/T
EPHX1	His139Arg	416A>G	*139Arg	rs2234922	A/A

EPHX1 contribute in the metabolism of several drugs including: Carbamazepine, Cisplatin, Cyclophosphamide, Docetaxel, Phenprocoumon, Phenytoin, Warfarin.

Genotype/Haplotype Details

NAT1

Allele Tested: *1,*5,*11,*14,*15,*17,*19,*22.

Genetic results: NAT1 *1/*1

Phenotype: Extensive acetylator

Gene	Protein change	Nucleotide change	Allele	Marker	Genotype
NAT1		*11A>G	*5	rs55793712	A/A
NAT1		-6-34A>T	*11	rs4986989	A/A
NAT1	Arg187Gln	560G>A	*14	rs4986782	G/G
NAT1	Arg187Ter	559C>T	*15	rs5030839	C/C
NAT1	Arg64Trp	190C>T	*17	rs56379106	C/C
NAT1	Arg33Ter	97C>T	*19	rs56318881	C/C
NAT1	Asp251Val	752A>T	*22	rs56172717	A/A

NAT1 contribute in the metabolism of several drugs including: Busulfan, Cotinine, Mesalazine.

Genotype/Haplotype Details

NAT2

Allele Tested: *4,*5A,*5B,*5C,*5D,*5E,*5G,*5J,*6A,*6B,*6C,*6E,*7A,*7B,*11A,*12A,*12B,*12C,*13,*14A,*14B,*14C,*14D,*14E,*14F,*14G,*17,*19,*22.

Genetic results: NAT2 *4/*4

Phenotype: Ultrarapid acetylator

Gene	Protein change	Nucleotide change	Allele	Marker	Genotype
NAT2	Ile114Thr	341T>C	*5	rs1801280	T/T
NAT2	Arg197Gln	590G>A	*6	rs1799930	G/G
NAT2	Gly286Glu	857G>A	*7	rs1799931	G/G
NAT2	Leu161Leu	481C>T	*11	rs1799929	C/C
NAT2	Arg268Lys	803A>G	*12	rs1208	A/A
NAT2	Tyr94Ter	282C>T	*13	rs1041983	C/C
NAT2	Arg64Gln	191G>A	*14	rs1801279	G/G
NAT2	Gln145Pro	434A>C	*17	rs72554616	A/A
NAT2	Arg64Trp	190C>T	*19	rs1805158	C/C
NAT2	Glu203Asp	609G>T	*22	rs45618543	G/G

NAT2 is the most important gene in the metabolism of: Hydralazine, Isoniazid, Isosorbide dinitrate, and certain sulfonamides such as Sulfadimidine, Sulfapyridine.

NAT2 contribute in the metabolism of several drugs including: Caffeine, Dapsone, Flunitrazepam, Procainamide, Nitrazepam.

Genotype/Haplotype Details

TPMT

Allele Tested: *1, *2, *3A, *3B, *3C, *3D, *4, *8, *14, *29, *37.

Genetic results: TPMT *1/*1

Phenotype: Extensive metabolizer

Gene	Protein change	Nucleotide change	Allele	Marker	Genotype
TPMT	Ala80Pro	238G>C	*2	rs1800462	G/G
TPMT	Ala154Thr	460G>A	*3A or *3B	rs1800460	G/G
TPMT	Tyr240Cys	719A>G	*3A or *3C	rs1142345	A/A
TPMT	Glu98Ter	292G>T	*3D	rs72552739	G/G
TPMT	Splicing defect	626-1G>A	*4	rs1800584	G/G
TPMT	Arg215His	644G>A	*8	rs56161402	G/G
TPMT	Met1Val	1A>G	*14	rs9333569	A/A
TPMT	Met1Thr	2T>C	*29	rs267607275	T/T
TPMT	Cys216Ter	648T>A	*37	rs398122996	T/T

TPMT contribute in the metabolism of several drugs including: Azathioprine, Mercaptopurine, Thioguanine.

Genotype/Haplotype Details

GSTP1

Allele Tested: *1A, *1B, *1D, *1C.

Genetic results: GSTP1 *1A/*1A

Phenotype: Extensive metabolizer

Gene	Protein change	Nucleotide change	Allele	Marker	Genotype
GSTP1	Ile105Val	313A>G	*1B or *1C	rs1695	A/A
GSTP1	Ala114Val	341C>T	*1C or *1D	rs1138272	C/C

GSTP1 contribute in the metabolism of several drugs including: Cisplatin, Doxorubicin, Fluorouracil.

Genotype/Haplotype Details

BCHE

Allele Tested: *1, *70G, *539T, *70G*539T, *418V, *271M.

Genetic results: BCHE *1/*1

Phenotype: Extensive function

Gene	Protein change	Nucleotide change	Allele	Marker	Genotype
BCHE	Asp98Gly	293A>G	*98G	rs1799807	A/A
BCHE	Ala567Thr	1699G>A	*567T	rs1803274	G/G
BCHE	Gly418Val	1253G>T	*418V	rs28933390	G/G
BCHE	Thr271Met	812C>T	*271M	rs28933389	C/C

BCHE is the most important gene in the metabolism of: Succinylcholine.

BCHE contribute in the metabolism of several drugs including: Cocaine, Oseltamivir, Prasugrel, Rivastigmine.

Genotype/Haplotype Details

UGT1A1

Allele Tested: *1, *6, *7, *27, *28, *29, *36, *37, *60, *80.

Genetic results: UGT1A1 *1/*1

Phenotype: Extensive metabolizer

Gene	Protein change	Nucleotide change	Allele	Marker	Genotype
UGT1A1		A(TA)(7,5,8)TAA	*28, *36, *37	rs8175347	6/6
UGT1A1	Gly71Arg	211G>A	*6	rs4148323	G/G
UGT1A1		-364C>T	*80	rs887829	C/C
UGT1A1	Tyr486Asp	1453T>G	*7	rs34993780	T/T
UGT1A1	Pro229Gln	686C>A	*27	rs35350960	C/C
UGT1A1	Arg367Gly	1099C>G	*29	rs55750087	C/C
UGT1A1		862-10021T>G	*60	rs4124874	T/T

UGT1A1 is the most important gene in the metabolism of: Bazedoxifene, Ezetimibe, Irinotecan, Raloxifene, Raltegravir, Rosuvastatin.

UGT1A1 contribute in the metabolism of several drugs including: Abacavir, Acetaminophen, Arformoterol, Atorvastatin, Axitinib, Buprenorphine, Carvedilol, Desogestrel, Dolutegravir, Ethinylestradiol, Estradiol, Etoposide, Febuxostat, Fluvastatin, Gemfibrozil, Indacaterol, Ketoconazole, Labetalol, Levothyroxine, Lithotriptone, Losartan, Lovastatin, Morphine, Naltrexone, Nilotinib, Pazopanib, Simvastatin, Telmisartan.

Genotype/Haplotype Details

UGT1A4

Allele Tested: *1, *2, *3.

Genetic results: UGT1A4 *1/*1

Phenotype: Extensive metabolizer

Gene	Protein change	Nucleotide change	Allele	Marker	Genotype
UGT1A4	Pro24Thr	70C>A	*2	rs1799807	C/C
UGT1A4	Leu48Val	142T>G	*3	rs2011425	T/T

UGT1A4 is the most important gene in the metabolism of: Lamotrigine, Olanzapine, Retigabine.

Genotype/Haplotype Details**UGT1A6**

Allele Tested: *1,*2.

Genetic results: UGT1A6 *1/*1

Phenotype: Extensive metabolizer

Gene	Protein change	Nucleotide change	Allele	Marker	Genotype
UGT1A6	Ser7Ala	19T>G	*2	rs6759892	T/T
UGT1A6	Thr181Ala	541A>G	*2	rs2070959	A/A
UGT1A6	Arg184Ser	552A>C	*2	rs1105879	A/A

UGT1A6 contribute in the metabolism of several drugs including: Acetaminophen, Entacapone, Ketoprofen, Naproxen, Nefazodone, Valproic acid.

Genotype/Haplotype Details**UGT1A8**

Allele Tested: *1,*2.

Genetic results: UGT1A8 *1/*1

Phenotype: Extensive metabolizer

Gene	Protein change	Nucleotide change	Allele	Marker	Genotype
UGT1A8	Ala173Gly	518C>T	*2	rs1042597	C/C

UGT1A8 contribute in the metabolism of several drugs including: Bazedoxifene, Morphine, Mycophenolate mofetil, Raloxifene, Valproic acid.

Genotype/Haplotype Details**UGT1A9**

Allele Tested: *1,*2.

Genetic results: UGT1A9 *1/*1

Phenotype: Extensive metabolizer

Gene	Protein change	Nucleotide change	Allele	Marker	Genotype
UGT1A9	Asp256Asn	766G>A	*22	rs58597806	T/T

UGT1A9 is the most important gene in the metabolism of: Dapagliflozin, Fenofibrate, Propofol, Tolcapone

Genotype/Haplotype Details**UGT2B7**

Allele Tested: *1a,*1d,*2a,*2b.

Genetic results: UGT2B7 *1a/*1a

Phenotype: Extensive metabolizer

Gene	Protein change	Nucleotide change	Allele	Marker	Genotype
UGT2B7	Arg124Arg	372A>G	*1d	rs28365063	A/A
UGT2B7	Tyr268His	802C>T	*2a	rs7439366	C/C
UGT2B7		-327G>A	*2b	rs7662029	G/G
UGT2B7		-161C>T	*2b	rs7668258	C/C

UGT2B7 is the most important gene in the metabolism of: Clofibrate, Diclofenac, Hydromorphone, Morphine, Lorazepam-r, Naloxone, Naltrexone, Oxazepam-r, Oxymorphone, Zidovudine.

Genotype/Haplotype Details**UGT2B15**

Allele Tested: *1,*2.

Genetic results: UGT2B15 *1/*1

Phenotype: Extensive metabolizer

Gene	Protein change	Nucleotide change	Allele	Marker	Genotype
UGT2B15	Tyr85Asp	253G>T	*2	rs1902023	G/G

UGT2B15 is the most important gene in the metabolism of: Lorazepam-s, Oxazepam-s.

Genotype/Haplotype Details**DYPD**

Allele Tested: *1,*2A,*2B,*3,*5,*7,*9A,*10,*9B,*12,*13,D949V,M166V.

Genetic results: DYPD *1/*1

Phenotype: Extensive metabolizer

Gene	Protein change	Nucleotide change	Allele	Marker	Genotype
DYPD		1905+1G>A	*2A	rs3918290	G/G
DYPD	Pro633Glnfs	1898delC	*3	rs72549303	C/C
DYPD	Ser534Asn	1601G>A	*4	rs1801158	G/G
DYPD	Ile543Val	1627A>G	*5	rs1801159	A/A
DYPD	Val732Ile	2194G>A	*6	rs1801160	G/G
DYPD	Phe100Serfs	295_298delTCAT	*7	rs72549309	TCAT/TCAT
DYPD	Arg235Trp	703C>T	*8	rs1801266	C/C
DYPD	Cys29Arg	85T>C	*9A/*9B	rs1801265	T/T
DYPD	Arg886His	2612C>T	*9B	rs1801267	G/G
DYPD	Val995Phe	2983G>T	*10	rs1801268	G/G
DYPD	Glu386Ter	1156G>T	*12	rs78060119	G/G
DYPD	Ile560Ser	1679T>G	*13	rs55886062	T/T
DYPD	Asp949Val	2846A>T	D949V	rs67376798	A/A
DYPD	Met166Val	496A>G	M166V	rs2297595	A/A

DYPD is the most important gene in the metabolism of: Cytarabine, Fluorouracil, Tegafur.

Genotype/Haplotype Details

OPRM1

Allele Tested: *1,*2.

Genetic results: OPRM1 *1/*1

Phenotype: Sensitive to Opioids

Gene	Protein change	Nucleotide change	Allele	Marker	Genotype
OPRM1	Asn40Asp	118A>G	*2	rs1799971	A/A

Genotype/Haplotype Details

NUDT15

Allele Tested: *1,*2,*3,*4,*5,*6.

Genetic results: NUDT15 *1/*1

Phenotype: Thiopurines resistance

Gene	Protein change	Nucleotide change	Allele	Marker	Genotype
NUDT15	Arg139Cys	415C>T	*2/*3	rs116855232	C/C
NUDT15	Val18_Val19insGlyVal	50_55dupGAGTCG	*2/*6	rs869320766	-/-
NUDT15	Arg139His	416G>A	*4	rs147390019	G/G
NUDT15	Val18Ile	52G>A	*5	rs186364861	G/G

NUDT15 contribute in the metabolism of several drugs including: Azathioprine, Mercaptopurine, Thioguanine.

Genotype/Haplotype Details

APOE

Allele Tested: *3,*2,*4,*1.

Genetic results: APOE *3/*3

Gene	Protein change	Nucleotide change	Allele	Marker	Genotype
APOE	Arg176Cys	526C>T	*2	rs7412	C/C
APOE	Cys130Arg	388T>C	*4	rs429358	T/T

Genotype/Haplotype Details

G6PD

Allele Tested: A+,A-,A-,B,M,Kaiping,Canton,Mira d'Aire,Kalyan,Viangchan,Miaoli.

Genetic results: G6PD B/B

Gene	Protein change	Nucleotide change	Allele	Marker	Genotype
G6PD	Asn126Asp	376A>G	A+	rs1050829	C/C
G6PD	Val68Met	202G>A	A-	rs1050828	A/A
G6PD	Leu323Pro	968T>C	A-	rs76723693	G/G
G6PD	Ser218Phe	653C>T	M	rs5030868	G/G
G6PD	Arg493His	1478G>A	Kaiping	rs72554664	T/T
G6PD	Arg489Leu	1376G>T	Canton	rs72554665	C/C
G6PD	Asp350Lis	1048G>C	Mira d'Aire	rs34193178	G/G
G6PD	Glu317Lys	949G>A	Kalyan	rs137852339	G/G
G6PD	Val291Met	871G>A	Viangchan	rs137852327	G/G
G6PD	Phe173Trp	519C>G	Miaoli	NC_000023.11:g.154534463G>C	G/G

Background

COMT: COMT is an enzyme that degrades dopamine and norepinephrine, primarily in the prefrontal cortex of the brain. A common single nucleotide polymorphism (SNP) 472G>A, also referred to by the amino acid change 158 Val>Met, is associated with altered COMT enzymatic activity. The 158 Met allele has lower enzymatic activity resulting in less dopamine degradation and higher dopamine concentrations as compared to those carrying the Val allele. Conversely, the 158 Val allele has higher activity and results in lower dopamine levels in the prefrontal cortex. Low dopamine concentrations are associated with cognitive impairments including working memory deficits. Val/Val homozygotes with depression are less likely to achieve remission when treated with SSRI antidepressants, and Val/Val homozygotes with schizophrenia are less likely to demonstrate improved cognitive effects when treated with antipsychotics. In contrast, the Met/Met homozygotes are more likely to achieve remission and demonstrate cognitive improvement when treated with SSRIs and antipsychotics, respectively. The frequency of the 158 Met variant varies from 25-43% depending on the population studied.

CYP1A2: CYP1A2 is a liver enzyme that metabolizes many medications, including theophylline, diazepam, caffeine, many antidepressants, and antipsychotics. CYP1A2 enzymatic activity can be induced by several medications, substrates, and constituents of tobacco smoke. CYP1A2 can also be inhibited by several medications. Detecting inherited variants of the CYP1A2 gene that lead to altered enzymatic activity, particularly in the presence of an inducer, can identify patients who may be at increased risk of having adverse drug reactions or therapeutic failure to standard dosages of CYP1A2 medications. CYP1A2 is responsible for more than 95% of the primary metabolism of caffeine. In several studies, "slow" caffeine metabolizers, had increased risk of myocardial infarction.

CYP2B6: Drugs metabolized mainly by CYP2B6 include artemisinin, bupropion, cyclophosphamide, efavirenz, ketamine, and methadone. CYP2B6 is one of the most polymorphic CYP genes in humans and variants have been shown to affect transcriptional regulation, splicing, mRNA and protein expression, and catalytic activity. Some variants appear to affect several functional levels simultaneously, thus, combined in haplotypes, leading to complex interactions between substrate-dependent and -independent mechanisms. The most common functionally deficient allele is CYP2B6*6 [Q172H, K262R], which occurs at frequencies of 15 to over 60% in different populations. The allele leads to lower expression in liver due to erroneous splicing.

CYP2C19: CYP2C19 metabolizes approximately 10-15% of all drugs, including clopidogrel, citalopram, diazepam, and many of the proton pump inhibitors. Detecting variants of the CYP2C19 gene that cause altered enzymatic activity can identify patients who may be at increased risk of having adverse drug reactions or therapeutic failure to standard dosages of CYP2C19 substrates.

CYP2C9: CYP2C9 metabolizes approximately 10% of all drugs, including warfarin, phenytoin, non-steroidal anti-inflammatory drugs (NSAIDs), and antihyperglycemicsulphonylureas. Detecting variants of the CYP2C9 gene that cause altered enzymatic activity can identify patients who may be at increased risk of having adverse drug reactions or therapeutic failure to standard dosages of CYP2C9 substrates.

CYP2D6: CYP2D6 metabolizes more than 25% of all drugs, including tamoxifen, many antidepressants, antipsychotics, beta-blockers, and opioids. Detecting variants of the CYP2D6 gene that cause altered enzymatic activity can identify patients who may be at increased risk of having adverse drug reactions or therapeutic failure to standard dosages of CYP2D6 substrates. Medications which require activation or inactivation by CYP2D6 should be used with caution in patients with CYP2D6 variants.

CYP3A4: CYP3A4 is a liver enzyme that, in concert with CYP3A5, metabolizes approximately 50% of medications, including many of the statins, benzodiazepines, antibiotics, and antipsychotics.

Detecting variants of the CYP3A4 gene that cause altered enzymatic activity can identify patients who may be at increased risk of having adverse drug reactions while taking standard dosages of 3A4 substrates. 3A4 has higher activity than 3A5 on CYP3A drugs. Roughly 4-10% of the general population possesses inherited differences in 3A4 that cause decreased metabolism. Poor metabolizers may be at increased risk for dose-dependent side effects to drugs normally inactivated by 3A4.

CYP3A5: CYP3A5 is a liver enzyme that, in concert with CYP3A4, metabolizes approximately 50% of medications, including many of the statins, benzodiazepines, antibiotics, and antipsychotics. Detecting variants of the CYP3A5 gene that cause altered enzymatic activity can identify patients who may be at increased risk of having adverse drug reactions while taking standard dosages of 3A5 substrates. More than half of the general population (60-80%) possesses inherited differences in 3A5 that cause decreased metabolism. Poor metabolizers may be at increased risk for dose-dependent side effects to drugs normally inactivated by 3A5.

GLP1R: Not only does GLP1R signaling have a tremendous impact on weight gain (one of the key limiting side-effects of atypical antipsychotics) but it also influences the hypothalamic-pituitary-adrenal axis (HPA) activation, stress and anxiety-related behaviours. GLP1R also has a significant effect on dopaminergic neurotransmission, a key target of antipsychotic drug action. Drugs that target GLP1R can lead to decreased appetite and weight loss.

MTHFR: MTHFR gene variants (c.665C>T and c.1286A>C) correlate with reduced MTHFR enzyme activity. MTHFR enzyme is involved in folate metabolism. The gene catalyzes 5,10-methylenetetrahydrofolate to 5-methyltetrahydrofolate and is a necessary cofactor for the remethylation of homocysteine. Reduced MTHFR enzyme function increases plasma homocysteine. MTHFR gene variants may be associated with methotrexate toxicity, especially in individuals with family history of intolerance, prolonged administration of methotrexate therapy (eg, ALL, CML, rheumatoid arthritis). Dose adjustment or discontinuation of therapy may be advised for individuals with high-risk MTHFR genotypes. The MTHFR gene status is essential to determine genetic cause for hyperhomocysteinemia, predict sensitivity to antifolate drugs (eg, methotrexate).

OPRM1: Opioid agonists, such as morphine, hydromorphone, and oxymorphone, exert their analgesic properties via stimulation of the mu-1 opioid receptor. Analgesic efficacy of mu-acting drugs has been linked to the 118A>G single nucleotide polymorphism (SNP) of OPRM1, the gene encoding the mu-1 receptor. The frequency of the variant G allele varies from 10% to 48% depending on the population studied. Studies show that patients carrying the GG (homozygous variant) genotype require much higher opioid doses to achieve pain relief. Additionally, patients with the AA genotype display higher relapse rates with respect to naltrexone treatment for alcohol dependence.

SLCO1B1: The SLCO1B1 gene encodes the liver enzyme OATP1B1, which assists in transport of statins medications into the liver. Roughly 15% of the population possesses the C variant, an inherited form of SLCO1B1 which increases risk of statin-induced myopathy 3 to 5 fold. Risk of myopathy with the C variant is most closely associated with simvastatin and to a lesser extent, atorvastatin. Patients with the C variant may need the lowest doses of simvastatin or an alternative statin to reduce risk of myopathy. The C variant has reduced activity, leading to higher drug concentrations and worse outcomes with statins.

SULT4A1: Sulfotransferase family 4A, member 1 is a brain sulfotransferase with many interesting properties. However, its exact activities and mechanisms remain unknown. It binds numerous classes of molecules that might impact psychosis like catecholamines – norepinephrine, epinephrine, isoprenolines (but not dopamine); neurosteroids and thyroid hormones. It is known to affect the action of antipsychotics like risperidone, olanzapine etc.

VKORC1: The vitamin K oxidoreductase (VKORC1) recycles vitamin K to support the activation of vitamin K-dependent (VKD) proteins, which have diverse functions that include hemostasis and calcification. Warfarin – an anticoagulant widely used throughout the world. Primary mechanism of action is to inhibit vitamin K epoxide reductase (VKOR). VKOR recycles vitamin K and activates clotting factors II, VII, IX, and X and exerts anticoagulant effects by reducing the concentration of these activated clotting factors. VKOR is the site of action for warfarin. The VKORC1 (c.-1639G>A) variant reduces gene expression and lowers the amount of VKOR protein, leading to warfarin sensitivity. Hence VKORC1 mutational analysis is warranted for Warfarin (Coumadin)-naïve individuals who are being considered for Warfarin therapy, for individuals with personal or family history of difficulty with warfarin, for individuals who are adherent to warfarin therapy, but are difficult to treat (eg, those requiring 49 mg per week to maintain therapeutic international normalized ratio [INR]) and for those individuals who expect to be taken off of warfarin, such as prior to an invasive procedure or surgery, to estimate time required to eliminate the drug.

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Note: This report is solely based on genetic makeup of the individuals and mutation detected at the time of sample collection. Individuals can show new mutations based on environmental changes that can alter the risk for different diseases.

Patient Information Card

An easily portable summary of the report patients can share with their medical professionals. (Please cut along dotted line.)



Pharmacogenomic Test Summary

CYP1A1	*1/*1	Extensive metabolizer
CYP1A2	*1A/*1A	Extensive metabolizer
CYP2A6	*1A/*1A	Extensive metabolizer
CYP2B6	Del/Dup or *1/*1	Extensive metabolizer
CYP2C8	*1/*1	Extensive metabolizer
CYP2C9	*1/*1	Extensive metabolizer
CYP2C19	*1A/*1A	Extensive metabolizer
CYP2D6	*1/*1	Extensive metabolizer
CYP2E1	*1/*1	Extensive metabolizer
CYP2J2	*1/*1	Extensive metabolizer
CYP3A4	*1A/*1A	Extensive metabolizer
CYP3A5	*1A/*1A	Extensive metabolizer
CYP4F2	*1/*1	Extensive metabolizer
VKORC1	H1/H1	Sensitive to Warfarin
SLC15A2	*1/*1	Extensive function
SLC22A1	*1/*1	Extensive function
SLC22A2	*1/*1	Extensive function
SLC22A6	*1/*1	Extensive function
SLCO1B1	*1A/*1A	Extensive function
SLCO1B3	*1/*1	Extensive function
SLCO2B1	*1/*1	Extensive function
ABC B1	*1/*1	Extensive function
ABCC2	*1/*1	Extensive function
ABCG2	*1/*1	Extensive function
ADH1B	*1/*1	Extensive function
SULT1A1	Del/Dup or *1/*1	Extensive metabolizer
EPHX1	*1/*1	Extensive metabolizer
NAT1	*1/*1	Extensive acetylator
NAT2	*4/*4	Ultrarapid acetylator
TPMT	*1/*1	Extensive metabolizer
GSTM1	*1/*1 or Del/Dup	Extensive metabolizer
GSTP1	*1A/*1A	Extensive metabolizer
GSTT1	Del/Dup or *1/*1	Extensive metabolizer
GSTT2b	Del/Dup or *1/*1	Extensive metabolizer
BCHE	*1/*1	Extensive function
UGT1A1	*1/*1	Extensive metabolizer
UGT1A3	*1/*1	Extensive metabolizer
UGT1A4	*1/*1	Extensive metabolizer
UGT1A6	*1/*1	Extensive metabolizer
UGT1A8	*1/*1	Extensive metabolizer
UGT1A9	*1/*1	Extensive metabolizer
UGT2B7	*1a/*1a	Extensive metabolizer
UGT2B15	*1/*1	Extensive metabolizer
UGT2B17	Del/Dup or *1/*1	Extensive metabolizer
DPYD	*1/*1	Extensive metabolizer
OPRM1	*1/*1	Sensitive to Opioids
NUDT15	*1/*1	Thiopurines resistance
APOE	*3/*3	
G6PD	B/B	

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