

**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

<b>Allergy</b>		Labetalol	<i>CYP2C19</i>	<b>Immunosuppressives</b>	
Loratadine	<i>CYP3A4</i>	Lidocaine	<i>CYP1A2 CYP2D6 CYP3A4/5</i>	Cyclosporine	<i>CYP3A4/5</i>
<b>Analgesic/Anesthesiology</b>		Losartan	<i>CYP2C9 CYP3A4/5</i>	Sirolimus	<i>CYP3A4/5</i>
Codeine	<i>CYP2D6 activates</i>	Lovastatin	<i>CYP3A4/5</i>	Tacrolimus	<i>CYP3A4/5</i>
Cyclobenzaprine	<i>CYP1A2 CYP2D6 CYP3A4/5</i>	Metoprolol	<i>CYP2D6</i>	Everolimus	<i>CYP3A4</i>
Fentanyl	<i>CYP3A4/5</i>	Nifedipine	<i>CYP3A4/5</i>	<b>Infectious Disease</b>	
Hydrocodone	<i>CYP2D6*</i>	Nisoldipine	<i>CYP3A4/5</i>	Boceprevir	<i>CYP3A4/5</i>
Methadone	<i>CYP2C19 CYP2C9 CYP2D6 CYP3A4/5</i>	Propafenone	<i>CYP2D6</i>	Clarithromycin	<i>CYP3A4</i>
Midazolam	<i>CYP3A4/5</i>	Propranolol	<i>CYP1A2 CYP2C19 CYP2D6</i>	Darunavir	<i>CYP3A4/5</i>
Oxycodone	<i>CYP2D6*</i>	Quinidine	<i>CYP3A4</i>	Efavirenz	<i>CYP3A4/5</i>
Tramadol	<i>CYP2D6 activates</i>	Ranolazine	<i>CYP2D6 CYP3A4/5</i>	Erythromycin	<i>CYP3A4</i>
<b>Anti-inflammatory</b>		Simvastatin**	<i>CYP3A4/5</i>	Fosamprenavir	<i>CYP3A4/5</i>
Celecoxib	<i>CYP2C9</i>	Timolol	<i>CYP2D6</i>	Indinavir	<i>CYP3A4/5</i>
Diclofenac	<i>CYP2C9 CYP3A4/5</i>	Verapamil	<i>CYP1A2 CYP2C9 CYP2C19 CYP3A4/5</i>	Nelfinavir	<i>CYP2C19</i>
<b>Anticoagulant/Antiplatelet</b>		<b>Endocrinology</b>		Nevirapine	<i>CYP3A4/5</i>
Apixaban	<i>CYP3A4/5</i>	Chlorpropamide	<i>CYP2C9</i>	Quinine	<i>CYP1A2 CYP2C9 CYP2C19 CYP2D6 CYP3A4/5</i>
Clopidogrel	<i>CYP2C19 activates</i>	Glimepiride	<i>CYP2C9</i>	Quinine Sulfate	<i>CYP1A2 CYP2C9 CYP2C19 CYP2D6 CYP3A4/5</i>
Ticagrelor	<i>CYP3A4/5</i>	Glyburide	<i>CYP2C9 CYP3A4/5</i>	Saquinavir	<i>CYP3A4/5</i>
Warfarin**	<i>CYP2C9</i>	Nateglinide	<i>CYP2C9 CYP3A4/5</i>	Telaprevir	<i>CYP3A4/5</i>
<b>Cardiovascular</b>		Tolbutamide	<i>CYP2C9</i>	Telithromycin	<i>CYP3A4/5</i>
Aliskiren	<i>CYP3A4/5</i>	<b>Other</b>		Terbinafine	<i>CYP1A2 CYP2C9 CYP2C19 CYP3A4/5</i>
Amiodarone	<i>CYP3A4/5</i>	Caffeine	<i>CYP1A2</i>	Voriconazole	<i>CYP2C19</i>
Amlodipine	<i>CYP3A4/5</i>	Eliglustat	<i>CYP2D6 CYP3A4/5</i>	<b>Neurology</b>	
Atorvastatin	<i>CYP3A4/5</i>	<b>Gastroenterology</b>		Cafegot	<i>CYP3A4/5</i>
Azilsartan	<i>CYP2C9 CYP2C19</i>	Aprepitant	<i>CYP3A4/5</i>	Carbamazepine**	<i>CYP3A4/5</i>
Carvedilol	<i>CYP2D6</i>	Dexlansoprazole	<i>CYP2C19 CYP3A4/5</i>	Clobazam	<i>CYP2C19</i>
Cilostazol	<i>CYP2C19 CYP3A4/5</i>	Dolasetron	<i>CYP2D6 CYP3A4/5</i>	Donepezil	<i>CYP2D6 CYP3A4/5</i>
Clonidine	<i>CYP1A2 CYP2D6 CYP3A4/5</i>	Esomeprazole	<i>CYP2C19</i>	Eletriptan	<i>CYP3A4/5</i>
Diltiazem	<i>CYP3A4/5</i>	Lansoprazole	<i>CYP2C19</i>	Phenytoin**	<i>CYP2C9</i>
Disopyramide	<i>CYP3A4/5</i>	Omeprazole	<i>CYP2C19</i>	Tetrabenazine	<i>CYP2D6</i>
Dofetilide	<i>CYP3A4/5</i>	Ondansetron	<i>CYP1A2 CYP2C19 CYP2D6 CYP3A4/5</i>		
Dronedarone	<i>CYP3A4/5</i>	Pantoprazole	<i>CYP2C19</i>		
Eplerenone	<i>CYP3A4/5</i>	Rabeprazole	<i>CYP2C19 CYP3A4/5</i>		
Flecainide	<i>CYP2D6</i>				
Guanabenz	<i>CYP1A2</i>				

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

<b>Oncology</b>		Desipramine	<i>CYP2D6</i>	<b>Rheumatology</b>	
Axitinib	<i>CYP1A2 CYP3A4/5</i>	Diazepam	<i>CYP2C19 CYP3A4/5</i>	Carisoprodol	<i>CYP2C19</i>
Belinostat**	<i>CYP2C9 CYP3A4/5</i>	Doxepin	<i>CYP1A2 CYP2D6 CYP3A4/5</i>	Cevimeline	<i>CYP2D6 CYP3A4/5</i>
Bortezomib	<i>CYP1A2 CYP2C9 CYP2C19 CYP2D6 CYP3A4/5</i>	Duloxetine	<i>CYP1A2 CYP2D6</i>	Colchicine	<i>CYP3A4/5</i>
Bosutinib monohydrate	<i>CYP3A4/5</i>	Escitalopram	<i>CYP2C19</i>	Tofacitinib	<i>CYP2C19 CYP3A4/5</i>
Brentuximab vedotin	<i>CYP3A4/5</i>	Fluoxetine	<i>CYP2D6</i>	<b>Sleep Medicine</b>	
Cabazitaxel	<i>CYP3A4/5</i>	Fluvoxamine	<i>CYP1A2 CYP2D6</i>	Eszopiclone	<i>CYP3A4/5</i>
Dasatinib	<i>CYP3A4/5</i>	Haloperidol	<i>CYP2D6</i>	Modafinil	<i>CYP3A4/5</i>
Docetaxel	<i>CYP3A4/5</i>	Iloperidone	<i>CYP2D6</i>	Triazolam	<i>CYP3A4/5</i>
Enzalutamide	<i>CYP3A4/5</i>	Imipramine	<i>CYP2C19 CYP2D6</i>	Zolpidem	<i>CYP3A4/5</i>
Erlotinib	<i>CYP1A2 CYP3A4/5</i>	Milnacipran	<i>CYP2C19 CYP2D6 CYP3A4/5</i>	<b>Urology</b>	
Etoposide	<i>CYP3A4/5</i>	Mirtazapine	<i>CYP1A2 CYP2D6 CYP3A4/5</i>	Darifenacin	<i>CYP3A4/5</i>
Exemestane	<i>CYP3A4/5</i>	Nortriptyline	<i>CYP2D6</i>	Finasteride	<i>CYP3A4/5</i>
Gleevec	<i>CYP1A2 CYP2C9 CYP2C19 CYP2D6 CYP3A4/5</i>	Olanzapine	<i>CYP1A2 CYP2D6</i>	Oxybutynin	<i>CYP3A4/5</i>
Ibrutinib	<i>CYP1A2 CYP3A4/5</i>	Paroxetine	<i>CYP2D6</i>	Tamsulosin	<i>CYP2D6 CYP3A4/5</i>
Imatinib	<i>CYP1A2 CYP2C9 CYP2C19 CYP2D6 CYP3A4/5</i>	Perphenazine	<i>CYP2D6</i>	Tolterodine	<i>CYP2D6 CYP3A4/5</i>
Lapatinib	<i>CYP2C19 CYP3A4/5</i>	Pimozide	<i>CYP2D6</i>	Vardenafil	<i>CYP2C9 CYP3A4/5</i>
Paclitaxel	<i>CYP3A4/5</i>	Protriptyline	<i>CYP2D6</i>		
Pazopanib**	<i>CYP1A2 CYP3A4/5</i>	Quetiapine	<i>CYP2D6 CYP3A4/5</i>		
Sorafenib	<i>CYP3A4/5</i>	Risperidone	<i>CYP2D6</i>		
Sunitinib	<i>CYP3A4/5</i>	Sertraline	<i>CYP2C19</i>		
Tamoxifen	<i>CYP2D6 activates</i>	Thioridazine	<i>CYP2D6</i>		
Temsirolimus	<i>CYP3A4/5</i>	Trazodone	<i>CYP3A4/5</i>		
Vemurafenib	<i>CYP3A4/5</i>	Trimipramine	<i>CYP2C19 CYP2D6</i>		
Vincristine	<i>CYP3A4/5</i>	Venlafaxine	<i>CYP2D6</i>		
<b>Psychiatry</b>		Vortioxetine	<i>CYP2C9 CYP2C19 CYP2D6 CYP3A4/5</i>		
Alprazolam	<i>CYP3A4</i>	Ziprasidone	<i>CYP1A2 CYP3A4/5</i>		
Amitriptyline	<i>CYP2C19 CYP2D6</i>	<b>Pulmonary</b>			
Aripiprazole	<i>CYP2D6</i>	Dextromethorphan	<i>CYP2D6</i>		
Atomoxetine	<i>CYP2D6</i>	Fluticasone	<i>CYP3A4/5</i>		
Brexpiprazole	<i>CYP2D6 CYP3A4/5</i>	Salmeterol	<i>CYP3A4/5</i>		
Bupropion	<i>CYP2D6 CYP3A4/5</i>	Sildenafil	<i>CYP2C9 CYP3A4/5</i>		
Buspirone	<i>CYP3A4/5</i>	Tadalafil	<i>CYP3A4/5</i>		
Citalopram	<i>CYP2C19</i>				
Clomipramine	<i>CYP2C19 CYP2D6</i>				
Clonazepam	<i>CYP3A4/5</i>				
Clozapine	<i>CYP2D6</i>				

**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**

<b>Allergy</b>		<b>Gastroenterology</b>		<b>Neurology</b>	
Chlorpheniramine	CYP2D6	Aprepitant	CYP3A4/5◆	Eslicarbazepine	CYP2C19
Clemastine	CYP2D6	Cimetidine	CYP1A2□ CYP2C19 CYP2D6□ CYP3A4/5□	Felbamate	CYP2C19
Diphenhydramine	CYP2D6	Esomeprazole	CYP2C19	Oxcarbazepine	CYP2C19
Hydroxyzine	CYP2D6	Lansoprazole	CYP2C19	Topiramate	CYP2C19
<b>Anesthesiology/Analgesic</b>		Metoclopramide	CYP2D6	<b>Oncology</b>	
Buprenorphine	CYP3A4/5 <sup>Δ</sup>	Omeprazole	CYP2C19	Crizotinib	CYP3A4/5
Celecoxib	CYP2D6	Pantoprazole	CYP2C19	Dasatinib	CYP3A4/5
Dexmedetomidine	CYP2D6	Rabeprazole	CYP2C19	Doxorubicin	CYP2D6
Indomethacin	CYP2C19	Ranitidine	CYP2D6	Imatinib	CYP3A4/5
Methadone	CYP2C19	<b>Infectious Disease</b>		Lapatinib	CYP3A4/5
Phenylbutazone	CYP2C19	Atazanavir	CYP3A4/5	Nilotinib	CYP2C9 CYP2D6 CYP3A4/5
<b>Anticoagulant</b>		Boceprevir	CYP3A4/5	Pazopanib	CYP2D6 CYP3A4/5
Ticlopidine	CYP1A2 CYP2C9 CYP2C19 CYP2D6	Chloramphenicol	CYP2C19 CYP3A4/5	Teniposide	CYP2C9
<b>Cardiovascular</b>		Ciprofloxacin	CYP1A2 <sup>Δ</sup> CYP3A4/5	<b>Psychiatry</b>	
Amiodarone	CYP1A2 CYP2C9◆ CYP2D6□ CYP3A4/5	Clarithromycin	CYP3A4/5 <sup>Δ</sup>	Bupropion	CYP2D6 <sup>Δ</sup>
Diltiazem	CYP3A4/5◆	Delaviridine	CYP3A4/5	Chlorpromazine	CYP2D6
Dronedarone	CYP2D6 CYP3A4/5◆	Efavirenz	CYP2C9 CYP2C19	Citalopram	CYP2D6
Fenofibrate	CYP2C9	Erythromycin	CYP3A4/5◆	Clomipramine	CYP2D6
Fluvastatin	CYP2C9	Fluconazole	CYP2C9 <sup>Δ</sup> CYP3A4/5◆	Duloxetine	CYP2D6◆
Lovastatin	CYP2C9	Fosamprenavir	CYP3A4/5	Escitalopram	CYP2D6
Midodrine	CYP2D6	Indinavir	CYP3A4/5 <sup>Δ</sup>	Fluoxetine	CYP2C19 CYP2D6 <sup>Δ</sup>
Quinidine	CYP2D6 <sup>Δ</sup>	Isoniazid	CYP2C9 CYP2C19 CYP3A4/5	Fluvoxamine	CYP1A2 <sup>Δ</sup> CYP2C9 CYP2C19 CYP3A4/5
Verapamil	CYP3A4/5◆	Itraconazole	CYP3A4/5 <sup>Δ</sup>	Haloperidol	CYP2D6
<b>Dermatology</b>		Ketoconazole	CYP2C19 CYP3A4/5 <sup>Δ</sup>	Paroxetine	CYP2C9 CYP2D6 <sup>Δ</sup>
Methoxsalen	CYP1A2	Nefazodone	CYP3A4/5 <sup>Δ</sup>	Sertraline	CYP2C9 CYP2D6◆
<b>Dietary</b>		Nelfinavir	CYP3A4/5 <sup>Δ</sup>	Verapamil	CYP3A4/5◆
Grapefruit Juice	CYP3A4/5◆	Norfloxacin	CYP3A4/5	<b>Pulmonary</b>	
Starfruit	CYP3A4/5	Quinine Sulfate	CYP2D6 CYP3A4/5	Zafirlukast	CYP2C9
<b>Drug of Abuse</b>		Quinolones	CYP1A2	<b>Rheumatology</b>	
Cocaine	CYP2D6	Ritonavir	CYP2D6 CYP3A4/5 <sup>Δ</sup>	Probenecid	CYP2C19
<b>Endocrinology</b>		Saquinavir	CYP3A4/5 <sup>Δ</sup>	<b>Sleep Medicine</b>	
Cinacalcet	CYP2D6 <sup>Δ</sup>	Sulfamethoxazole	CYP2C9	Modafinil	CYP2C19
Mifepristone	CYP3A4/5	Telaprevir	CYP3A4/5		
		Telithromycin	CYP3A4/5 <sup>Δ</sup>		
		Terbinafine	CYP2D6◆		
		Voriconazole	CYP2C9 CYP2C19 CYP3A4/5		

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 an 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. <sup>Δ</sup> = 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

Esllicarbazepine 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**

Afinitin⊥

Afutuzumab⊥

Alemtuzumab⊥

Asparaginase

Bevacizumab⊥

Carboplatin

Cetuximab⊥

Ibritumomab⊥

Lenalidomide

Obinutuzumab

Ofatumumab⊥

Oxaliplatin

Panitumumab⊥

Pemetrexed

Pertuzumab⊥

Rituximab⊥

Temozolomide

Thalidomide

Trastuzumab⊥

Vorinostat

Bleomycin

Chlorambucil

Fulvestrant♣

**Ophthalmology**

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<sup>⚡</sup>  
 Antistine<sup>⚡</sup>  
 Diphenhydramine<sup>⚡</sup>  
 Pyribenzamine<sup>⚡</sup>  
 Tripelennamine<sup>⚡</sup>

**Analgesic**

Acetaminophen<sup>⚡</sup>  
 Acetanilide<sup>♠</sup>  
 Acetophenetidin<sup>Φ</sup>  
 Aminophenazone<sup>⚡</sup>  
 Antipyrine<sup>⚡</sup>  
 Aspirin<sup>Φ</sup>  
 Dipyrone<sup>Φ</sup>  
 Metamizole<sup>Φ</sup>  
 Paracetamol<sup>⚡</sup>  
 Phenacetin<sup>Φ</sup>  
 Phenazone<sup>⚡</sup>  
 Tiaprofenic acid<sup>⚡</sup>

**Anticoagulant**

Menadione<sup>Φ</sup>  
 Menadione sodium bisulfite<sup>Φ</sup>  
 Menaphthone<sup>Φ</sup>  
 Phytomenadione<sup>Φ</sup>

**Cardiovascular**

Isosorbide dinitrate<sup>⚡</sup>  
 Procainamide<sup>⚡</sup>  
 Quinidine Gluconate<sup>Φ</sup>  
 Quinidine Sulfate<sup>♠</sup>

**Dermatology**

Dapsone<sup>♠</sup>  
 Diaphenylsulfone<sup>♠</sup>  
 Para-aminobenzoic acid<sup>⚡</sup>

**Endocrinology**

Chlorpropamide<sup>♠</sup>  
 Glibenclamide<sup>♠</sup>  
 Glyburide<sup>♠</sup>  
 Glimepiride<sup>♠</sup>  
 Glipizide<sup>♠</sup>

**Gastroenterology**

Aminosalicylic acid<sup>Φ</sup>  
 Mesalazine<sup>Φ</sup>  
 MoviPrep<sup>♠</sup>  
 Salazopyrin<sup>Φ</sup>  
 Sulfapyridine<sup>♠</sup>  
 Sulfasalazine<sup>Φ</sup>

**Hematology**

Acetylphenylhydrazine<sup>♠</sup>  
 Methylene blue<sup>♠</sup>  
 Methylthioninium chloride<sup>♠</sup>

**Infectious Disease**

Aldesulfone sodium<sup>Φ</sup>  
 Aminosalicylic acid<sup>Φ</sup>  
 Beta-Naphthol<sup>♠</sup>  
 Chloramphenicol<sup>Φ</sup>  
 Chlorguanidine<sup>⚡</sup>  
 Chloroquine<sup>♠</sup>  
 Ciprofloxacin<sup>Φ</sup>  
 Dapsone<sup>♠</sup>  
 Diaphenylsulfone<sup>♠</sup>  
 Furazolidone<sup>Φ</sup>  
 Glucosulfone<sup>♠</sup>  
 Isoniazid<sup>⚡</sup>  
 Mafenide<sup>♠</sup>  
 Mepacrine<sup>Φ</sup>  
 Moxifloxacin<sup>♠</sup>  
 Nalidixic acid<sup>♠</sup>  
 Niridazole<sup>♠</sup>  
 Nitrofurantoin<sup>♠</sup>

Nitrofurantoin<sup>♠</sup>

Nitrofurazone<sup>♠</sup>

Norfloxacin<sup>Φ</sup>

Ofloxacin<sup>Φ</sup>

Pamaquine<sup>♠</sup>

Pentaquine<sup>Φ</sup>

Primaquine<sup>♠</sup>

Proguanil<sup>⚡</sup>

Promin<sup>♠</sup>

Pyrimethamine<sup>⚡</sup>

Quinacrine<sup>Φ</sup>

Quinine<sup>Φ</sup>

Stibophen<sup>♠</sup>

Streptomycin<sup>⚡</sup>

Sulfacetamide<sup>Φ</sup>

Sulfacytine<sup>⚡</sup>

Sulfadiazine<sup>Φ</sup>

Sulfadimidine<sup>Φ</sup>

Sulfafurazone<sup>Φ</sup>

Sulfafurazone<sup>Φ</sup>

Sulfaguandine<sup>⚡</sup>

Sulfamerazine<sup>Φ</sup>

Sulfamethoxazole<sup>♠</sup>

Sulfamethoxyipyridazine<sup>⚡</sup>

Sulfanilamide<sup>Φ</sup>

Sulfisoxazole<sup>Φ</sup>

Sulfoxone<sup>Φ</sup>

Trimethoprim<sup>♠</sup>

Trimethoprim<sup>♠</sup>

**Neurology**

Benzhexol<sup>Φ</sup>  
 Levodopa<sup>⚡</sup>  
 Phenytoin<sup>⚡</sup>  
 Trihexyphynidyl<sup>Φ</sup>

**Nutraceutical**

Acalypha indica extract<sup>Φ</sup>  
 Ascorbic acid<sup>Φ</sup>  
 Vitamin C<sup>Φ</sup>

**Oncology**

Dabrafenib<sup>♠</sup>  
 Doxorubicin<sup>Φ</sup>  
 Rasburicase<sup>♠</sup>

**Other/Industrial/Environmental**

Arsine<sup>♠</sup>  
 Napthalene<sup>♠</sup>  
 Phenylhydrazine<sup>♠</sup>  
 Thiazosulfone<sup>Φ</sup>  
 Tolonium chloride<sup>♠</sup>  
 Toluidine blue<sup>♠</sup>  
 Trinitrotoluene<sup>♠</sup>

**Rheumatology**

Colchicine<sup>⚡</sup>  
 Pegloticase<sup>♠</sup>  
 Phenylbutazone<sup>⚡</sup>  
 Probenecid<sup>Φ</sup>  
 Sulfapyridine<sup>♠</sup>

**Toxicology**

Dimercaprol<sup>Φ</sup>  
 Dimercaptosuccinic acid<sup>♠</sup>  
 Isobutyl Nitrite<sup>♠</sup>  
 Sodium Nitrite<sup>♠</sup>  
 Succimer<sup>♠</sup>

**Urology**

Phenazopyridine<sup>♠</sup>

**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.

**Table 6: Additional Pharmacogenomic Genes and Associated Drugs****Anticoagulant/Antiplatelet**Warfarin *VKORC1 CYP4F2* rs12777823**Cardiovascular**Simvastatin *SLC01B1***Infectious Disease**Abacavir *HLA-B\*57:01*Atazanavir *UGT1A1*<sup>§</sup>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*<sup>§</sup>Fluoropyrimidines *DPYD*Nilotinib *UGT1A1*<sup>§</sup>Pazopanib *HLA-B\*57:01 UGT1A1*<sup>§</sup>Belinostat *UGT1A1*<sup>§</sup>Cisplatin<sup>□</sup> *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, HLA-B\*57:01, and HLA-B\*58:01. Drugs impacted by solute carrier organic anion transporter 1B1 (SLC01B1) 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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