MAYO CLINIC LABORATORIES | *Pharmacogenomic Associations Tables*

Disclaimer: This is educational material intended for health care professionals. This list is not comprehensive for all of the drugs in the pharmacopeia but focuses on commonly used drugs with high levels of evidence that the CYPs (CYP1A2, CYP2C9, CYP2C19, CYP2D6, CYP3A4 and CYP3A5 only) and other select genes are relevant to a given drug's metabolism. If a drug is not listed, there is not enough evidence for inclusion at this time. Other CYPs and other genes not described here may also be relevant but are out of scope for this document. This educational material is not intended to supersede the care provider's experience and knowledge of her or his patient to establish a diagnosis or a treatment plan. All medications require careful clinical monitoring regardless of the information presented here.

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Table 1: Substrates of Cytochrome P450 (CYP) Enzymes

Allergy

Loratadine	*CYP3A4*

Analgesic/Anesthesiology

Codeine	*CYP2D6 activates*
Cyclobenzaprine	*CYP1A2 CYP2D6 CYP3A4/5*
Fentanyl	*CYP3A4/5*
Hydrocodone	*CYP2D6**
Methadone	*CYP2C19 CYP2C9 CYP2D6 CYP3A4/5*
Midazolam	*CYP3A4/5*
Oxycodone	*CYP2D6**
Tramadol	*CYP2D6 activates*

Anti-inflammatory

Celecoxib	*CYP2C9*
Diclofenac	*CYP2C9 CYP3A4/5*

Anticoagulant/Antiplatelet

Apixaban	*CYP3A4/5*
Clopidogrel	*CYP2C19 activates*
Ticagrelor	*CYP3A4/5*
Warfarin**	*CYP2C9*

Cardiovascular

Aliskiren	*CYP3A4/5*
Amiodarone	*CYP3A4/5*
Amlodipine	*CYP3A4/5*
Atorvastatin	*CYP3A4/5*
Azilsartan	*CYP2C9 CYP2C19*
Carvedilol	*CYP2D6*
Cilostazol	*CYP2C19 CYP3A4/5*
Clonidine	*CYP1A2 CYP2D6 CYP3A4/5*
Diltiazem	*CYP3A4/5*
Disopyramide	*CYP3A4/5*
Dofetilide	*CYP3A4/5*
Dronedarone	*CYP3A4/5*
Eplerenone	*CYP3A4/5*
Flecainide	*CYP2D6*
Guanabenz	*CYP1A2*
Labetalol	*CYP2C19*
Lidocaine	*CYP1A2 CYP2D6 CYP3A4/5*
Losartan	*CYP2C9 CYP3A4/5*
Lovastatin	*CYP3A4/5*
Metoprolol	*CYP2D6*
Nifedipine	*CYP3A4/5*
Nisoldipine	*CYP3A4/5*
Propafenone	*CYP2D6*
Propranolol	*CYP1A2 CYP2C19 CYP2D6*
Quinidine	*CYP3A4*
Ranolazine	*CYP2D6 CYP3A4/5*
Simvastatin**	*CYP3A4/5*
Timolol	*CYP2D6*
Verapamil	*CYP1A2 CYP2C9 CYP2C19 CYP3A4/5*

Endocrinology

Chlorpropamide	*CYP2C9*
Glimepiride	*CYP2C9*
Glyburide	*CYP2C9 CYP3A4/5*
Nateglinide	*CYP2C9 CYP3A4/5*
Tolbutamide	*CYP2C9*

Other

Caffeine	*CYP1A2*
Eliglustat	*CYP2D6 CYP3A4/5*

Gastroenterology

Aprepitant	*CYP3A4/5*
Dexlansoprazole	*CYP2C19 CYP3A4/5*
Dolasetron	*CYP2D6 CYP3A4/5*
Esomeprazole	*CYP2C19*
Lansoprazole	*CYP2C19*
Omeprazole	*CYP2C19*
Ondansetron	*CYP1A2 CYP2C19 CYP2D6 CYP3A4/5*
Pantoprazole	*CYP2C19*
Rabeprazole	*CYP2C19 CYP3A4/5*

Immunosuppressives

Cyclosporine	*CYP3A4/5*
Sirolimus	*CYP3A4/5*
Tacrolimus	*CYP3A4/5*
Everolimus	*CYP3A4*

Infectious Disease

Boceprevir	*CYP3A4/5*
Clarithromycin	*CYP3A4*
Darunavir	*CYP3A4/5*
Efavirenz	*CYP3A4/5*
Erythromycin	*CYP3A4*
Fosamprenavir	*CYP3A4/5*
Indinavir	*CYP3A4/5*
Nelfinavir	*CYP2C19*
Nevirapine	*CYP3A4/5*
Quinine	*CYP1A2 CYP2C9 CYP2C19 CYP2D6 CYP3A4/5*
Quinine Sulfate	*CYP1A2 CYP2C9 CYP2C19 CYP2D6 CYP3A4/5*
Saquinavir	*CYP3A4/5*
Telaprevir	*CYP3A4/5*
Telithromycin	*CYP3A4/5*
Terbinafine	*CYP1A2 CYP2C9 CYP2C19 CYP3A4/5*
Voriconazole	*CYP2C19*

Neurology

Cafergot	*CYP3A4/5*
Carbamazepine**	*CYP3A4/5*
Clobazam	*CYP2C19*
Donepezil	*CYP2D6 CYP3A4/5*
Eletriptan	*CYP3A4/5*
Phenytoin**	*CYP2C9*
Tetrabenazine	*CYP2D6*

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Table 1: Substrates of Cytochrome P450 (CYP) Enzymes (continued)

Oncology

Axitinib	*CYP1A2 CYP3A4/5*
Belinostat**	*CYP2C9 CYP3A4/5*
Bortezomib	*CYP1A2 CYP2C9 CYP2C19 CYP2D6 CYP3A4/5*
Bosutinib monohydrate	*CYP3A4/5*
Brentuximab vedotin	*CYP3A4/5*
Cabazitaxel	*CYP3A4/5*
Dasatinib	*CYP3A4/5*
Docetaxel	*CYP3A4/5*
Enzalutamide	*CYP3A4/5*
Erlotinib	*CYP1A2 CYP3A4/5*
Etoposide	*CYP3A4/5*
Exemestane	*CYP3A4/5*
Gleevec	*CYP1A2 CYP2C9 CYP2C19 CYP2D6 CYP3A4/5*
Ibrutinib	*CYP1A2 CYP3A4/5*
Imatinib	*CYP1A2 CYP2C9 CYP2C19 CYP2D6 CYP3A4/5*
Lapatinib	*CYP2C19 CYP3A4/5*
Paclitaxel	*CYP3A4/5*
Pazopanib**	*CYP1A2 CYP3A4/5*
Sorafenib	*CYP3A4/5*
Sunitinib	*CYP3A4/5*
Tamoxifen	*CYP2D6 activates*
Temsirolimus	*CYP3A4/5*
Vemurafenib	*CYP3A4/5*
Vincristine	*CYP3A4/5*

Psychiatry

Alprazolam	*CYP3A4*
Amitriptyline	*CYP2C19 CYP2D6*
Aripiprazole	*CYP2D6*
Atomoxetine	*CYP2D6*
Brexpiprazole	*CYP2D6 CYP3A4/5*
Bupropion	*CYP2D6 CYP3A4/5*
Buspirone	*CYP3A4/5*
Citalopram	*CYP2C19*
Clomipramine	*CYP2C19 CYP2D6*
Clonazepam	*CYP3A4/5*
Clozapine	*CYP2D6*
Desipramine	*CYP2D6*
Diazepam	*CYP2C19 CYP3A4/5*
Doxepin	*CYP1A2 CYP2D6 CYP3A4/5*
Duloxetine	*CYP1A2 CYP2D6*
Escitalopram	*CYP2C19*
Fluoxetine	*CYP2D6*
Fluvoxamine	*CYP1A2 CYP2D6*
Haloperidol	*CYP2D6*
Iloperidone	*CYP2D6*
Imipramine	*CYP2C19 CYP2D6*
Milnacipran	*CYP2C19 CYP2D6 CYP3A4/5*
Mirtazapine	*CYP1A2 CYP2D6 CYP3A4/5*
Nortriptyline	*CYP2D6*
Olanzapine	*CYP1A2 CYP2D6*
Paroxetine	*CYP2D6*
Perphenazine	*CYP2D6*
Pimozide	*CYP2D6*
Protriptyline	*CYP2D6*
Quetiapine	*CYP2D6 CYP3A4/5*
Risperidone	*CYP2D6*
Sertraline	*CYP2C19*
Thioridazine	*CYP2D6*
Trazodone	*CYP3A4/5*
Trimipramine	*CYP2C19 CYP2D6*
Venlafaxine	*CYP2D6*
Vortioxetine	*CYP2C9 CYP2C19 CYP2D6 CYP3A4/5*
Ziprasidone	*CYP1A2 CYP3A4/5*

Pulmonary

Dextromethorphan	*CYP2D6*
Fluticasone	*CYP3A4/5*
Salmeterol	*CYP3A4/5*
Sildenafil	*CYP2C9 CYP3A4/5*
Tadalafil	*CYP3A4/5*

Rheumatology

Carisoprodol	*CYP2C19*
Cevimeline	*CYP2D6 CYP3A4/5*
Colchicine	*CYP3A4/5*
Tofacitinib	*CYP2C19 CYP3A4/5*

Sleep Medicine

Eszopiclone	*CYP3A4/5*
Modafinil	*CYP3A4/5*
Triazolam	*CYP3A4/5*
Zolpidem	*CYP3A4/5*

Urology

Darifenacin	*CYP3A4/5*
Finasteride	*CYP3A4/5*
Oxybutynin	*CYP3A4/5*
Tamsulosin	*CYP2D6 CYP3A4/5*
Tolterodine	*CYP2D6 CYP3A4/5*
Vardenafil	*CYP2C9 CYP3A4/5*

Legend: The cytochrome P450 (CYP) enzymes responsible for metabolism of commonly used drugs are listed. Note this is not a comprehensive list. Only CYP1A2, CYP2C9, CYP2C19, CYP2D6, CYP3A4 and CYP3A5 and their substrates are considered for this table. Note that in most instances if CYP3A4 is involved in metabolism of a drug, CYP3A5 is also expected to be involved but to a lesser extent (exceptions are noted). In cases where a drug is converted from an inactive or partially active prodrug to an active and therapeutic metabolite by the CYP enzyme shown, the word "activates" is present. *Drug metabolites are more active than the parent drug. **This drug is listed on the Additional Pharmacogenomic Genes & Associated Drugs table.

Table 2: Inhibitors of Cytochrome P450 (CYP) Enzymes

Allergy

Chlorpheniramine	*CYP2D6*
Clemastine	*CYP2D6*
Diphenhydramine	*CYP2D6*
Hydroxyzine	*CYP2D6*

Anesthesiology/Analgesic

Buprenorphine	*CYP3A4/5*Δ
Celecoxib	*CYP2D6*
Dexmedetomidine	*CYP2D6*
Indomethacin	*CYP2C19*
Methadone	*CYP2C19*
Phenylbutazone	*CYP2C19*

Anticoagulant

Ticlopidine	*CYP1A2 CYP2C9 CYP2C19 CYP2D6*

Cardiovascular

Amiodarone	*CYP1A2 CYP2C9*◆ *CYP2D6*□ *CYP3A4/5*
Diltiazem	*CYP3A4/5*◆
Dronedarone	*CYP2D6 CYP3A4/5*◆
Fenofibrate	*CYP2C9*
Fluvastatin	*CYP2C9*
Lovastatin	*CYP2C9*
Midodrine	*CYP2D6*
Quinidine	*CYP2D6*Δ
Verapamil	*CYP3A4/5*◆

Dermatology

Methoxsalen	*CYP1A2*

Dietary

Grapefruit Juice	*CYP3A4/5*◆
Starfruit	*CYP3A4/5*

Drug of Abuse

Cocaine	*CYP2D6*

Endocrinology

Cinacalcet	*CYP2D6*Δ
Mifepristone	*CYP3A4/5*

Gastroenterology

Aprepitant	*CYP3A4/5*◆
Cimetidine	*CYP1A2*□ *CYP2C19 CYP2D6*□ *CYP3A4/5*□
Esomeprazole	*CYP2C19*
Lansoprazole	*CYP2C19*
Metoclopramide	*CYP2D6*
Omeprazole	*CYP2C19*
Pantoprazole	*CYP2C19*
Rabeprazole	*CYP2C19*
Ranitidine	*CYP2D6*

Infectious Disease

Atazanavir	*CYP3A4/5*
Boceprevir	*CYP3A4/5*
Chloramphenicol	*CYP2C19 CYP3A4/5*
Ciprofloxacin	*CYP1A2*Δ *CYP3A4/5*
Clarithromycin	*CYP3A4/5*Δ
Delaviridine	*CYP3A4/5*
Efavirenz	*CYP2C9 CYP2C19*
Erythromycin	*CYP3A4/5*◆
Fluconazole	*CYP2C9*Δ *CYP3A4/5*◆
Fosamprenavir	*CYP3A4/5*
Indinavir	*CYP3A4/5*Δ
Isoniazid	*CYP2C9 CYP2C19 CYP3A4/5*
Itraconazole	*CYP3A4/5*Δ
Ketoconazole	*CYP2C19 CYP3A4/5*Δ
Nefazodone	*CYP3A4/5*Δ
Nelfinavir	*CYP3A4/5*Δ
Norfloxacin	*CYP3A4/5*
Quinine Sulfate	*CYP2D6 CYP3A4/5*
Quinolones	*CYP1A2*
Ritonavir	*CYP2D6 CYP3A4/5*Δ
Saquinavir	*CYP3A4/5*Δ
Sulfamethoxazole	*CYP2C9*
Telaprevir	*CYP3A4/5*
Telithromycin	*CYP3A4/5*Δ
Terbinafine	*CYP2D6*◆
Voriconazole	*CYP2C9 CYP2C19 CYP3A4/5*

Neurology

Eslicarbazepine	*CYP2C19*
Felbamate	*CYP2C19*
Oxcarbazepine	*CYP2C19*
Topiramate	*CYP2C19*

Oncology

Crizotinib	*CYP3A4/5*
Dasatinib	*CYP3A4/5*
Doxorubicin	*CYP2D6*
Imatinib	*CYP3A4/5*
Lapatinib	*CYP3A4/5*
Nilotinib	*CYP2C9 CYP2D6 CYP3A4/5*
Pazopanib	*CYP2D6 CYP3A4/5*
Teniposide	*CYP2C9*

Psychiatry

Bupropion	*CYP2D6*Δ
Chlorpromazine	*CYP2D6*
Citalopram	*CYP2D6*
Clomipramine	*CYP2D6*
Duloxetine	*CYP2D6*◆
Escitalopram	*CYP2D6*
Fluoxetine	*CYP2C19 CYP2D6*Δ
Fluvoxamine	*CYP1A2*Δ *CYP2C9 CYP2C19 CYP3A4/5*
Haloperidol	*CYP2D6*
Paroxetine	*CYP2C9 CYP2D6*Δ
Sertraline	*CYP2C9 CYP2D6*◆
Verapamil	*CYP3A4/5*◆

Pulmonary

Zafirlukast	*CYP2C9*

Rheumatology

Probenecid	*CYP2C19*

Sleep Medicine

Modafinil	*CYP2C19*

Legend: The extent of inhibition may not be well defined and/or the degree of inhibition may vary for the drugs listed. Note this is not a exhaustive list of all CYP inhibitors and only the genes CYP1A2, CYP2C9, CYP2C19, CYP2D6, CYP3A4 and CYP3A5 are considered. Also note that if a drug inhibits CYP3A4 it is expected to induce CYP3A5 although literature proving this for each drug is not available. Δ = Strong Inhibitor, ◆ = Moderate Inhibitors, □ = Weak Inhibitors

Table 3: Inducers of Cytochrome P450 (CYP) Enzymes

Anti-Inflammatory	
Glucocorticoids	*CYP3A4/5*
Dietary	
Broccoli	*CYP1A2*
Brussel sprouts	*CYP1A2*
Char-grilled meat	*CYP1A2*
Environment	
Tobacco	*CYP1A2*
Endocrinology	
Insulin	*CYP1A2*
Pioglitazone	*CYP3A4/5*
Gastroenterology	
Aprepitant	*CYP2C9*
Omeprazole	*CYP1A2*
Infectious Disease	
Efavirenz	*CYP3A4/5*
Fosamprenavir	*CYP3A4/5*
Nafcillin	*CYP1A2*
Nevirapine	*CYP3A4/5*
Rifampin	*CYP2C9 CYP2C19 CYP2D6 CYP3A4/5*
Neurology	
Carbamazepine	*CYP1A2 CYP2C19 CYP3A4/5*
Eslicarbazepine	*CYP3A4/5*
Oxcarbazepine	*CYP3A4/5*
Phenobarbital	*CYP2C9 CYP3A4/5*
Phenytoin	*CYP3A4/5*
Nutraceutical	
St. John's Wort	*CYP3A4/5*
Oncology	
Nilotinib	*CYP2C9*
Sleep Medicine	
Modafinil	*CYP1A2 CYP3A4/5*
Secobarbital	*CYP2C9*

Legend: The extent of induction is not well defined for any of these drugs. Note that this is not a exhaustive list of all CYP inducers and only the genes CYP1A2, CYP2C9, CYP2C19, CYP2D6, CYP3A4 and CYP3A5 are considered. Also note that if a drug inhibits CYP3A4 it is expected to induce CYP3A5 although literature proving this for each drug is not available.

Table 4: Drugs NOT metabolized by CYP1A2, CYP2C9, CYP2C19, CYP2D6, CYP3A4 or CYP3A5 Enzymes

Allergy
- Phenylephrine
- Desloratadine

Analgesic/Anesthesiology
- Dexmedetomidine
- Hydromorphone
- Morphine
- Naloxone
- Propofol

Anti-inflammatory
- Beclomethasone

Anticoagulant/Antiplatelet
- Dalteparin
- Enoxaparin
- Heparin
- Prasugrel♣

Cardiovascular
- Atenolol
- Chlorthalidone
- Colesevelam
- Digoxin
- Enalapril
- Ezetimibe
- Fenofibric acid
- Furosemide
- Hydralazine
- Hydrochlorothiazide
- Lisinopril
- Nitroglycerin
- Rosuvastatin
- Telmisartan
- Fosinopril
- Sotalol

Endocrinology
- Ibandronate
- Levothyroxine
- Metformin
- Propylthiouracil
- Raloxifene
- Vasopressin
- Exenatide

Gastroenterology
- Certolizumab Pegol

Hematology
- Azacitidine
- Darbepoetin alfa
- Decitabine
- Epoetin alfa

Immunosuppressives
- Mycophenolate

Infectious Disease
- Abacavir**
- Atazanavir**
- Ceftriaxone
- Flucytosine
- Levofloxacin
- Meropenem
- Moxifloxacin
- Piperacillin
- Vancomycin
- Zanamivir

Neurology
- Gabapentin
- Lamotragine
- Levetiracetam
- Oxcarbazepine**
- Pramipexole
- Rivastigmine
- Vigabatrin

Oncology
- Afatinib⊥
- Afutuzumab⊥
- Alemtuzumab⊥
- Asparaginase
- Bevacizumab⊥
- Carboplatin
- Cetuximab⊥
- Ibritumomab⊥
- Lenalidomide
- Obinutuzumab
- Ofatumumab⊥
- Oxaliplatin
- Panitumumab⊥
- Pemetrexed
- Pertuzumab⊥
- Rituximab⊥
- Temozolomide
- Thalidomide
- Trastuzumab⊥
- Vorinostat
- Bleomycin
- Chlorambucil
- Fulvestrant♣

Opthalmology
- Verteporfin

Other
- Carglumic acid
- Risedronate

Psychiatry
- Lorazepam
- Varenicline

Pulmonary
- Montelukast

Rheumatology
- Allopurinol**
- Etanercept
- Belimumab

Sleep Medicine
- Zaleplon

Legend: Drugs not metabolized by CYP1A2, CYP2C9, CYP2C19, CYP2D6, CYP3A4 and CYP3A5. This is not an exhaustive list for all of the alternate drugs in the pharmacopeia but focuses on commonly used drugs. Note that other genes (and factors) may contribute to the metabolism of the listed drugs. In addition, other CYPs and other genes not described here may also be relevant but are out of scope for this document. **This drug is listed on the Additional Pharmacogenomic Genes & Associated Drugs table. ⊥ Genetic or tumor testing maybe needed to establish the indication for use of this drug. ♣ Although a CYP gene is involved in the metabolism of this drug, per the FDA label genetic variation within the gene does not impact or has minimal impact on metabolism.

Table 5: Glucose-6-Phosphate Dehydrogenase (G6PD) Associated Drugs and Compounds

Allergy
- Antazoline♈
- Antistine♈
- Diphenhydramine♈
- Pyribenzamine♈
- Tripelennamine♈

Analgesic
- Acetaminophen♈
- Acetanilide ♠
- Acetophenetidin Φ
- Aminophenazone♈
- Antipyrine ♈
- Aspirin Φ
- Dipyrone Φ
- Metamizole Φ
- Paracetamol♈
- Phenacetin Φ
- Phenazone♈
- Tiaprofenic acid♈

Anticoagulant
- Menadione Φ
- Menadione sodium bisulfite Φ
- Menaphthone Φ
- Phytomenadione Φ

Cardiovascular
- Isosorbide dinitrate♈
- Procainamide♈
- Quinidine Gluconate Φ
- Quinidine Sulfate ♠

Dermatology
- Dapsone ♠
- Diaphenylsulfone ♠
- Para-aminobenzoic acid♈

Endocrinology
- Chlorpropamide ♠
- Glibenclamide ♠
- Glyburide ♠
- Glimepiride ♠
- Glipizide ♠

Gastroenterology
- Aminosalicyclic acid Φ
- Mesalazine Φ
- MoviPrep ♠
- Salazopyrin Φ
- Sulfapyridine ♠
- Sulfasalazine Φ

Hematology
- Acetylphenylhydrazine ♠
- Methylene blue ♠
- Methylthioninium chloride ♠

Infectious Disease
- Aldesulfone sodium Φ
- Aminosalicyclic acid Φ
- Beta-Naphthol ♠
- Chloramphenicol Φ
- Chlorguanidine♈
- Chloroquine ♠
- Ciprofloxacin Φ
- Dapsone ♠
- Diaphenylsulfone ♠
- Furazolidone Φ
- Glucosulfone ♠
- Isoniazid♈
- Mafenide ♠
- Mepacrine Φ
- Moxifloxacin ♠
- Nalidixic acid ♠
- Niridazole ♠
- Nitrofural ♠
- Nitrofurantoin ♠
- Nitrofurazone ♠
- Norfloxacin Φ
- Ofloxacin Φ
- Pamaquine ♠
- Pentaquine Φ
- Primaquine ♠
- Proguanil♈
- Promin ♠
- Pyrimethamine♈
- Quinacrine Φ
- Quinine Φ
- Stibophen ♠
- Streptomycin♈
- Sulfacetamide Φ
- Sulfacytine♈
- Sulfadiazine Φ
- Sulfadimidine Φ
- Sulfafurazole Φ
- Sulfafurazone Φ
- Sulfaguanidine♈
- Sulfamerazine Φ
- Sulfamethoxazole ♠
- Sulfamethoxypyridazine♈
- Sulfanilamide Φ
- Sulfisoxazole Φ
- Sulfoxone Φ
- Trimethoprim ♠

Neurology
- Benzhexol Φ
- Levodopa♈
- Phenytoin♈
- Trihexyphynidyl Φ

Nutraceutical
- Acalypha indica extract Φ
- Ascorbic acid Φ
- Vitamin C Φ

Oncology
- Dabrafenib ♠
- Doxorubicin Φ
- Rasburicase ♠

Other/Industrial/Environmental
- Arsine ♠
- Napthalene ♠
- Phenylhydrazine ♠
- Thiazosulfone Φ
- Tolonium chloride ♠
- Toluidine blue ♠
- Trinitrotoluene ♠

Rheumatology
- Colchicine♈
- Hydroxychloroquine ♠
- Pegloticase ♠
- Phenylbutazone♈
- Probenecid Φ
- Sulfapyridine ♠

Toxicology
- Dimercaprol Φ
- Dimercaptosuccinic acid ♠
- Isobutyl Nitrite ♠
- Sodium Nitrite ♠
- Succimer ♠

Urology
- Phenazopyridine ♠

Legend: This is a listing of drugs and compounds reviewed for safety in G6PD deficient patients by the Clinical Pharmacogenetics Implementation Consortium (CPIC) and the FDA. ♠ = A compound/drug for which all references with an available review are in agreement that there is a risk of hemolysis in G6PD deficient individuals or the FDA label for the drug/compound indicates the risk is present. Φ = A compound/drug for which conflicting references are available regarding the potential risk of hemolysis in G6PD deficient individuals. ♈ = Compound/drug for which all references with an available review are in agreement that there is a low risk of hemolysis in G6PD deficient individuals.

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Table 6: Additional Pharmacogenomic Genes and Associated Drugs

Anticoagulant/Antiplatelet

Warfarin	*VKORC1 CYP4F2* rs12777823

Cardiovascular

Simvastatin	*SLCO1B1*

Infectious Disease

Abacavir	*HLA-B*57:01*
Atazanavir	*UGT1A1*§
Interferon + Ribavirin	*IL28B*
Isoniazid	*NAT2*

Neurology

Carbamazepine	*HLA-B*15:02 HLA-A*31:01*
Eslicarbazepine	*HLA-B*15:02 HLA-A*31:01*
Fosphenytoin	*HLA-B*15:02 HLA-A*31:01*
Lamotrigine	*HLA-B*15:02 HLA-A*31:01*
Oxcarbazepine	*HLA-B*15:02 HLA-A*31:01*
Phenytoin	*HLA-B*15:02 HLA-A*31:01*

Oncology

Irinotecan	*UGT1A1*§
Fluoropyrimidines	*DPYD*
Nilotinib	*UGT1A1*§
Pazopanib	*HLA-B*57:01 UGT1A1*§
Belinostat	*UGT1A1*§
Cisplatin◘	*TPMT*
Mercaptopurine	*TPMT NUDT15*
Azathioprine	*TPMT NUDT15*
Thiopurine	*TPMT NUDT15*

Psychiatry

SSRI response	*SLC6A4*
Antipsychotics	*HTR2A HTR2C*
SSRI	*HTR2A HTR2C*

Rheumatology

Allopurinol	*HLA-B *58:01*

Legend: This is not an exhaustive list of all known pharmacogenomic drug gene combinations. Human leukocyte antigen (HLA) – related drugs are shown for HLA-A*31:01, HLA-B*15:02, HLB-B*57:01, and HLA-B*58:01. Drugs impacted by solute carrier organic anion transporter 1B1 (SLCO1B1) and UDP – glucuronosyltransferase 1 family peptide A1 (UGT1A1) are listed.
§ Note that UGT1A1 also has implications for the hereditary forms of unconjugated hyperbilirubinemia (Gilbert syndrome and Crigler-Najjar syndrome). Individuals with a significant decrease in UGT1A1 enzyme activity (example homozygous *28 [TA7/7], and various other genetic variant combinations) may want to consider an alternative to Atazanavir, since they are at risk of developing Atazanavir-associated indirect hyperbilirubinemia. ◘ Genetic variants in TPMT have been associated with a cisplatin-related ototoxicity.

This is educational material intended for health care professionals. The information provided in the Pharmacogenomic Association Tables are not intended to supersede the care provider's experience and knowledge of her/his patient to establish a diagnosis or a treatment plan. All medications require careful clinical monitoring regardless of the information presented here.

All information listed in the Pharmacogenomic Associations Tables is based on data from:

1. https://cpicpgx.org/genes-drugs/
2. https://www.pharmgkb.org/view/drug-labels.do
3. http://www.fda.gov/drugs/scienceresearch/researchareas/pharmacogenetics/ucm083378.htm
4. https://dailymed.nlm.nih.gov/dailymed/index.cfm

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