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Requesting Physician DNA	**Patient Name** DOE, RITZA	**Accession ID:** 8360291
Patient SSN:	**Medication:** ASPIRIN	**Collected:** 11/10/2016 00:00
Patient DOB: --		**Received:** 11/11/2016 11:15am
DX Code:		**Report Date:** 11/16/2016 07:09am

Test Results

Test	Genotype Result	Phenotype Result	Flag
CYP2D6	*5/*10	INTERMEDIATE METABOLIZER	ATTN
CYP2C19	*1/*1	EXTENSIVE (NORMAL) METABOLIZER	
CYP2C9	*1/*1	EXTENSIVE (NORMAL) METABOLIZER	
CYP3A4	*1/*1	EXTENSIVE (NORMAL) METABOLIZER	
CYP3A5	*3/*3		
SLCO1B1 521 T>C	521TT	NORMAL TRANSPORTER FUNCTION. NO INCREASE IN SIMVASTATIN MYOPATHY RISK.	
ABCB1 1236C/A>T 2677G>T/A 3435C/A>T	1236CT 2677GG 3435CT	NORMAL EFFLUX TRANSPORTER FUNCTION	
VKORC1 1639G/T>A	AA	HIGH WARFARIN SENSITIVITY	ATTN
FII(Prothrombin) 20210G>A	20210GG	NEGATIVE FOR 20210G>A MUTATION. NO INCREASED RISK FOR VENOUS THROMBOSIS (risk interpretation is based only on FII genotype)	
FV(Leiden) 1691G>A	1691GG	NEGATIVE FOR 1691G>A MUTATION. NO INCREASED RISK FOR VENOUS THROMBOSIS (risk interpretation is based only on FV genotype)	
MTHFR 677C>T 1298A>C	677CC 1298AC	NO INCREASED RISK OF HYPERHOMOCYSTEINEMIA	

Test Methodology: Multiplex Polymerase Chain Reaction (PCR) and multiplex Allele Specific Primer Extension (ASPE) with LMD's proprietary universal array sorting system on the Luminex platforms. The following allelic variants may be detected in the assay: CYP2D6 *1, *2, *3, *4, *5, *6, *7, *8, *9, *10, *11, *12, *14, *15, *17, *29,*35, *41, gene duplication; CYP2C19 *1, *2, *3, *4, *5, *6, *7, *8, *9, *10, *13, *17; CYP2C9 *1, *2, *3; CYP3A4 *1, *1B, *2, *3, *8, *11, *12, *13, *16, *17, *22; CYP3A5 *1, *1D, *2, *3, *3B, *6, *7, *8, *9; VKORC1 –1639 G/T>A; ABCB1 C1236C/A>T, 2677G>T/A, 3435C/A>T; SLCO1B1 521T>C; FII 20210G>A; FV 1691G>A; MTHFR 677C>T, 1298A>C.

Assay Limitations: Only the targeted genetic variants are detected. In the case of rare alleles that assay is not designed to detect, the genotype will default to wild type allele, or an allele that is most genetically similar. Test results do not rule out the possibility that this individual is a carrier of other mutations/variations not detected by genotyping assays.

FDA Disclaimer: CYP2D6 genotyping assay has been cleared by FDA (510(k) Number k130189). Genotyping assays for CYP2C19, CYP2C9, CYP3A4, CYP3A5, VKORC1, ABCB1, SLCO1B1, FII, FV, MTHFR were developed and their performance characteristics determined by Cygenex Inc. The tests have not been cleared by FDA. The FDA does not require clearance or approval for clinical laboratory developed tests. The laboratory is regulated under the Clinical Laboratory Improvement Act of 1988 as qualified to perform high complexity clinical testing.

Disclaimer: The report below is provided as supplementary information. It presents an interpretation of genetic results based on published commentary on clinical implementation of pharmacogenetic data. Dosing guidelines and recommendations provided in Patient Medication section are excerpts from FDA drug labels and dosing guidelines published by Clinical Pharmacogenetics Implementation Consortium (CPIC) or Dutch Pharmacogenetics Working Group (DPWC). Source of each recommendation is indicated. Cygenex does not take responsibility for dosing guidelines or recommendations that is provided as supplemental information. This report shall be used in conjunction with other clinical findings in guiding therapeutic approach for the patient. Cygenex does not and cannot prescribe or advise any treatment for the patient. The treating healthcare professional has ultimate responsibility for all treatment decisions made with regard to the patient, including any made on the basis of the patient's genotype. Therefore, Cygenex and/or its employees, deny any liability to any person or entity with regard to claims, loss, damage arising, or alleged to arise, directly or indirectly, from the use of information contained in this report.

Patient Medications

Medication Taken	Clinical Recommendations / Predicted Metabolic Response[#1] (Prediction is based solely on the results of genetic testing. Other factors may influence drug metabolism)	Alternative Medications with Low Genetic Impact[#2] (Use standard precautions)
ASPIRIN	* No Pharmacogenetic Guidance available [#2].	

Based on patient's genotype, the medication can be prescribed according to standard regimens.

Based on patient's genotype, the medication has potentially reduced efficacy or increased toxicity. Clinical monitoring is recommended.

Based on patient's genotype, guidelines exist for adjusting dosage or selection of alternative medication.

#1 Metabolic pathways were identified for each medication based on the comprehensive database of Cytochrome P450 enzymes: Nucleic Acids Res. 2010 Jan;38(Database issue): D237-43

#2 Results include information on drug metabolizing enzymes/transporters for which testing was performed. Listed drugs may undergo metabolism via additional metabolic pathways.

Phenotype Interpretation

CYP2D6 *5/*10 INTERMEDIATE METABOLIZER

This patient has one copy of a non-functional CYP2D6 allele and one copy of an allele encoding CYP2D6 protein with reduced activity. CYP2D6 gene duplication was not detected. Patient exhibits reduced CYP2D6 enzyme activity.
Prodrugs (i.e. Codeine, Tramadol, Oxycodone, Hydrocodone, Tamoxifen): The conversion of prodrugs metabolized by CYP2D6 to their active metabolites is reduced. Patient may experience inadequate or attenuated therapeutic effect when treated with a prodrug due to active metabolite not reaching the therapeutic dose. If efficacy problems occur, consider selecting an alternative medication not metabolized through CYP2D6 pathway.
Drugs deactivated by CYP2D6: Patient may develop higher serum concentration of drug due to decreased drug clearance. Patient is at increased risk of concentration-dependent adverse drug reactions, drug toxicity or prolonged therapeutic effect. If safety (ADRs) problems occur, consider dose decrease or alternative medication that is not metabolized through CYP2D6 pathway. CYP2D6 inhibitors further decrease CYP2D6 enzymatic activity. Be extra cautious when prescribing CYP2D6 substrate to a patient who is concurrently taking CYP2D6 inhibiters. Further dose adjustment may be required in such case. If medication is metabolized by multiple CYPs (i.e. CYP3A4/5, CYP2C19), be aware of patient's metabolizing status and co-administered inducers/inhibitors for any of the major participating CYPs.

CYP2D6 SUBSTRATES (this list is not all inclusive):

Opioids: Codeine (Prodrug), Tramadol (Prodrug), Oxycodone (Prodrug). Psychiatry: Thioridazine, Zuclopenthixol. Antidepressants: Amitriptyline, Clomipramine, Desipramine, Doxepin, Imipramine, Nortriptyline, Trimipramine. Cardiovascular: Flecainide, Metoprolol, Propafenone. Cancer treatment: Tamoxifen (Prodrug).

Opioids: Hydrocodone (Prodrug). Psychiatry: Aripiprazole, Benztropine, Chlorpromazine, Cevimeline, Clozapine, Donepezil, Dextromethorphan, Fluphenazine, Galantamine, Haloperidol, Iloperidone, Modafinil, Olanzapine, Perphenazine, Pimozide, Risperidone, Tetrabenazine. Antidepressants: Atomoxetine, Citalopram, Duloxetine, Escitalopram, Fluoxetine, Fluvoxamine, Mirtazapine, Paroxetine, Sertaline, Venlafaxine, Vortioxetine. Cardiovascular: Alprenolol, Bufuralol, Carvediol, Clonidine, Debrisoquine, Mexiletine, Nebivolol, Perhexiline, Propranolol, Sparteine, Timolol. Antihistamines: Chlorphenamine, Diphenhydramine, Hydroxyzine. Anti-diabetic: Phenformin. Anti-nausea: Metoclopramide, Ondansetron, Promethazine.

CYP2D6 INHIBITORS: Strong inhibitors: Bupropion, Fluoxetine, Paroxetine, Quinidine. Moderate inhibitors: Cinacalcet, Duloxetine, Terbinafine. Weak Inhibitors: Amiodarone, Celecoxib, Cimetidine, Desvenlafaxine, Diltiazem, Diphenhydramine, Echinacea (herbal), Escitalopram, Febuxostat, Gefitinib, Hydralazine, Hydroxychloroquine, Imatinib, Methadone, Oral contraceptives, Propafenone, Ranitidine, Ritonavir, Sertraline, Telithromycin, Verapamil. **CYP2D6 INDUCERS:** None known.

CYP2C19 *1/*1 EXTENSIVE (NORMAL) METABOLIZER

This patient has two copies of alleles encoding CYP2C19 protein with normal activity. Patient metabolizes drugs at normal rate. Consider following standard dosing practices. Therapeutic drug monitoring and dose adjustment might be required if patient is prescribed CYP2C19 substrate and concurrently taking enzyme inhibitors or inducers. If medication is metabolized by multiple CYPs (i.e. CYP3A4/5, CYP2D6), be aware of patient's metabolizing status and co-administered inducers/inhibitors for any of the major participating CYPs.

CYP2C19 SUBSTRATES (this list is not all inclusive):

Cardiovascular: Clopidogrel (Prodrug), Propranolol. Opioids: Meperidine, R-Methadone. NSAIDs: Indomethacin. Muscle relaxants: Carisoprodol. Psychiatry: Diazepam, Hexobarbital, Mephenytoin, Mephobarbital, Phenobarbital, Phenytoin, Primidone.

Antidepressants: Amitriptyline, Citalopram, Clomipramine, Doxepin, Escitalopram, Imipramine, Moclobemide, Sertaline, Trimipramine. Proton Pump Inhibitors: Dexlansoprazole, Esomeprazole, Lansoprazole, Omeprazole, Pantoprazole, Rabeprazole. HIV treatment: Nelfinavir. Antibiotics/Antifungal: Chloramphenicol, Voriconazole. Antimalarial: Proguanil (Prodrug).

CYP2C19 INHIBITORS: Strong inhibitors: Fluconazole, Fluvoxamine, Ticlopidine. Moderate inhibitors: Esomeprazole, Fluoxetine, Moclobemide, Omeprazole, Voriconazole. Weak Inhibitors: Allicin (garlic derivative), Armodafinil, Carbamazepine, Cimetidine, Etravirine, Human growth hormone (rhGH), Felbamate, Ketoconazole, Oral contraceptives. **CYP2C19 INDUCERS:** Rifampin, Artemisinin.

CYP2C9	***1/*1**	**EXTENSIVE (NORMAL) METABOLIZER**

This patient carries two copies of normal activity CYP2C9 allele. Patient is anticipated to have normal CYP2C9 enzyme activity. Consider following standard dosing practices when prescribing CYP2C9 metabolized drugs. Note that inhibitors and inducers of CYP2C9 may change patient's metabolizing status.

CYP2C9 SUBSTRATES (this list is not all inclusive):

Cardiovascular: Acenocoumarol, Candesartan, Irbesartan, Losartan (Prodrug), Phenprocoumone, Torsemide, Valsartan, Warfarin. Statins: Fluvastatin; Pulmonology: Bosentan. NSAIDs: Aceclofenac, Celecoxib*, Diclofenac, Flurbiprofen, Naproxen, Ibuprofen, Indomethacin, Lornoxicam, Mefenamic acid, Meloxicam, Piroxicam, Tenoxicam, Valdecoxib. Psychiatry: Fluoxetine, Phenytoin. Anti-diabetic: Glibenclamide, Glimepiride, Gliclazide, Tolbutamide, Nateglinide. Steroids: Mestranol (Prodrug)

CYP2C9 INHIBITORS: Moderate inhibitors: Amiodarone, Fluconazole, Miconazole, Oxandrolone. Weak Inhibitors: Capecitabine, Cotrimoxazole, Etravirine, Fluvastatin, Fluvoxamine, Metronidazole, Sulfinpyrazone, Tigecycline, Voriconazole, Zafirlukast.
CYP2C9 INDUCERS: Carbamazepine, Rifampin, Aprepitant, Bosentan, Phenobarbital, St. John's Wort.

CYP3A4	***1/*1**	**NORMAL METABOLIZER**	**EXTENSIVE (NORMAL) METABOLIZER**
CYP3A5	***3/*3**	**NORMAL 3A5 NON-EXPRESSER**	

The patient is anticipated to have normal levels of CYP3A4/5 enzyme activity. Note that CYP3A metabolism is highly sensitive to inhibition and induction when a patient is taking multiple medications.

CYP3A4/5 SUBSTRATES (this list is not all inclusive):

Cardiovascular: Amlodipine, Conivaptan, Dronedarone, Eplerenone, Felodipine, Ivabradine, Lercanidipine, Nicardipine, Nifedipine, Nimodipine, Nisoldipine, Nitrendipine, Ticagrelol, Tolvaptan, Vesnarinone. Statins: Atorvastatin, Lovastatin, Simvastatin. Psychiatry: Aripiprazole, Buspirone, Dihydroergotamine, Eletripan, Estazolam, Ergotamine, Lurasidone, Midazolam, Nitrazepam, Pimozide, Risperidone, Quetiapine, Triazolam, Zonisamide. Antidepressants: Amitriptyline, Clomipramine, Doxepin, Imipramine, Mirtazapine, Nefazodone, Reboxetine, Trazadone, Trimipramine, Venlafaxine. Opioids: Alfentanil, Codeine, Fentanyl, Hydrocodone, Meperidine, Methadone, Propoxyphene, Tramadol, Sufentanil. Steroids: Budesonide, Cortisol, Estradiol, Gestrodene, Hydrocortisone, Fluticasone. Proton Pump Inhibitors: Esomeprazole, Lansoprazole, Omeprazole, Pantoprazole. Immunosupressants: Cyclosporin, Everolimus, Sirolimus, Tacrolimus. Cancer treatment: Cabazitaxel, Dasatinib, Gefitinib, Ruxolitinib, Sunitinib, Tamoxifen . Antibiotics/antifungals: Clarithromycin, Dirithromycin, Erythromycin, Telithromycin, Voriconazole, Posaconazole. Anti-nausea: Aprepitant, Granisetron. HIV treatment: Amprenavir, Darunavir, Fosamprenavir, Indinavir, Nelfinavir, Ritonavir, Tipranavir, Lopinavir, Maraviroc, Saquinavir. Others: Sildenafil (Viagra), Vardenafil (Levitra).

CYP3A INHIBITORS: Strong inhibitors: Boceprevir, Clarithromycin, Conivaptan, Grapefruit juice, Indinavir, Itraconazole, Ketoconazole, Lopinavir/ritonavir, Mibefradil, Nefazodone, Nelfinavir, Posaconazole, Ritonavir, Saquinavir, Telaprevir, Telithromycin, Voriconazole. Moderate inhibitors: Amprenavir, Aprepitant, Atazanavir, Ciprofloxacin, Darunavir/ritonavir, Diltiazem, Erythromycin, Fluconazole, Fosamprenavir, Imatinib, Verapamil. Weak Inhibitors: Alprazolam, Amiodarone, Amlodipine, Atorvastatin, Bicalutamide, Cilostazol, Cimetidine, Cyclosporine, Fluoxetine, Fluvoxamine, Ginkgo, Goldenseal, Isoniazid, Nilotinib, Oral contraceptives, Ranitidine, Ranolazine, Tipranavir/ritonavir, Zileuton. **CYP3A INDUCERS:** Avasimibe, Carbamazepine, Phenytoin, Rifampin, St. John's wort, Bosentan, Efavirenz, Etravirine, Modafinil, Nafcillin, Amprenavir, Aprepitant, Armodafinil, Echinacea, Pioglitazone, Prednisone, Rufinamide.

SLCO1B1	**521TT**	**NORMAL TRANSPORTER FUNCTION. NO INCREASE IN SIMVASTATIN MYOPATHY RISK.**

This patient has two copies of normal function allele of the SLCO1B1 gene. The patient is predicted to have normal SLCO1B1 hepatic uptake transporter function and does not require dose adjustment for most medications that are affected by SLCO1B1 (including simvastatin) on the basis of SLCO1B1 genetic status.
Simvastatin: Prescribe desired starting dose and adjust doses of simvastatin based on disease-specific guidelines*.
* Ramsey LB et al., The Clinical Pharmacogenetics Implementation Consortium Guideline for SLCO1B1 and Simvastatin-Induced Myopathy: 2014 Update, Clinical pharmacology & Therapeutics, 96(4): 423-8.

SLCO1B1 SUBSTRATES (this list is not all inclusive):

Statins: Atorvastatin, Lovastatin, Pitavastatin, Pravastatin, Rosuvastatin, Simvastatin. Cardiovascular: Bosentan,

Enalapril, Olmesartan, Valsartan. Antibiotics/Antifungal: Benzylpenicillin, Caspofungin, Rifampin. Cancer treatment: Methotrexate, SN-38 (active metabolite of irinotecan). Anti-diabetic: Glyburide, Repaglinide.
SLCO1B1 INHIBITORS: Atazanavir, Cyclosporine, Eltrombopag, Gemfibrozil, Lopinavir, Rifampin, Ritonavir, Saquinavir, Tipranavir.

ABCB1	**1236CT 2677GG 3435CT**	**NORMAL EFFLUX TRANSPORTER FUNCTION**

ABCB1 gene (also known as P-gp, MDR1) encodes major efflux transporter that controls drug bioavailability and limits penetration of drugs into brain, gonads and fetus. Some combinations of ABCB1 gene polymorphisms (haplotype) are associated with compromised efflux pump efficiency. This patient's ABCB1 haplotype is associated with normal efflux function of ABCB1 transporter. Note that ABCB1 function is highly sensitive to inhibition and induction where inhibitors increase and inducers decrease tissue-to-plasma ratio of ABCB1 substrates.

ABCB1 SUBSTRATES (this list is not all inclusive): Cardiovascular: Aliskiren, Clopidogrel, Dabigatran etexilate, Digoxin, Digitoxin, Diltiazem, Losartan, Mibefradil, Quinidine, Ranolazine, Talinolol, Tolvaptan, Verapamil. Statins: Atorvastatin, Fluvastatin, Lovastatin, Pravastatin, Simvastatin. Psychiatry: Amitriptyline, Carbamazepine, Midazolam, Nefazodone, Nortriptyline, Phenytoin, Risperidone, Quetiapine. Opioids: Fentanyl, Loperamide, Methadone, Morphine. Pulmonology: Ambrisentan. Anti-diabetic: Glyburide, Saxagliptin, Sitagliptin. Antihistamines: Cimetidine, Fexofenadine, Ranitidine, Tetfenadine. Immunosuppressants: Cyclosporine, Everolimus, Tacrolimus. Cancer treatment: Actinomycin D, Bisantrene, Colchicine, Daunorubicin, Docetaxel, Doxorubicin, Epirubicin, Etoposide, Irinotecan, Imatinib, Lapatinib, Methotrexate, Mithramycin, Mitomycin C, Mitoxantrone, Nilotinib, Paclitaxel, Temozolomide, Teniposide, Topotecan, Vinblastine. Antibiotics/antifungals: Amoxicillin, Ciprofloxacin, Erythromycin, Itraconazole, Posaconazole, Rifampin, Sparfloxacin. Anti-nausea: Ondansetron. HIV treatment: Amprenavir, Indinavir, Maraviroc, Nelfinavir, Ritonavir, Saquinavir.

ABCB1 INHIBITORS: Amiodarone, Azithromycin, Captopril, Carvedilol, Clarithromycin, Conivaptan, Cyclosporine, Diltiazem, Dronedarone, Erythromycin, Felodipine, Itraconazole, Ketoconazole, Indinavir/Ritonavir, Quercetin, Quinidine, Ranolazine, Verapamil. **ABCB1 INDUCERS:** Avasimibe, Carbamazepine, Phenytoin, Rifampin, St John's wort.

VKORC1	**AA**	**HIGH WARFARIN SENSITIVITY**

This patient has VKORC1 AA genotype (homozygous for -1639 G/T>A mutation). The VKORC1 gene encodes the Vitamin K epoxide reductase protein, which is a molecular target of warfarin. For warfarin dosing, consider using the online resource http://www.warfarindosing.org or the table below.

Note that hereditary or acquired deficiency of protein C or its cofactor, protein S, has been associated with tissue necrosis following administration of warfarin.

Warfarin Drug Label: Range of Expected Therapeutic Warfarin Doses Based on CYP2C9 and VKORC1 Genotypes

VKORC1	CYP2C9					
	*1/*1	*1/*2	*1/*3	*2/*2	*2/*3	*3/*3
GG	5-7 mg	5-7 mg	3-4 mg	3-4 mg	3-4 mg	0.5-2 mg
AG	5-7 mg	3-4 mg	3-4 mg	3-4 mg	0.5-2 mg	0.5-2 mg
AA	3-4 mg	3-4 mg	0.5-2 mg	0.5-2 mg	0.5-2 mg	0.5-2 mg

Other clinical factors (e.g., age, race, body weight, sex, concomitant medications, and comorbidities) are generally accounted for along with genotype in the ranges expressed in the Table. VKORC1 1639 G/T>A variant is used in this table. Other co-inherited VKORC1 variants may also be important determinants of warfarin dose. Patients with CYP2C9 *1/*3, *2/*2, *2/*3 and *3/*3 may require more prolonged time (>2 to 4 weeks) to achieve maximum INR effect for a given dosage regimen.

FII	**20210GG**	**NEGATIVE FOR 20210G>A MUTATION. NO INCREASED RISK FOR VENOUS THROMBOSIS (risk interpretation is based only on FII genotype)**

This patient is negative for FII (Prothrombin) gene mutation 20210G>A. Venous thrombosis is multifactorial and person who experienced thrombotic event may carry a risk factor for recurrent thrombosis even if found to be negative for factor II 20210G>A mutation. Consideration should be given to factor V Leiden DNA testing, biochemical measurement of plasma homocysteine, and functional coagulation assays for antithrombin III, protein C, and protein S.

FV	**1691GG**	**NEGATIVE FOR 1691G>A MUTATION. NO INCREASED RISK FOR VENOUS THROMBOSIS (risk interpretation is based only on FV genotype)**

This patient is negative for factor V Leiden mutation. Person who experienced thrombotic event may carry a risk factor for recurrent thrombosis even if found to be negative for factor V Leiden*. Venous thrombosis is multifactorial, and the presence of more than one genetic risk factor is not uncommon. Consideration should be given to supplementing factor V Leiden DNA testing with factor II (prothrombin) DNA testing, biochemical measurement of plasma homocysteine, and functional coagulation assays for antithrombin III, protein C, and protein S.

* Grody WW, et al. (2007) American College of Medical Genetics Consensus Statement on Factor V Leiden Mutation Testing

MTHFR	677CC 1298AC	NO INCREASED RISK OF HYPERHOMOCYSTEINEMIA

MTHFR catalyzes conversion of folate to its major active form which is involved in neurotransmitter synthesis, conversion of homocysteine to methionine, and is important for cardiovascular health and normal nervous system function. This patient is negative for 677C>T mutation, and carries one 1298A>C mutation of the MTHFR gene. This genotype is associated with normal folic acid conversion. Patient's MTHFR genotype is NOT associated with increased risk of hyperhomocysteinemia* or methotrexate (and other anti-folate drug) toxicity**. MTHFR gene mutation test does not detect other causes of hyperhomocysteinemia (renal failure, zinc deficiency, leukemia, psoriasis, or antifolate drug therapy).
* Hickey SE et al, ACMG Practice Guidelines Genet Med 2013:15(2):153-156
**Song GG et al., Clin Rheumatol (2014) V 33(12):1715-24

Legend


Normal phenotype. Follow standard dosing practices or treatment regimen.


Increased risk for the indicated condition. Medications that are substrates to the listed pathway have potentially reduced efficacy or increased toxicity. Clinical monitoring is recommended.


Guidelines exist for adjusting dasage or selection of alternative medication. Consult FDA drug label and/or www.pharmgkb.org for published clinical guidelines and treatment adjustments.

Medical Specialty	Medication	Brand Name	CYP2D6	CYP2C19	CYP3A4/5	CYP2C9	ABCB1	SLCO1B1
PAIN MANAGEMENT	**Opioids**							
	Alfentanil	Alfenta			NORMAL			
	Buprenorphine	Buprenex, Suboxone, Subutex			NORMAL			
	Butorphanol							
	Codeine (Prodrug)	Tylenol#3. Tylenol#4	DECREASED		NORMAL			
	Dihydrocodeine (Prodrug)	Synalgos, Novocodin, Drocode, Parzone	DECREASED		NORMAL			
	Fentanyl	Duragesic, Actiq			NORMAL		NORMAL	
	Hydrocodone (Prodrug)	Vicodin, Hydrocet, Norco, Lortab, Lorcet	DECREASED		NORMAL		NORMAL	
	Hydromorphone	Dilaudid, Hydrostat, Exalgo						
	Levorphanol	Levo Dromoran						
	Loperamide	Imodium			NORMAL		NORMAL	
	Methadone	Dolophine, Methadose		NORMAL	NORMAL		NORMAL	
	Meperidine	Demerol			NORMAL			
	Morphine	MSContin, Avinza, Roxanol, Oramorph					NORMAL	
	Oxymorphone	Opana, Numorphan, Numorphone						
	Oxycodone (Prodrug)	Percocet, OxyContin	DECREASED		NORMAL			
	Propoxyphene	Darvon			NORMAL			
	Sufentanil	Sufenta			NORMAL			
	Tapentadol	Nucynta, Palexia						
	Tramadol (Prodrug)	Ultram, Ryzolt, ConZip	DECREASED		NORMAL		NORMAL	
	Opioid Receptor Antagonists							
	Naloxone	Narcan, Evzio						
	Naltrexone	Revia						
	NSAIDs							
	Aceclofenac	Acebid, Nofenac				NORMAL		
	Acetaminophen	Tylenol						
	Aspirin	Ecotrin						
	Celecoxib	Celebrex				NORMAL		
	Diclofenac	Voltaren				NORMAL		
	Etodolac	Lodine				NORMAL		
	Fenoprofen	Nalfon						

Medical Specialty	Medication	Brand Name	CYP2D6	CYP2C19	CYP3A4/5	CYP2C9	ABCB1	SLCO1B1
PAIN MANAGEMENT	**NSAIDs**							
	Flurbiprofen	Ansaid				NORMAL		
	Ibuprofen	Advil				NORMAL		
	Indomethacin	Indocin		NORMAL		NORMAL		
	Ketoprofen	Orudis, Oruvail, Actron				NORMAL		
	Ketorolac	Toradol						
	Lornoxicam	Zornica				NORMAL		
	Mefenamic acid	Ponstel				NORMAL		
	Meloxicam	Mobic				NORMAL		
	Naproxen	Aleve, Naprosyn, Anaprox, Naprelan				NORMAL		
	Nabumetone	Relafen						
	Oxaprozin	Daypro				NORMAL		
	Piroxicam	Feldene				NORMAL		
	Sulindac	Clinoril						
	Tenoxicam	Oxicam, Tilcotil				NORMAL		
	Valdecoxib	Bextra			NORMAL	NORMAL		
	Muscle Relaxants							
	Baclofen	Lioresal						
	Carisoprodol	Soma		NORMAL				
	Cyclobenzaprine	Flexeril, Amrix	DECREASED		NORMAL			
	Chlorzoxarone	Lorzone, Parafon, Paraflex, Relaxazone						
	Metaxalone	Skelaxin	DECREASED		NORMAL			
	Methocarbamol	Robaxin						
	Oxybutynin	Ditropan XL, Urotrol			NORMAL			
	Orphenadrine	Norflex, Norgesic			NORMAL			
	Tizanidine	Zanaflex						
	Antidepressants							
	Amitriptyline	Amitril, Elavil, Endep	DECREASED	NORMAL	NORMAL		NORMAL	
	Amoxapine	Asendin	DECREASED					
	Bupropion	Wellbutrin, Zyban, Aplenzin, Forfivo XL						
	Buspirone	Buspar			NORMAL			
	Citalopram	Celexa	DECREASED	NORMAL	NORMAL		NORMAL	

Medical Specialty	Medication	Brand Name	CYP2D6	CYP2C19	CYP3A4/5	CYP2C9	ABCB1	SLCO1B1
PSYCHIATRY / NEUROLOGY	**Antidepressants**							
	Clomipramine	Anafranil	DECREASED	NORMAL	NORMAL			
	Desipramine	Norpramin	DECREASED		NORMAL		NORMAL	
	Doxepin	Silenor, Sinequan	DECREASED	NORMAL	NORMAL			
	Duloxetine	Cymbalta	DECREASED					
	Fluoxetine	Prozac, Symbyax	DECREASED		NORMAL	NORMAL	NORMAL	
	Fluvoxamine	Luvox, Luvox CR	DECREASED					
	Escitalopram	Lexapro		NORMAL	NORMAL		NORMAL	
	Imipramine	Tofranil, Tofranil-PM	DECREASED	NORMAL	NORMAL			
	Levomilnacipran	Fetzima			NORMAL			
	Moclobemide	Aurorix	DECREASED	NORMAL				
	Milnacipran	Savella						
	Mirtazapine	Remeron	DECREASED		NORMAL			
	Nortriptyline	Aventyl, Pamelor	DECREASED		NORMAL		NORMAL	
	Paroxetine	Brisdelle, Paxil, Pexeva	DECREASED				NORMAL	
	Reboxetine	Edronax, Norebox, Solvex, Davedax			NORMAL		NORMAL	
	Sertraline	Zoloft		NORMAL	NORMAL			
	Symbyax	Symbyax	DECREASED					
	Trazodone	Desyrel, Oleptro			NORMAL			
	Trimipramine	Surmontil	DECREASED	NORMAL			NORMAL	
	Venlafaxine	Effexor XR	DECREASED		NORMAL		NORMAL	
	Vilazodone	Viibryd			NORMAL			
	Vortioxetine	Brintellix	DECREASED		NORMAL			
	ADHD treatment							
	Amphetamine	Adderall	DECREASED					
	Dextroamphetamine	Dexedrine	DECREASED					
	Lisdexamfetamine	Vyvanse	DECREASED					
	Methylphenidate	Concerta, Ritalin						
	Dexmethylphenidate	Focalin						
	Atomoxetine	Strattera	DECREASED	NORMAL				
	Clonidine	Catapres, Kapvay	DECREASED					

Medical Specialty	Medication	Brand Name	CYP2D6	CYP2C19	CYP3A4/5	CYP2C9	ABCB1	SLCO1B1
PSYCHIATRY / NEUROLOGY	**ADHD treatment**							
✓	Guanfacine	Intuniv			NORMAL			
✓	Buproprion	Wellbutrin						
	Benzodiazepines							
✓	Alprazolam	Xanax			NORMAL	NORMAL		
✓	Bromazepam	Bromazanil, Dormoc, Lexotanil, Normoc		NORMAL	NORMAL			
✓	Clobazam	Frisium		NORMAL	NORMAL			
✓	Clonazepam	Klonopin			NORMAL			
✓	Diazepam	Valium, Diastat		NORMAL	NORMAL			
✓	Estazolam	ProSom, Eurodin			NORMAL			
✓	Flurazepam	Dalmane, Dalmadorm			NORMAL			
✓	Lorazepam	Ativan						
✓	Midazolam	Meberal			NORMAL			
✓	Medazepam	Nobrium, Tranquirax, Rudotel, Raporan		NORMAL	NORMAL			
✓	Nitrazepam	Serzone			NORMAL			
✓	Oxazepam	Serax			NORMAL			
✓	Quazepam	Doral, Dormali		NORMAL	NORMAL	NORMAL		
✓	Prazepam	Centrax, Dementrin			NORMAL			
✓	Temazepam	Restoril		NORMAL	NORMAL			
✓	Triazolam	Mellaril, Sonopax			NORMAL			
	Sedatives-hypnotics							
✓	Eszopiclone	Lunesta			NORMAL	NORMAL		
✓	Zolpidem	Ambien			NORMAL			
	Antipsychotics							
	Aripiprazole	Abilify	DECREASED		NORMAL		NORMAL	
	Chlorpromazine	Thorazine	DECREASED				NORMAL	
	Clozapine	Clozaril, Verzacloz	DECREASED		NORMAL		NORMAL	
	Fluphenazine	Prolixin	DECREASED					
	Haloperidol	Haldol	DECREASED		NORMAL			
	Iloperidone	Fanapt	DECREASED		NORMAL			
✓	Lurasidone	Latuda			NORMAL			
	Olanzapine and fluoxetine*	Symbyax	DECREASED				NORMAL	
	Paliperidone	Invega	DECREASED		NORMAL		NORMAL	

Medical Specialty	Medication	Brand Name	CYP2D6	CYP2C19	CYP3A4/5	CYP2C9	ABCB1	SLCO1B1
PSYCHIATRY / NEUROLOGY	**Antipsychotics**							
	Perphenazine	Etrafon	DECREASED		NORMAL			
	Pimozide	Orap	DECREASED		NORMAL			
✓	Quetiapine	Seroquel, Seroquel XR			NORMAL			
	Risperidone	Risperdal	DECREASED				NORMAL	
	Tetrabenazine	Xenazine	DECREASED					
!	Thioridazine	Halcion	DECREASED					
✓	Ziprasidone	Geodon			NORMAL			
!	Zuclopenthixol	Clopixol	DECREASED					
	Barbiturates							
✓	Hexobarbital	Barbidorm		NORMAL		NORMAL		
✓	Mephobarbital	Versed		NORMAL				
✓	Phenobarbital	Luminal		NORMAL		NORMAL	NORMAL	
	Anticonvulsants							
✓	Carbamazepine	Tegretol, Carbatrol			NORMAL		NORMAL	
✓	Gabapentin	Neurontin						
✓	Lamotrigine	Lamictal					NORMAL	
✓	Mephenytoin	Mesantoin		NORMAL		NORMAL		
✓	Phenytoin	Dilantin		NORMAL		NORMAL		
✓	Pregabalin	Lyrica						
✓	Primidone	Mysoline		NORMAL				
✓	Rufinamide	Banzel						
✓	Zonisamide	Zonegran			NORMAL			
	Treatment Of Alzheimer's							
	Donepezil	Aricept	DECREASED		NORMAL		NORMAL	
	Galantamine	Razadyne	DECREASED		NORMAL			
✓	Memantine	Namenda						
	Treatment Of Migraine							
✓	Ergotamine	Replax			NORMAL			
✓	Dihydroergotamine	Migranal, D.H.E 45			NORMAL			
✓	Eletriptan	Relpax			NORMAL			
	Other Medications Used In Neurology							
	Benzatropine	Cogentin	DECREASED	NORMAL				
	Cevimeline	Evoxac	DECREASED		NORMAL			
	Modafinil	Alertec, Provigil	DECREASED		NORMAL			

Medical Specialty	Medication	Brand Name	CYP2D6	CYP2C19	CYP3A4/5	CYP2C9	ABCB1	SLCO1B1
	Other Medications Used In Neurology							
	NUEDEXTA	NUEDEXTA	DECREASED		NORMAL			
	Tetrabenazine	Xenazine	DECREASED					
CARDIOLOGY	**Antiarrhythmics**							
	Amiodarone	Cordarone			NORMAL			
	Bretylium							
	Dofetilide	Tikosyn			NORMAL			
	Dronedarone	Multaq			NORMAL			
	Flecainide	Tambocor	DECREASED					
	Ibutilide	Corvert						
	Lidocaine	Xylocaine			NORMAL			
	Mexiletine	Mexitil	DECREASED		NORMAL			
	Propafenone	Rythmol	DECREASED		NORMAL			
	Quinidine	Quinidex			NORMAL			
	Sotalol	Betapace						
	Sparteine	Spal	DECREASED					
	Cardiac Glycosides							
	Digitoxin	Digibind			NORMAL		NORMAL	
	Digoxin	Digitek, Lanoxin			NORMAL		NORMAL	
	Antianginal							
	Ivabradine	Bradid, Ceralan			NORMAL			
	Perhexiline	Pexsig	DECREASED					
	Ranolazine	Ranexa	DECREASED		NORMAL		NORMAL	
	Hypotensives: Beta Blockers							
	Alprenolol	Atenenol	DECREASED					
	Atenolol	Tenormin						
	Carvedilol	Coreg	DECREASED			NORMAL		
	Metoprolol	Lopressor, Toprol XL	DECREASED					
	Nadolol	Corgard						
	Nebivolol	Bystolic	DECREASED					
	Propranolol	Inderal, Inderal LA	DECREASED					
	Timolol	Blocarden	DECREASED					
	Hypotensives: Calcium Channel Blockers							
	Amlodipine	Norvasc			NORMAL			
	Diltiazem	Cardizem, Tiazac			NORMAL			

Medical Specialty	Medication	Brand Name	CYP2D6	CYP2C19	CYP3A4/5	CYP2C9	ABCB1	SLCO1B1
CARDIOLOGY	**Hypotensives: Calcium Channel Blockers**							
	Felodipine	Plendil			NORMAL			
	Lercanidipine	Landip, Larpin, Lerka			NORMAL			
	Mibefradil	Posicor			NORMAL		NORMAL	
	Nifedipine	Adalat, Procardia			NORMAL			
	Nimodipine	Nimotop, Nymalize			NORMAL			
	Nisoldipine	Sular			NORMAL			
	Nitrendipine	Balodopine			NORMAL			
	Verapamil	Calan, Verelan, Calan SR, Isoptin			NORMAL	NORMAL	NORMAL	
	Ace Inhibitors							
	Benazepril	Lotensin						
	Captopril	Capoten	DECREASED					
	Enalapril	Vasotec			NORMAL			NORMAL
	Lisinopril	Privinil						
	Moexipril	Univasc						
	Perindopril	Aceon						
	Quinapril	Accupril						
	Ramipril	Altace						
	Trandolapril	Mavik, Tarka						
	Angiotensin Ii Receptor Blockers							
	Candesartan	Atacand				NORMAL		
	Eprosartan	Teveten						
	Irbesartan	Avapro				NORMAL		
	Losartan (Prodrug)	Cozaar				NORMAL	NORMAL	
	Olmesartan	Olmetec						NORMAL
	Telmisartan	Micardis						
	Valsartan	Diovan				NORMAL		NORMAL
	Other Hypotensives							
	Aliskiren	Tekturna					NORMAL	
	Bosentan	Trasleer			NORMAL	NORMAL		NORMAL
	Clonidine	Catapres-TTS, Jenloga	DECREASED					
	Conivaptan	Vaprisol			NORMAL			
	Debrisoquine	Declinax	DECREASED					

Medical Specialty	Medication	Brand Name	CYP2D6	CYP2C19	CYP3A4/5	CYP2C9	ABCB1	SLCO1B1
CARDIOLOGY	**Other Hypotensives**							
	Eplerenone	Inspra			NORMAL			
	Tolvaptan	Samsca			NORMAL		NORMAL	
	Antiplatelet Agents							
	Clopidogrel (Prodrug)	Plavix		NORMAL			NORMAL	
	Prasugrel (Prodrug)	Effient			NORMAL	NORMAL		
	Ticagrelor	Brilinta			NORMAL			
	Anticoagulant Therapy							
	Acenocoumarol	Sintrom, Sinthrome		NORMAL		NORMAL		
	Apixaban	Eliquis			NORMAL			
	Dabigatran	Pradaxa						
	Fondaparinux	Arixtra						
	Phenprocoumon	Marcoumar, Marcumar			NORMAL	NORMAL		
	Rivaroxaban	Xarelto			NORMAL			
	Warfarin	Coumadine				NORMAL		
	Diuretics							
	Indapamide	Lozide	DECREASED		NORMAL	NORMAL		
	Furosemide	Lasix						
	Metolazone	Zaroxolyn						
	Spironolactone	Aldactone						
	Torsemide	Demadex				NORMAL		
	Statins							
	Atorvastatin	Lipitor, Torvast			NORMAL			NORMAL
	Fluvastatin	Lescol, Lescol XL				NORMAL		
	Lovastatin	Mevacor, Lescol, Advicor			NORMAL			NORMAL
	Pitavastatin	Livalo, Pitava						NORMAL
	Pravastatin	Pravachol, Selektine, Lipostat						NORMAL
	Rosuvastatin	Crestor						
	Simvastatin	Zocor, Lipex, Simcor			NORMAL			NORMAL
GASTRO-ENTROLOGY	**Proton Pump Inhibitors**							
	Dexlansoprazole	Dexilant, Kapidex		NORMAL				
	Esomeprazole	Nexium		NORMAL	NORMAL			
	Lansoprazole	Prevacid		NORMAL	NORMAL			
	Omeprazole	Prilosec		NORMAL	NORMAL		NORMAL	
	Pantoprazole	Protonix		NORMAL	NORMAL		NORMAL	

Medical Specialty	Medication	Brand Name	CYP2D6	CYP2C19	CYP3A4/5	CYP2C9	ABCB1	SLCO1B1
GASTRO-ENTROLOGY	**Proton Pump Inhibitors**							
✓	Rabeprazole	Aciphex		NORMAL				
ENDOCRINOLOGY	**Insulin Secretagogues**							
✓	Gliclazide					NORMAL		
✓	Glimepiride	Amaryl				NORMAL		
✓	Glipizide	Glucotrol				NORMAL		
✓	Glyburide	Diabeta, Glynase				NORMAL		NORMAL
✓	Nateglinide	Starlix			NORMAL	NORMAL		
✓	Repaglinide	Prandin, NovoNorm			NORMAL	NORMAL		NORMAL
✓	Tolbutamide					NORMAL		
	Insulin Sensitizers							
✓	Metformin	Glucophage						
✓	Rosiglitazone	Avandia				NORMAL		
✓	Pioglitazone	Actos			NORMAL			
UROLOGY	**Bph Drugs**							
✓	Alfuzosin	Uroxatral			NORMAL			
	Doxazosin	Cardura	DECREASED		NORMAL	NORMAL		
✓	Dutasteride	Avodart			NORMAL			
✓	Finasteride	Proscar						
✓	Silodosin	Rapaflo			NORMAL			
	Tamsulosin	Flomax	DECREASED		NORMAL			
✓	Terazosin	Hytrin			NORMAL			
	Urinary Antispasmodics							
	Darifenacin	Enablex	DECREASED		NORMAL			
	Fesoterodine	Toviaz	DECREASED		NORMAL			
✓	Oxybutynin	Ditropan XL, Urotrol			NORMAL			
✓	Solifenacin	Vesicare			NORMAL			
	Tolterodine	Detrol	DECREASED		NORMAL			
✓	Trospium	Sanctura						
	Phosphodiesterase-5 Inhibitors (treatment Of Erectile Dysfunction)							
✓	Sildenafil	Viagra			NORMAL	NORMAL		
✓	Tadalafil	Levitra			NORMAL			
✓	Vardenafil	Avodart			NORMAL			

INCREASED	ULTRARAPID METABOLIZER or ULTRARAPID TO NORMAL METABOLIZER		MEDICATION WITH LOW GENETIC IMPACT
DECREASED	INTERMEDIATE METABOLIZER or INTERMEDIATE TO NORMAL METABOLIZER or DECREASED ABCB1 TRANSPORTER ACTIVITY		DOSING GUIDELINES EXIST FOR THIS MEDICATION. CONSULT FDA LABEL OR www.pharmgkb.org FOR TREATMENT ADJUSTMENT
NORMAL	EXTENSIVE (NORMAL) METABOLIZER or NORMAL ABCB1 TRANSPORTER ACTIVITY	**NOTE:** Medications metabolized by multiple enzymes are expected to be less sensitive to effect of genetic markers. The chart only includes genotype information on major drug metabolizing enzymes/transporters for which testing is available. Note that listed drugs may undergo metabolism via additional metabolic pathways. This chart is based on information from pharmacokinetic databases www.drugbank.ca, www.pharmgkb.org, and published research.	
LOW	POOR METABOLIZER		

For more information:
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Patient: DOE, RITZA **DOB:**

Gene	Genotype	Phenotype
CYP2D6	*5/*10	INTERMEDIATE METABOLIZER
CYP2C19	*1/*1	EXTENSIVE (NORMAL) METABOLIZER
CYP2C9	*1/*1	EXTENSIVE (NORMAL) METABOLIZER
CYP3A4/5	*1/*1 *3/*3	EXTENSIVE (NORMAL) METABOLIZER
SLCO1B1	521TT	NORMAL TRANSPORTER FUNCTION. NO INCREASE IN SIMVASTATIN MYOPATHY RISK.
ABCB1	1236CT	NORMAL EFFLUX TRANSPORTER FUNCTION
	2677GG	
	3435CT	
VKORC1	AA	HIGH WARFARIN SENSITIVITY
FII	20210GG	NEGATIVE FOR 20210G>A MUTATION. NO INCREASED RISK FOR VENOUS THROMBOSIS (risk interpretation is based only on FII genotype)
FV	1691GG	NEGATIVE FOR 1691G>A MUTATION. NO INCREASED RISK FOR VENOUS THROMBOSIS (risk interpretation is based only on FV genotype)
MTHFR	677CC	NO INCREASED RISK OF HYPERHOMOCYSTEINEMIA
	1298AC	