SAMPLE REPORT

Patient Information:

Patient: John Smith
Patient ID: 495
DOB: Jun 09, 1977
Collection Date: Jun 21, 2017
Accession #: 6

Physician: Dr. Dan Erlanger
Physician ID: 6
Report Generated: Jun 26, 2017
Gender: Male

Current Patient Prescriptions

Medical Name	Common Name	Dosage	Time on Medication
Ketoconazole	Nizoral	400 mg	6 weeks

Current Medical Diseases and Disorders

Disease or Disorder	Time of Disease or Disorder
ADHD	12 months

I. Genetic Summary

Gene	Diplotype	Phenotype
VKORC1	*1/*2	Intermediate Metabolizer
CYP1A2	*1F/*1F	Increased Metabolism
CYP3A4	*1/*1	Normal Metabolizer
CYP3A5	*3/*3	Poor Metabolizer
FKBP5	G/G	Decreased Response
APOE	*3/*4	Decreased Response
CYP2D6	*4/*4	Poor Metabolizer
UGT2B15	*1/*2	Slightly decreased enzymatic activity
HTR2A	TC/GA	Normal Response
SLCO1B1	*1/*5	Intermediate Metabolizer
ITGB3	N/A2	Defective Receptor Protein
GRIK4	T/C	Reduced Response
CYP2C9	*1/*1	Normal Metabolizer
HTR2C	T/C	Slightly Increased Risk
MTHFR	677/677	Greatly Reduced Activity
CYP2C19	*1/*2	Intermediate Metabolizer
COMT	Val/Met	Slightly Reduced Activity

II. Drug-Genome Interaction Guide

Psychotropic Medications					
Standard Precaution		**Use with Caution**		**Consider Alternatives**	
Medical Name	**Common Name**	**Medical Name**	**Common Name**	**Medical Name**	**Common Name**
Diazepam	Valium	Risperidone	Risperdal	Olanzapine	Zyprexa
Moclobemide	Manerix	Citalopram	Celexa	Iloperidone	Fanapt
Sertraline	Zoloft	Clobazam	Onfi	Perphenazine	Trilafon
Oxazepam	Serax	Escitalopram	Lexapro	Vortioxetine	Brintellix
Lorazepam	Ativan	Clozapine	Clozaril	Pimozide	Orap
Flibanserin	Addyi	Amphetamine	Adderall	Zuclopenthixol	Clopixol
Donepezil	Aricept	Dexmethylphenidate	Focalin	Brexpiprazole	Rexulti
Protriptyline	Vivactil	Methylphenidate	Ritalin	Haloperidol	Haldol
Fluoxetine	Prozac	Lisdexamfetamine	Vyvanse	Tetrabenazine	Xenazine
Flupentixol	Depixol	Dextroamphetamine	Dexedrine	Thioridazine	Mellaril
Mirtazapine	Remeron	Venlafaxine	Effexor	Atomoxetine	Strattera

Standard Precaution		Use with Caution		Consider Alternatives	
Medical Name	**Common Name**	**Medical Name**	**Common Name**	**Medical Name**	**Common Name**
Galantamine	Razadyne	Amoxapine	Amoxapine	Maprotiline	Ludiomil
Desvenlafaxine	Pristiq	Clonidine	Kapvay	Nortriptyline	Pamelor
Nefazodone	Serzone	Fluvoxamine	Luvox	Paroxetine	Paxil
Paliperidone	Invega			Desipramine	Norpramin
Ondansetron	Zofran			Clomipramine	Anafranil
Duloxetine	Cymbalta			Amitriptyline	Elavil
				Trimipramine	Surmontil
				Doxepin	Silenor
				Imipramine	Tofranil
				Aripiprazole	Abilify

Cardiovascular Medications

Standard Precaution		Use with Caution		Consider Alternatives	
Medical Name	**Common Name**	**Medical Name**	**Common Name**	**Medical Name**	**Common Name**
Fluvastatin	Lescol	Atorvastatin	Lipitor	Clopidogrel	Plavix
Pitavastatin	Livalo	Lovastatin	Mevacor	Simvastatin	Zocor
Rosuvastatin	Crestor	Pravastatin	Pravachol	Warfarin	Coumadin
Irbesartan	Avapro	Timolol	Timoptic	Acenocoumarol	Sintrom
Losartan	Cozaar	Ranolazine	Ranexa	Phenprocoumon	Marcumar
Torsemide	Demadex			Propafenone	Rythmol
Propranolol	Inderal			Metoprolol	Lopressor
Nebivolol	Bystolic			Flecainide	Tambocor
Carvedilol	Coreg				

Pain Medications

Standard Precaution		Use with Caution		Consider Alternatives	
Medical Name	**Common Name**	**Medical Name**	**Common Name**	**Medical Name**	**Common Name**
Carisoprodol	Soma	Morphine	Ms Contin	Oxycodone	Percocet
Tizanidine	Zanaflex	Aspirin	Ecotrin	Tramadol	Ultram
Ibuprofen	Motrin	Dihydrocodeine	Synalgos-dc	Codeine	Codeine
Celecoxib	Celebrex	Hydrocodone	Vicodin		
Diclofenac	Voltaren				
Flurbiprofen	Ansaid				
Indomethacin	Indocin				
Meloxicam	Mobic				
Piroxicam	Feldene				

Other Medications

Standard Precaution		Use with Caution		Consider Alternatives	
Medical Name	**Common Name**	**Medical Name**	**Common Name**	**Medical Name**	**Common Name**
Lacosamide	Vimpat	Brivaracetam	Briviact	Methotrexate	Trexall
Phenobarbital	Luminal	Cevimeline	Evoxac	Dextromethorphan	Robitussin
Zonisamide	Zonegran	Darifenacin	Enablex	Eliglustat	Cerdelga

Standard Precaution		Use with Caution		Consider Alternatives	
Medical Name	**Common Name**	**Medical Name**	**Common Name**	**Medical Name**	**Common Name**
Rabeprazole	Aciphex	Dolasetron	Anzemet	Tamoxifen	Soltamox
Omeprazole	Prilosec	Tamsulosin	Flomax		
Dexlansoprazole	Dexilant	Metoclopramide	Reglan		
Esomeprazole	Nexium				
Lansoprazole	Prevacid				
Voriconazole	Vfend				
Bortezomib	Velcade				
Pantoprazole	Protonix				
Tacrolimus	Prograf				
Rucaparib	Rubraca				
Hymecromone	Hymecromone				
Estradiol	Estrace				
Dihydrotestosterone	DHT				
Tolbutamide	Orinase				
Fosphenytoin	Cerebyx				
Nateglinide	Starlix				
Glipizide	Glucotrol				
Chlorpropamide	Diabinese				
Glimepiride	Amaryl				
Glyburide	Micronase				
Lesinurad	Zurampic				
Dronabinol	Marinol				
Phenytoin	Dilantin				
Fesoterodine	Toviaz				
Palonosetron	Aloxi				
Quinine	Qualaquin				
Tolterodine	Detrol				
Gefitinib	Iressa				
Tropisetron	Navoban				

III. Drug-Drug Interaction Guide

Nizoral Drug-Drug Interaction Guide			
Major Risk		**Moderate Risk**	
Medical Name	**Common Name**	**Medical Name**	**Common Name**
Fentanyl	Actiq	Aripiprazole	Abilify
Esomeprazole	Nexium	Zaleplon	Sonata
Astemizole	Hismanal	Cinacalcet	Mimpara
Midazolam	Versed	Docetaxel	Taxotere
Lansoprazole	Prevacid	Aliskiren	Tekturna
Cisapride	Propulsid	Bosentan	Tracleer
Estazolam	Prosom	Almotriptan	Axert
Cyclosporine	Restasis	Tacrolimus	Prograf
		Vardenafil	Levitra

Major Risk		Moderate Risk	
Medical Name	**Common Name**	**Medical Name**	**Common Name**
		Alosetron	Lotronex
		Eszopiclone	Lunesta

IV. Drug-Disease Interaction Guide

ADHD Drug-Disease Interaction Guide			
Major Risk		**Moderate Risk**	
Medical Name	**Common Name**	**Medical Name**	**Common Name**
		Lovastatin	Mevacor

V. Drug Appendix:

Major

Clopidogrel (Plavix)

Genotype: CYP2C19 *1/*2
Phenotype: CYP2C19 Intermediate Metabolizer
Implication: Patient's genotype in combination with clopidogrel can cause an increased risk for reduced response to clopidogrel. This can mean reduced platelet inhibition, increased residual platelet aggregation, and increased risk for adverse cardiovascular events.
Clinical Dosing Guideline: Consider an alternative antiplatelet therapy, such as prasugrel or ticagrelor. Prasugrel is to a much smaller extent metabolized by CYP2C19, however it does come with an increased bleeding risk compared to clopidogrel.

Major

Doxepin (Silenor)

Genotype: CYP2C19 *1/*2, CYP2D6 *4/*4
Phenotype: CYP2C19 Intermediate Metabolizer, CYP2D6 Poor Metabolizer
Implication: CYP2C19: Reduced metabolism of tertiary amines, such as doxepin, when compared to normal metabolizers. CYP2D6: Patient's genotype can lead to greatly reduced metabolism of Doxepin when compared to normal metabolizers which may result in elevated plasma concentrations of Doxepin, and an increased chance of adverse side effects.
Clinical Dosing Guideline: CYP2C19: Despite slightly increased metabolism, it is recommended to initiate therapy with recommended starting dose. CYP2D6: It is recommended to consider an alternative drug that is not metabolized by CYP2D6. Avoid the use of tricyclic drugs due to the possibility of adverse side effects. If a tricyclic is needed, consider a 50% reduction of drug from the recommended starting dose. Monitor therapeutic effects closely to guide dose adjustments.

Major

Imipramine (Tofranil)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: Patient's genotype can lead to greatly reduced metabolism of imipramine when compared to normal metabolizers which may result in elevated plasma concentrations of Imipramine. This results in an increased chance of adverse side effects.
Clinical Dosing Guideline: It is recommended to consider an alternative drug that is not metabolized by CYP2D6. Avoid the use of tricyclic drugs due to the possibility of adverse side effects. If a tricyclic is needed, consider a 50% reduction of drug from the recommended starting dose. Monitor therapeutic effects closely to guide dose adjustments.

Major

Tetrabenazine (Xenazine)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: Although no systemic studies have been completed on the clinical effect of poor metabolizer status on tetrabenazine or its metabolites, it is likely that the exposure to metabolites, alpha-HTBZ and beta-HTBZ, would be increased similar to what is observed in patients taking strong CYP2D6 inhibitors.
Clinical Dosing Guideline: The maximum daily dose in PMs is 50 mg with a maximum single dose of 25 mg. Titration should follow: 12.5 mg daily first week, 25 mg daily second week, slowly titrate at weekly intervals by 12.5 mg according to patient toleration. Be alert to serious adverse events; if side effects arise, halt titration and reduce dose until side effects resolve. Consider an alternative if side effects continue.

Major

Perphenazine (Trilafon)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: Patient's genotype may metabolize perphenazine more slowly and can experience higher concentrations compared with normal metabolizers.
Clinical Dosing Guideline: It is recommended to closely monitor clinical effects and consider a dose reduction to avoid toxicity when prescribing perphenazine to patients already receiving antipsychotic therapy. Lower doses than usually prescribed for either the antipsychotic or the other drug may be required. Closer monitoring of clinical effects on elderly patients is also recommended.

Major

Phenprocoumon (Marcumar)

Genotype: VKORC1 *1/*2, CYP2C9 *1/*1
Phenotype: VKORC1 Intermediate Metabolizer, CYP2C9 Normal Metabolizer
Implication: VKORC1: The VKORC1 *2 allele is associated with reduced expression of the phenprocoumon target, vitamin K epoxide reductase (VKOR). CYP2C9: Patient's CYP2C9 genotype predicts normal response to phenprocoumon.
Clinical Dosing Guideline: VKORC1: Consider a reduced dose of phenprocoumon or select an alternative anticoagulant. CYP2C9: Follow standard dosing and administration guidelines for phenprocoumon.

Major

Oxycodone (Percocet)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: Patient's genotype may lead to an increased oxycodone plasma concentration.
Clinical Dosing Guideline: Due to insufficient data to allow calculation of dose adjustment, it is recommended to select an alternate drug that is NOT Tramadol or Codeine. Or be alert to symptoms of insufficient pain relief.

Major

Eliglustat (Cerdelga)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: Patient's genotype may lead to an increased eliglustat plasma concentration.
Clinical Dosing Guideline: It is recommended to make the dose 84 mg eliglustat once daily in CYP2D6 poor metabolizers.

Major

Olanzapine (Zyprexa)

Genotype: HTR2C T/C, CYP1A2 *1F/*1F, CYP2D6 *4/*4
Phenotype: HTR2C Slightly Increased Risk, CYP1A2 Increased Metabolism, CYP2D6 Poor Metabolizer
Implication: HTR2C: No data is available for the heterozygous case of HTR2C (rs3813929). The cytosine allele increases risk of psychotic-induced weight gain; whereas, the thymine allele decreases the risk. CYP1A2: Higher enzyme activity leads to lower serum levels and higher clearance rates of olanzapine, causing lower efficacy of the drug. CYP2D6: Patient's genotype may lead to an increase in olanzapine blood levels.
Clinical Dosing Guideline: HTR2C: Lack of evidence for antipsychotic-induced weight gain. Use caution when prescribing olanzapine. CYP1A2: Consider an increase in dosage and use with caution. CYP2D6: Due to CYP2D6 playing a minor role in the metabolism of olanzapine, no theraputic dose recommendation is currently available. Continue with standard dosing and administration guidelines and closely monitor clinical effects of drug.

Major

Iloperidone (Fanapt)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: Patient's genotype may lead to higher exposure to iloperidone.
Clinical Dosing Guideline: It is recommended to reduce dose by 50% for the patient.

Major

Clomipramine (Anafranil)

Genotype: CYP2C19 *1/*2, CYP2D6 *4/*4
Phenotype: CYP2C19 Intermediate Metabolizer, CYP2D6 Poor Metabolizer
Implication: CYP2C19: Reduced metabolism of tertiary amines, such as clomipramine, when compared to normal metabolizers. CYP2D6: Patient's genotype can lead to greatly reduced metabolism of clomipramine when compared to normal metabolizers which may result in elevated plasma

concentrations of clomipramine. This results in an increased chance of adverse side effects.
Clinical Dosing Guideline: CYP2C19: Despite slightly increased metabolism, it is recommended to initiate therapy with recommended starting dose. CYP2D6: It is recommended to consider an alternative drug that is not metabolized by CYP2D6. Avoid the use of tricyclic drugs due to the possibility of adverse side effects. If a tricyclic is needed, consider a 50% reduction of drug from the recommended starting dose. Monitor therapeutic effects closely to guide dose adjustments.

Major

Codeine (Codeine)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: Patient's genotype predicts a greatly reduced morphine formation following codeine administration, leading to insufficient pain relief.
Clinical Dosing Guideline: It is recommended to avoid codeine use due to lack of drug efficacy. Consider alternatives that are not affected by this CYP2D6 phenotype, like morphine and non-opioid analgesics. Tramadol, and to a lesser extent hydrocodone and oxycodone, are NOT good alternatives because their metabolism is affected by CYP2D6 activity.

Major

Tramadol (Ultram)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: Patient's genotype may lead to a significantly decreased metabolic capacity of CYP2D6, which can increase plasma levels of tramadol.
Clinical Dosing Guideline: It is recommended to select an alternative drug to administer that are NOT oxycodone or codeine. Also, be alert to symptoms of insufficient pain relief

Major

Tamoxifen (Soltamox)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: Patient's genotype can lead to significantly decreased function of CYP2D6 enzymes resulting in higher plasma levels of tamoxifen, and less of the active metabolite. This can lead to an increased risk for relapse of breast cancer.
Clinical Dosing Guideline: Consider an aromatase inhibitor for postmenopausal women

Major

Acenocoumarol (Sintrom)

Genotype: VKORC1 *1/*2, CYP2C9 *1/*1
Phenotype: VKORC1 Intermediate Metabolizer, CYP2C9 Normal Metabolizer
Implication: VKORC1: The VKORC1 *2 allele is associated with reduced expression of the acenocoumarol target, vitamin K epoxide reductase (VKOR). CYP2C9: Patient's CYP2C9 genotype predicts normal response to acenocoumarol.
Clinical Dosing Guideline: VKORC1: Consider a reduced dose of acenocoumarol or select an alternative anticoagulant. CYP2C9: Follow standard dosing and administration guidelines for acenocoumarol.

Major

Maprotiline (Ludiomil)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: Similar to other tricyclic and tetracyclic antidepressants, maprotiline is metabolized by CYP2D6. Decreased CYP2D6 enzyme activity results in higher maprotiline concentrations potentially leading to higher adverse events including seizures and cardiotoxicity.
Clinical Dosing Guideline: Although there are no established guidelines yet for patient's poor metabolizer status, there are several studies that suggest poor metabolizers should receive a lower dosage due to risk of high maprotiline serum concentrations. This may result in adverse events.

Major

Methotrexate (Trexall)

Genotype: MTHFR 677/677
Phenotype: MTHFR Greatly Reduced Activity
Implication: Increased risk for hepatic toxicity from methotrexate treatment due to significantly decreased serum folate levels, significantly decreased metabolism of folic acid, and significantly increased homocysteine levels.
Clinical Dosing Guideline: No theraputic dose recommendation is currently available. Use caution. Continue with standard dosing and administration guidelines and closely monitor clinical effects of drug.

Major

Atomoxetine (Strattera)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: Patient's genotype predicts a higher exposure to atomoxetine (10-fold higher AUC and a 5 fold-higher Cmax). This may result in adverse drug events.
Clinical Dosing Guideline: The drug label states that CYP2D6 poor metabolizers, the drug should be initiated at 0.5 mg/kg/day and only increased to the usual target dose of 1.2 mg/kg/day if symptoms fail to improve after 4 weeks and the initial dose is well tolerated. It is recommended to use caution in titration and adjusting dosage. Monitor for toxicity until a favorable response is achieved.

Major

Pimozide (Orap)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: Patient's genotype may lead to an increased pimozide plasma concentration.
Clinical Dosing Guideline: For children, adjust dosage no sooner than every 14 days, max dosage of 0.05 mg/kg/d. For adults, adjust dosage no sooner than every 14 days, max dosage of 4 mg/d.

Major

Zuclopenthixol (Clopixol)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: Patient's genotype may lead to an increase in zuclopenthixol plasma concentrations.
Clinical Dosing Guideline: It is recommended to reduce the dosage of zuclopenthixol by 50% or select an alternative drug such as flupenthixol, quetiapine, olanzapine, or clozapine.

Major

Simvastatin (Zocor)

Genotype: CYP3A4 *1/*1, SLCO1B1 *1/*5, APOE *3/*4
Phenotype: CYP3A4 Normal Metabolizer, SLCO1B1 Intermediate Metabolizer, APOE Decreased Response
Implication: CYP3A4: Normal inactivation of simvastatin by CYP3A4 is expected. SLCO1B1: When compared with other statins, simvastatin exhibits higher risk of myopathy with the SNP mutation at rs4149056. APOE: The *4 allele for APOE is linked to increased concentrations of total cholesterol levels, LDL-cholesterol and ApoB. This allele has also been linked to poorer response to statins.
Clinical Dosing Guideline: CYP3A4: Patient's genotype predicts standard simvastatin response. Continue with standard dosing and administration guidelines. SLCO1B1: FDA recommends against 80 mg. Consider a lower dose; if suboptimal efficacy, consider an alternative statin. APOE: Patient's genotype predicts slightly poorer response to statins. Use caution when prescribing statins.

Major

Thioridazine (Mellaril)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: Patient's genotype predicts increased CYP2D6 activity which has been linked to drug-induced arrhythmia, which may result in death.
Clinical Dosing Guideline: Avoid prescribing thioridazine. Patient's reduced CYP2D6 enzyme activity may lead to Torsades de Pointes and/or sudden death.

Major

Vortioxetine (Brintellix)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: Patient's genotype may lead to approximately twice the vortioxetine plasma concentration of extensive metabolizers.
Clinical Dosing Guideline: It is recommended to reduce the dose of vortioxetine by 50% when patients are receiving a CYP2D6 strong inhibitor, such as bupropion, fluoxetine, paroxetine, or quinidine, concomitantly. The maximum recommended dose of vortioxetine is 10 mg/day in known CYP2D6 poor metabolizers

Major

Dextromethorphan (Robitussin)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer

Implication: Patient's genotype may lead to an increased dextromethorphan plasma concentration.
Clinical Dosing Guideline: Due to the quinidine component of dextromethorphan being a CYP2D6 inhibitor used to increase the plasma availability of dextromethorphan, which is metabolized by CYP2D6, poor metabolizers may be at risk of experiencing toxicity.

Major

Amitriptyline (Elavil)

Genotype: CYP2C19 *1/*2 CYP2D6 *4/*4
Phenotype: CYP2C19 Intermediate Metabolizer CYP2D6 Poor Metabolizer
Implication: Patient's genotype predicts greatly reduced CYP2D6 enzyme activity. This may lead to adverse events from prolonged medication exposure.
Clinical Dosing Guideline: Avoid use of medication. If the use of amitriptyline is warranted, consider reducing the dosage by 50% for the patient.

Major

Flecainide (Tambocor)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: Patient's genotype may lead to higher plasma concentrations of flecainide.
Clinical Dosing Guideline: It is recommended to reduce dose by 50%, record ECG, and monitor plasma concentration.

Major

Nortriptyline (Pamelor)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: Patient's genotype can lead to greatly reduced metabolism of nortriptyline when compared to normal metabolizers which may result in elevated plasma concentrations of nortriptyline. This results in an increased chance of adverse side effects.
Clinical Dosing Guideline: It is recommended to consider an alternative drug that is not metabolized by CYP2D6. Avoid the use of tricyclic drugs due to the possibility of adverse side effects. If a tricyclic is needed, consider a 50% reduction of drug from the recommended starting dose. Monitor therapeutic effects closely to guide dose adjustments.

Major

Brexpiprazole (Rexulti)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: Patient's genotype may lead to higher brexpiprazole concentrations than normal metabolizers of CYP2D6.
Clinical Dosing Guideline: It is recommended to reduce the standard dose by 50% when prescribing brexpiprazole. If taking strong/moderate CYP3A4 inhibitors, then administer 25% of the standard dose.

Major

Paroxetine (Paxil)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: Patient's genotype can lead to greatly reduced metabolism of paroxetine when compared to normal metabolizers which may result in elevated plasma concentrations of paroxetine. This results in an increased chance of adverse side effects.
Clinical Dosing Guideline: It is recommended to select an alternative drug not primarily metabolized by CYP2D6. If paroxetine is needed, consider a 50% reduction of drug from the recommended starting dose and adjust to theraputic response.

Major

Trimipramine (Surmontil)

Genotype: CYP2C19 *1/*2, CYP2D6 *4/*4
Phenotype: CYP2C19 Intermediate Metabolizer, CYP2D6 Poor Metabolizer
Implication: CYP2C19: Patient's genotype predicts reduced metabolism of tertiary amines compared to normal metabolizers. CYP2D6: Patient's genotype can lead to greatly reduced metabolism of Trimipramine when compared to normal metabolizers which may result in elevated plasma concentrations of Trimipramine. This results in an increased chance of adverse side effects.
Clinical Dosing Guideline: CYP2C19: It is recommended to consider a 25% reduction of the drug from the recommended starting dose CYP2D6: It is recommended to consider an alternative drug that is not metabolized by CYP2D6. Avoid the use of tricyclic drugs due to the possibility of adverse side effects. If a tricyclic is needed, consider a 50% reduction of drug from the recommended starting dose. Monitor therapeutic effects closely to guide dose adjustments.

Major

Aripiprazole (Abilify)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: Patient's genotype can increase the risk for long term toxicity since high aripiprazole concentrations might remain undetected due to the absence of acute toxicity.
Clinical Dosing Guideline: It is recommended to reduce the aripiprazole dose by 50%. Adjust to achieve a favorable clinical response. If the patient is administered a strong CYP3A4 inhibitor, the dose of aripiprazole should be reduced by 25%.

Major

Metoprolol (Lopressor)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: Patient's genotype may lead to, when concomitantly using CYP2D6 inhibiting drugs, an increase (several-fold) in metoprolol blood levels, decreasing metoprolol's cardioselectivity.
Clinical Dosing Guideline: Due to the risk of heart failure, it is recommended to select an alternative drug, such as bisoprolol or carvedilol. If metoprolol is warranted, reduce dose by 75%. Be alert to adverse effects such as bradycardia or cold extremities.

Major

Propafenone (Rythmol)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: Patient's genotype may lead to an adverse drug reaction, including proarrhythmia.
Clinical Dosing Guideline: When prescribing propafenone, it is recommended to reduce dose by 70%, record ECG, and monitor plasma concentration.

Major

Haloperidol (Haldol)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: Patient's genotype may lead to an increased haloperidol plasma concentration.
Clinical Dosing Guideline: It is recommended to reduce the dose by 50%. Or consider selecting an alternative drug, such as pimozide, flupenthixol, fluphenazine, quetiapine, olanzapine, and clozapine.

Major

Desipramine (Norpramin)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: Patient's genotype can lead to greatly reduced metabolism of desipramine when compared to normal metabolizers which may result in elevated plasma concentrations of Desipramine. This results in an increased chance of adverse side effects.
Clinical Dosing Guideline: It is recommended to consider an alternative drug that is not metabolized by CYP2D6. Avoid the use of tricyclic drugs due to the possibility of adverse side effects. If a tricyclic is needed, consider a 50% reduction of drug from the recommended starting dose. Monitor therapeutic effects closely to guide dose adjustments.

Moderate

Dexmethylphenidate (Focalin)

Genotype: COMT Val/Met
Phenotype: COMT Slightly Reduced Activity
Implication: Patient's COMT Val/Met genotype is believed to result in slightly more dopamine and norepinephrine available in the prefrontal cortex region of the brain due to decreased metabolism of these catecholamines. Stimulants act to increase catecholamines in the same region of the brain; however, there is no clinical data relating this genotype to stimulant response.
Clinical Dosing Guideline: Slightly reduced response, use with caution.

Moderate

Citalopram (Celexa)

Genotype: CYP2C19 *1/*2, GRIK4 T/C, HTR2A TC/GA, FKBP5 G/G
Phenotype: CYP2C19 Intermediate Metabolizer, GRIK4 Reduced Response, HTR2A Normal Response, FKBP5 Decreased Response
Implication: CYP2C19: Reduced metabolism when compared to normal metabolizers which may result in elevated plasma concentrations of citalopram. GRIK4: No data is available for the heterozygous case of GRIK4 (rs1954787). However, individuals who are homozygous for the thymine allele have

displayed reduced response to citalopram. HTR2A: No data is available for the heterozygous case of HTR2A. FKBP5: FKBP5 (rs4713916) G/G genotype is associated with increased rate of remission among patients taking citalopram.
Clinical Dosing Guideline: CYP2C19: Initiate therapy with recommended starting dose. Although patient may have elevated plasma concentrations, clinical studies suggest that minimal dose adjustments are necessary for intermediate metabolizers. GRIK4: No theraputic dose recommendation is currently available. Continue with standard dosing and administration guidelines and closely monitor clinical effects of drug. HTR2A: Use citalopram with caution and with more frequent monitoring. FKBP5: No theraputic dose recommendation is currently available. Use caution. Continue with standard dosing and administration guidelines and closely monitor clinical effects of drug.

Moderate

Aspirin (Ecotrin)

Genotype: ITGB3 N/A2
Phenotype: ITGB3 Defective Receptor Protein
Implication: Patient's ITGB3 genotype predicts increased chance of resistance to drug and risk of myocardial infarction or heart disease.
Clinical Dosing Guideline: The patient will likely experience decreased drug efficacy. No theraputic dose recommendation is currently available. Continue with standard dosing and administration guidelines and closely monitor clinical effects of drug.

Moderate

Hydrocodone (Vicodin)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: The conversion of hydrocodone to the active metabolite hydromorphone is primarily mediated by CYP2D6 enzymes. Patient's genotype predicts an decreased conversion in this pathway due to decreased CYP2D6 enzyme activity. This may result in an decreased response to drug.
Clinical Dosing Guideline: There is not enough clinical data regarding hydrocodone pain relief for lower CYP2D6 enzyme activity. Consider increasing dose according to patient pain symptoms to account for decreased active metabolite concentrations, and adjust according to patient pain symptoms If patient experiences poor pain relief or adverse events, consider an alternative opioid not metabolized by CYP2D6 enzymes such as buprenorphine, fentanyl, hydromorphone, methadone, morphine, or oxymorphone.

Moderate

Atorvastatin (Lipitor)

Genotype: CYP3A4 *1/*1, SLCO1B1 *1/*5, APOE *3/*4
Phenotype: CYP3A4 Normal Metabolizer, SLCO1B1 Intermediate Metabolizer, APOE Decreased Response
Implication: CYP3A4: Normal inactivation of atorvastatin by CYP3A4 is expected. SLCO1B1: To date, there is little evidence that rs4149056 genotype influences symptomatic intolerance or myopathy for atorvastatin. APOE: The *4 allele for APOE is linked to increased concentrations of total cholesterol levels, LDL-cholesterol and ApoB. This allele has also been linked to poorer response to statins.
Clinical Dosing Guideline: CYP3A4: Patient's genotype predicts standard atorvastatin response. Continue with standard dosing and administration guidelines. SLCO1B1: Prescribe desired starting dose and adjust doses of atorvastatin based on disease-specific guidelines or consider alternative statin. APOE: Patient's genotype predicts slightly poorer response to statins. Use caution when prescribing statins.

Moderate

Dextroamphetamine (Dexedrine)

Genotype: COMT Val/Met
Phenotype: COMT Slightly Reduced Activity
Implication: Patient's COMT Val/Met genotype is believed to result in slightly more dopamine and norepinephrine available in the prefrontal cortex region of the brain due to decreased metabolism of these catecholamines. Stimulants act to increase catecholamines in the same region of the brain; however, there is no clinical data relating this genotype to stimulant response.
Clinical Dosing Guideline: Slightly reduced response, use with caution.

Moderate

Fluvoxamine (Luvox)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: Patient's genotype can lead to greatly reduced metabolism of fluvoxamine when compared to normal metabolizers which may result in elevated plasma concentrations of fluvoxamine. This results in an increased chance of adverse side effects.
Clinical Dosing Guideline: It is recommended to consider a 25-50% reduction of drug from the recommended starting dose and adjust accoding to the theraputic response. Or, use an alternative drug not metabolized by CYP2D6.

Moderate

Methylphenidate (Ritalin)

Genotype: COMT Val/Met

Phenotype: COMT Slightly Reduced Activity
Implication: Patient's COMT Val/Met genotype is believed to result in slightly more dopamine and norepinephrine available in the prefrontal cortex region of the brain due to decreased metabolism of these catecholamines. Stimulants act to increase catecholamines in the same region of the brain; however, there is no clinical data relating this genotype to stimulant response.
Clinical Dosing Guideline: Slightly reduced response, use with caution.

Moderate

Lisdexamfetamine (Vyvanse)

Genotype: COMT Val/Met
Phenotype: COMT Slightly Reduced Activity
Implication: Patient's COMT Val/Met genotype is believed to result in slightly more dopamine and norepinephrine available in the prefrontal cortex region of the brain due to decreased metabolism of these catecholamines. Stimulants act to increase catecholamines in the same region of the brain; however, there is no clinical data relating this genotype to stimulant response.
Clinical Dosing Guideline: Slightly reduced response, use with caution.

Moderate

Timolol (Timoptic)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: Potentiated systemic beta-blockade (e.g., decreased heart rate) has been reported during timolol treatment by patients with decreased CYP2D6 activity.
Clinical Dosing Guideline: Monitor patient for treatment-related adverse effects if prescribing timolol.

Moderate

Amoxapine (Amoxapine)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: Similar to other tricyclic and tetracyclic antidepressants, amoxapine is metabolized by CYP2D6. Patient's genotype predicts higher plasma concentrations of cyclic antidepressants than normal metabolizers. Therefore, patient's risk for adverse drug events is elevated. However, the overall contribution of CYP2D6 enzymes in the metabolism of this drug is not well documented.
Clinical Dosing Guideline: There are no established dosing adjustments for patients with decreased CYP2D6 function. Therefore, therapy must be initiated cautiously and adjusted according to the patient's response.

Moderate

Lovastatin (Mevacor)

Genotype: CYP3A4 *1/*1, SLCO1B1 *1/*5, APOE *3/*4
Phenotype: CYP3A4 Normal Metabolizer, SLCO1B1 Intermediate Metabolizer, APOE Decreased Response
Implication: CYP3A4: Normal inactivation of lovastatin by CYP3A4 is expected. SLCO1B1: To date, there is little evidence that rs4149056 genotype influences symptomatic intolerance or myopathy for lovastatin. APOE: The *4 allele for APOE is linked to increased concentrations of total cholesterol levels, LDL-cholesterol and ApoB. This allele has also been linked to poorer response to statins.
Clinical Dosing Guideline: CYP3A4: Patient's genotype predicts standard lovastatin response. Continue with standard dosing and administration guidelines. SLCO1B1: Prescribe desired starting dose and adjust doses of lovastatin based on disease-specific guidelines or consider alternative statin. APOE: Patient's genotype predicts slightly poorer response to statins. Use caution when prescribing statins.

Moderate

Brivaracetam (Briviact)

Genotype: CYP2C19 *1/*2
Phenotype: CYP2C19 Intermediate Metabolizer
Implication: Patient's genotype can cause a significant decrease in the production of the hydroxy metabolite and an increase in the blood level of brivaracetam.
Clinical Dosing Guideline: A dose reduction of brivaracetam may be required.

Moderate

Cevimeline (Evoxac)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: Patient's genotype predicts increased drug exposure which may result in adverse drug events.
Clinical Dosing Guideline: Due to CYP2D6 enzyme deficiency, cevimeline should be used with caution for patient because of increased risk of adverse events.

Moderate

Ranolazine (Ranexa)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: Patient's genotype predicts increased exposure to ranolazine which may lead to adverse effects. The EMA states that at 500 mg twice daily, poor metabolizers are expected to have 62% higher AUC than normal metabolizers. The corresponding difference at the 1000 mg twice-daily dose was 25%.
Clinical Dosing Guideline: It is recommended to frequently monitor for adverse events, reduce dose, and discontinue treatment, if needed.

Moderate

Risperidone (Risperdal)

Genotype: HTR2C T/C, CYP2D6 *4/*4
Phenotype: HTR2C Slightly Increased Risk, CYP2D6 Poor Metabolizer
Implication: HTR2C: No data is available for the heterozygous case of HTR2C (rs3813929). The cytosine allele increases risk of psychotic-induced weight gain; whereas, the thymine allele decreases the risk. CYP2D6: Patient's genotype may lead to both an increase in side effects and a stronger decrease in schizophrenia symptoms. In addition to this, the genetic variation may lead to a decrease in the required dose. However, as the effect on the dose is smaller than that of the normal biological variation, action is not useful.
Clinical Dosing Guideline: HTR2C: Lack of evidence for antipsychotic-induced weight gain. Use caution when prescribing risperidone. CYP2D6: Follow standard dosing and administration guidelines for risperidone.

Moderate

Tamsulosin (Flomax)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: Patient's genotype predicts a prolonged presence of tamsulosin in the plasma. This increases risk of an adverse reaction such as hypotension, dizziness, and fainting.
Clinical Dosing Guideline: Tamsulosin should be used with caution in patients known to be CYP2D6 poor metabolizers, particularly at a dose higher than 0.4 mg.

Moderate

Pravastatin (Pravachol)

Genotype: SLCO1B1 *1/*5, APOE *3/*4
Phenotype: SLCO1B1 Intermediate Metabolizer, APOE Decreased Response
Implication: SLCO1B1: To date, there is little evidence that rs4149056 genotype influences symptomatic intolerance or myopathy for pravastatin. APOE: The *4 allele for APOE is linked to increased concentrations of total cholesterol levels, LDL-cholesterol and ApoB. This allele has also been linked to poorer response to statins.
Clinical Dosing Guideline: SLCO1B1: Prescribe desired starting dose and adjust doses of pravastatin based on disease-specific guidelines or consider alternative statin. APOE: Patient's genotype predicts slightly poorer response to statins. Use caution when prescribing statins.

Moderate

Clozapine (Clozaril)

Genotype: HTR2C T/C, HTR2A TC/GA, CYP1A2 *1F/*1F, CYP2D6 *4/*4
Phenotype: HTR2C Slightly Increased Risk, HTR2A Normal Response, CYP1A2 Increased Metabolism, CYP2D6 Poor Metabolizer
Implication: HTR2C: No data is available for the heterozygous case of HTR2C (rs3813929). The cytosine allele increases risk of psychotic-induced weight gain; whereas, the thymine allele decreases the risk. HTR2A: There is no data on the heterozygous case of HTR2A (rs6311). The T allele for rs6311 is associated with better clozapine response; however, due to the patient's heterozygous genotype, no clear conclusion can be drawn. CYP1A2: Increased activity of enzyme leads to lower serum levels and may compromise the efficacy of clozapine. CYP2D6: Patient's genotype can lead to higher than expected plasma concentrations of clozapine when given normal doses.
Clinical Dosing Guideline: HTR2C: Lack of evidence for antipsychotic-induced weight gain. Use caution when prescribing clozapine. HTR2A: No theraputic dose recommendation is currently available. Use caution. Continue with standard dosing and administration guidelines and closely monitor clinical effects of drug. CYP1A2: Patient may respond poorly to clozapine therapy. However, the treatment response is improved by increasing the dose of clozapine, and also co-administering fluvoxamine, a CYP1A2 inhibitor. CYP2D6: Consider a dose reduction for the patient due to decreased enzyme activity.

Moderate

Clonidine (Kapvay)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: Patient's genotype predicts higher response to clonidine.

Clinical Dosing Guideline: When prescribing drug therapy for patients, clinicians should be aware that the patient may experience an increased drug effect and be at risk of side effects. No guidelines have been established; use caution if prescribing clonidine.

Moderate

Clobazam (Onfi)

Genotype: CYP2C19 *1/*2
Phenotype: CYP2C19 Intermediate Metabolizer
Implication: Based on patient's genotype, expect plasma levels of the active metabolite N-desmethylclobazam to be 2-fold higher than normal metabolizers.
Clinical Dosing Guideline: The dose adjustment for intermediate metabolizers is not well established. For poor metabolizers, the FDA recommends an initial dose of 5 mg/day for this patient due to poor metabolism. Patient should be titrated initially to 10-20 mg/day, and may be titrated further to a maximum daily dose of 40 mg if tolerated. However, plasma levels for poor metabolizers are 5-fold higher than normal metabolizers.

Moderate

Dolasetron (Anzemet)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: Patient's genotype may lead to increased dolasetron plasma concentration. However, due to insufficient data no clinical effect of this can be given.
Clinical Dosing Guideline: No theraputic dose recommendation is currently available. Continue with standard dosing and administration guidelines and closely monitor clinical effects of drug.

Moderate

Amphetamine (Adderall)

Genotype: COMT Val/Met
Phenotype: COMT Slightly Reduced Activity
Implication: Patient's COMT Val/Met genotype is believed to result in slightly more dopamine and norepinephrine available in the prefrontal cortex region of the brain due to decreased metabolism of these catecholamines. Stimulants act to increase catecholamines in the same region of the brain; however, there is no clinical data relating this genotype to stimulant response.
Clinical Dosing Guideline: Slightly reduced response, use with caution.

Moderate

Venlafaxine (Effexor)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: Patient's genotype may lead to some of the adverse effects of venlafaxine therapy that have been reported to occur more frequently in poor metabolizers, like gastrointestinal side effects, such as vomiting and diarrhea, and cardiovascular side effects, such as hypertension, tachycardia, and prolonged QTc interval.
Clinical Dosing Guideline: Due to insufficient data to allow calculation of dose adjustment, it is recommended to select an alternative drug, such as Citalopram or Sertraline. Or adjust the dose until a clinical response is achieved and monitor O-desmethylvenlafaxine plasma concentration.

Moderate

Morphine (Ms Contin)

Genotype: COMT Val/Met
Phenotype: COMT Slightly Reduced Activity
Implication: Patient's genotype predicts higher sensitivity to pain.
Clinical Dosing Guideline: Based on the genotype, the patient may require average to high doses of morphine for adequate pain control. Dosing regimen needs to be individualized for each patient, taking into account the patient's prior analgesic treatment experience.

Moderate

Metoclopramide (Reglan)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: Patient's genotype predicts decreased activity of CYP2D6 enzymes, resulting in significantly increased serum concentrations of drug. Metoclopramide is known to have central nervous system and extrapyramidal adverse effects.
Clinical Dosing Guideline: Use caution when prescribing metoclopramide. It is recommended to closely monitor for toxicity and eventually consider decreasing dose. Patients with renal disease are at increased risk for adverse events.

Moderate

Darifenacin (Enablex)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: Patient is expected to have approximately 30% increased exposure. However, no data on the clinical effect of this is available.
Clinical Dosing Guideline: Although patient may not need dosage adjustment, monitor for increased side effects when darifenacin is prescribed according to standard dosage and administration guidelines.

Moderate

Escitalopram (Lexapro)

Genotype: CYP2C19 *1/*2
Phenotype: CYP2C19 Intermediate Metabolizer
Implication: Reduced metabolism when compared to normal metabolizers which may result in elevated plasma concentrations of escitalopram.
Clinical Dosing Guideline: Initiate therapy with recommended starting dose. Although patient may have elevated plasma concentrations, clinical studies suggest that minimal dose adjustments are necessary for intermediate metabolizers.

Moderate

Dihydrocodeine (Synalgos-dc)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: The conversion of dihydrocodeine to the active metabolite dihydromorphine is primarily mediated by CYP2D6 enzymes. Patient's genotype predicts an decreased conversion in this pathway due to decreased CYP2D6 enzyme activity. This may result in an decreased response to drug.
Clinical Dosing Guideline: Consider using higher dihydrocodeine doses to account for decreased active metabolite concentrations. If patient experiences poor pain relief or adverse events, consider an alternative opioid not metabolized by CYP2D6 enzymes such as buprenorphine, fentanyl, hydromorphone, methadone, morphine, or oxymorphone.

Standard

Nefazodone (Serzone)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: The FDA deemed no clinically relevant implications for patient's genotype.
Clinical Dosing Guideline: Follow standard dosing and administration guidelines for nefazodone.

Standard

Esomeprazole (Nexium)

Genotype: CYP2C19 *1/*2
Phenotype: CYP2C19 Intermediate Metabolizer
Implication: Patient's decreased rate of metabolism can cause standard doses of esomeprazole to result in higher exposure to the drug.
Clinical Dosing Guideline: No theraputic dose recommendation is currently available. Continue with standard dosing and administration guidelines and closely monitor clinical effects of drug.

Standard

Glyburide (Micronase)

Genotype: CYP2C9 *1/*1
Phenotype: CYP2C9 Normal Metabolizer
Implication: Patient's CYP2C9 genotype predicts normal response to glyburide.
Clinical Dosing Guideline: Follow standard dosing and administration guidelines for glyburide.

Standard

Oxazepam (Serax)

Genotype: UGT2B15 *1/*2
Phenotype: UGT2B15 Slightly decreased enzymatic activity
Implication: Decreased glucuronidation of S-oxazepam possibly leading to lower plasma clearance of the drug.
Clinical Dosing Guideline: No theraputic dose recommendation is currently available. The exact clinical effect of lower oxazepam plasma clearance is uknown. Use caution. Continue with standard dosing and administration guidelines and closely monitor clinical effects of drug.

Standard

Flibanserin (Addyi)

Genotype: CYP2C9 *1/*1, CYP2D6 *4/*4
Phenotype: CYP2C9 Normal Metabolizer, CYP2D6 Poor Metabolizer
Implication: CYP2C9: Patient's CYP2C9 genotype predicts normal response to flibanserin. CYP2D6: Steady state AUC of flibanserin 50 mg twice daily is increased 18% compared to normal metabolizers.
Clinical Dosing Guideline: CYP2C9: Follow standard dosing and administration guidelines for flibanserin. CYP2D6: Due to insufficient data concerning the effect of slightly increased exposure to flibanserin, no estabilished clinical dosing guidelines exist. Continue with dosing and administration guidelines and closely monitor clinical effects of drug.

Standard

Voriconazole (Vfend)

Genotype: CYP2C19 *1/*2
Phenotype: CYP2C19 Intermediate Metabolizer
Implication: Higher dose-adjusted trough concentrations of voriconazole when compared to normal metabolizers.
Clinical Dosing Guideline: Initiate therapy with standard starting dose.

Standard

Carisoprodol (Soma)

Genotype: CYP2C19 *1/*2
Phenotype: CYP2C19 Intermediate Metabolizer
Implication: No clinical data is currently available for this genotype and carisoprodol.
Clinical Dosing Guideline: No theraputic dose recommendation is currently available. Continue with standard dosing and administration guidelines and closely monitor clinical effects of drug.

Standard

Diclofenac (Voltaren)

Genotype: CYP2C9 *1/*1
Phenotype: CYP2C9 Normal Metabolizer
Implication: Patient's CYP2C9 genotype predicts normal response to diclofenac.
Clinical Dosing Guideline: Follow standard dosing and administration guidelines for diclofenac.

Standard

Fluvastatin (Lescol)

Genotype: SLCO1B1 *1/*5, CYP2C9 *1/*1
Phenotype: SLCO1B1 Intermediate Metabolizer, CYP2C9 Normal Metabolizer
Implication: SLCO1B1: To date, there is little evidence that rs4149056 genotype influences symptomatic intolerance or myopathy for fluvastatin. CYP2C9: Patient's CYP2C9 genotype predicts normal response to fluvastatin.
Clinical Dosing Guideline: SLCO1B1: Prescribe desired starting dose and adjust doses of fluvastatin based on disease-specific guidelines or consider alternative statin. CYP2C9: Follow standard dosing and administration guidelines for fluvastatin.

Standard

Carvedilol (Coreg)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: Patient may experience higher rate of dizziness during up-titration. Additionally, expect a 2- to 3-fold plasma concentration increase of R-carvedilol when compared to normal metabolizers.
Clinical Dosing Guideline: Due to multiple metabolic pathways to multiple active metabolites and a high therapeutic index, carvedilol can be prescribed at standard label-recommended dosage and administration.

Standard

Donepezil (Aricept)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: Patient's genotype may lead to slower clearance of donepezil.
Clinical Dosing Guideline: No theraputic dose recommendation is currently available. Continue with standard dosing and administration guidelines and closely monitor clinical effects of drug.

Standard

Bortezomib (Velcade)

Genotype: CYP2C19 *1/*2
Phenotype: CYP2C19 Intermediate Metabolizer
Implication: Patient's genotype predicts lower activity of CYP2C19 enzymes. However, although CYP2C19 and CYP2D6 are involved in the metabolism of bortezomib, the number of functional CYP2C19 and CYP2D6 alleles is not associated with neurological adverse reactions to bortezomib.
Clinical Dosing Guideline: Follow standard dosing and administration guidelines for bortezomib.

Standard

Fesoterodine (Toviaz)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: Patient may have increased maximum plasma concentrations (Cmax and AUC of the active metabolite are increased 1.7- and 2-fold, respectively) of the active metabolite of fesoterodine when compared to normal metabolizers. However, there is no data on the clinical significance of these increased concentrations.
Clinical Dosing Guideline: Due to insufficient data concerning the effect of slightly increased exposure to fesoterodine, no estabilished clinical dosing guidelines exist. Continue with standard dosing and administration guidelines and closely monitor clinical effects of drug.

Standard

Phenytoin (Dilantin)

Genotype: CYP2C9 *1/*1
Phenotype: CYP2C9 Normal Metabolizer
Implication: Patient's CYP2C9 genotype predicts normal response to phenytoin.
Clinical Dosing Guideline: Follow standard dosing and administration guidelines for phenytoin.

Standard

Tropisetron (Navoban)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: No clinical data is currently available on the effect of poor metabolism on the elimination and response to tropisetron.
Clinical Dosing Guideline: No theraputic dose recommendation is currently available. Continue with standard dosing and administration guidelines and closely monitor clinical effects of drug.

Standard

Rabeprazole (Aciphex)

Genotype: CYP2C19 *1/*2
Phenotype: CYP2C19 Intermediate Metabolizer
Implication: Patient's genotype can lead to increased exposure to rabeprazole at standard dosage.
Clinical Dosing Guideline: No theraputic dose recommendation is currently available. Continue with standard dosing and administration guidelines and closely monitor clinical effects of drug.

Standard

Indomethacin (Indocin)

Genotype: CYP2C9 *1/*1
Phenotype: CYP2C9 Normal Metabolizer
Implication: Patient's CYP2C9 genotype predicts normal response to indomethacin.
Clinical Dosing Guideline: Follow standard dosing and administration guidelines for indomethacin.

Standard

Diazepam (Valium)

Genotype: CYP2C19 *1/*2
Phenotype: CYP2C19 Intermediate Metabolizer
Implication: Patient's genotype predicts slightly increased metabolism of diazepam, but no clinically significant effect has been observed when compared to normal metabolizers.
Clinical Dosing Guideline: Diazepam can be prescribed at standard label recommended-dosage and administration.

Standard

Rosuvastatin (Crestor)

Genotype: SLCO1B1 *1/*5
Phenotype: SLCO1B1 Intermediate Metabolizer
Implication: To date, there is little evidence that rs4149056 genotype influences symptomatic intolerance or myopathy for rosuvastatin.
Clinical Dosing Guideline: Prescribe desired starting dose and adjust doses of rosuvastatin based on disease-specific guidelines.

Standard

Irbesartan (Avapro)

Genotype: CYP2C9 *1/*1
Phenotype: CYP2C9 Normal Metabolizer
Implication: Patient's CYP2C9 genotype predicts normal response to irbesartan.
Clinical Dosing Guideline: Follow standard dosing and administration guidelines for irbesartan.

Standard

Mirtazapine (Remeron)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: Patient's genotype may lead to an increase in mirtazapine blood levels.
Clinical Dosing Guideline: No theraputic dose recommendation is currently available. Continue with standard dosing and administration guidelines and closely monitor clinical effects of drug.

Standard

Tacrolimus (Prograf)

Genotype: CYP3A5 *3/*3
Phenotype: CYP3A5 Poor Metabolizer
Implication: Patient will experience higher dose-adjusted trough concentrations of tacrolimus. However these concentrations are considered normal and give the patient an increased chance of achieving target tacrolimus concentrations.
Clinical Dosing Guideline: Initiate therapy with standard recommended dose. Use therapeutic drug monitoring to guide dose adjustments. Typically with other CYP enzymes, normal metabolizers do not require a dose adjustment. However, in the case of CYP3A5 and tacrolimus, a CYP3A5 expresser (normal or intermediate metabolizer) would require a higher recommended starting dose and the CYP3A5 non-expresser (poor metabolizer) would require the standard recommended starting dose.

Standard

Propranolol (Inderal)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: The FDA states that there is no difference between CYP2D6 normal metabolizers and poor metabolizers with respect to oral clearance or elimination half-life of propranolol.
Clinical Dosing Guideline: Follow standard dosing and administration guidelines for propranolol.

Standard

Lacosamide (Vimpat)

Genotype: CYP2C19 *1/*2
Phenotype: CYP2C19 Intermediate Metabolizer
Implication: No clinical data is currently available for this genotype and lacosamide.
Clinical Dosing Guideline: No theraputic dose recommendation is currently available. Continue with standard dosing and administration guidelines and closely monitor clinical effects of drug.

Standard

Dihydrotestosterone (DHT)

Genotype: UGT2B15 *1/*2
Phenotype: UGT2B15 Slightly decreased enzymatic activity
Implication: Decreased glucuronidation of dihydrotestosterone possibly leading to lower plasma clearance of the drug.
Clinical Dosing Guideline: No theraputic dose recommendation is currently available. The exact clinical effect of lower dihydrotestosterone plasma clearance is uknown. Use caution. Continue with standard dosing and administration guidelines and closely monitor clinical effects of drug.

Standard

Gefitinib (Iressa)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: CYP2D6 metabolizes gefitinib to O-desmethyl gefitinib. FDA states that poor metablizers O-desmethyl gefitinib concentration was not measurable and the mean exposure to gefitinib was 2-fold higher as compared to normal metabolizers. This increase in exposure may result in adverse reactions.
Clinical Dosing Guideline: No dose adjustment is recommended, but patient should be closely monitored for adverse drug events.

Standard

Dexlansoprazole (Dexilant)

Genotype: CYP2C19 *1/*2
Phenotype: CYP2C19 Intermediate Metabolizer
Implication: Patient's genotype in combination with dexlansoprazole can lead to higher systemic exposure to drug.
Clinical Dosing Guideline: No theraputic dose recommendation is currently available. Continue with standard dosing and administration guidelines and closely monitor clinical effects of drug.

Standard

Sertraline (Zoloft)

Genotype: CYP2C19 *1/*2
Phenotype: CYP2C19 Intermediate Metabolizer
Implication: Patient's genotype predicts clinically insignificant increase in sertraline plasma concentrations.
Clinical Dosing Guideline: Initiate therapy with recommended starting dose.

Standard

Tolterodine (Detrol)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: Expect patient to metabolize tolterodine slower than normal metabolizers, resulting in significantly higher serum concentrations of tolterodine and much lower concentrations of 5-hydroxymethytolterodine, the active metabolite.
Clinical Dosing Guideline: The same dosage as a normal metabolizer can be given to patient because tolterodine (not the active metabolite) accounts for the major clinical effect. The effect of tolterodine on the QT interval prolongation is greater for 8 mg/day (two times the therapeutic dose) compared to 4 mg/day, and is more pronounced in CYP2D6 poor metabolizers than normal metabolizers. Caution should be taken for patients with a known history of QT prolongation, or patients who are taking Class IA or Class III antiarrhythmics.

Standard

Flupentixol (Depixol)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: No clinical data is currently available for this genotype and flupentixol.
Clinical Dosing Guideline: No theraputic dose recommendation is currently available. Continue with standard dosing and administration guidelines and closely monitor clinical effects of drug.

Standard

Desvenlafaxine (Pristiq)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: CYP2D6 does not play a major role in desvenlafaxine metabolism. Expect normal response to therapy.
Clinical Dosing Guideline: Although CYP2D6 plays a small role in desvenlafaxine metabolism, the elimination is more dependent on CYP3A4. Therefore, continue with standard prescribing guidelines.

Standard

Hymecromone (Hymecromone)

Genotype: UGT2B15 *1/*2
Phenotype: UGT2B15 Slightly decreased enzymatic activity
Implication: Decreased glucuronidation of hymecromone possibly leading to lower plasma clearance of the drug.
Clinical Dosing Guideline: No theraputic dose recommendation is currently available. The exact clinical effect of lower hymecromone plasma clearance is uknown. Use caution. Continue with standard dosing and administration guidelines and closely monitor clinical effects of drug.

Standard

Paliperidone (Invega)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: No difference was seen in intermediate metabolizers versus normal metabolizers for paliperidone elimination or response..
Clinical Dosing Guideline: Follow standard dosing and administration guidelines for paliperidone.

Standard

Lansoprazole (Prevacid)

Genotype: CYP2C19 *1/*2
Phenotype: CYP2C19 Intermediate Metabolizer
Implication: Patient's decreased rate of metabolism can cause standard doses of lansoprazole to result in higher exposure to the drug.
Clinical Dosing Guideline: No theraputic dose recommendation is currently available. Continue with standard dosing and administration guidelines and closely monitor clinical effects of drug.

Standard

Flurbiprofen (Ansaid)

Genotype: CYP2C9 *1/*1
Phenotype: CYP2C9 Normal Metabolizer
Implication: Patient's CYP2C9 genotype predicts normal response to flurbiprofen.
Clinical Dosing Guideline: Follow standard dosing and administration guidelines for flurbiprofen.

Standard

Nateglinide (Starlix)

Genotype: CYP2C9 *1/*1
Phenotype: CYP2C9 Normal Metabolizer
Implication: Patient's CYP2C9 genotype predicts normal response to nateglinide.
Clinical Dosing Guideline: Follow standard dosing and administration guidelines for nateglinide.

Standard

Protriptyline (Vivactil)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: Patient's genotype may lead to higher than expected plasma concentrations of tricyclic antidepressants (TCAs) when given usual doses.
Clinical Dosing Guideline: No theraputic dose recommendation is currently available. Continue with standard dosing and administration guidelines and closely monitor clinical effects of drug.

Standard

Glipizide (Glucotrol)

Genotype: CYP2C9 *1/*1
Phenotype: CYP2C9 Normal Metabolizer
Implication: Patient's CYP2C9 genotype predicts normal response to glipizide.
Clinical Dosing Guideline: Follow standard dosing and administration guidelines for glipizide.

Standard

Ondansetron (Zofran)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: No clinical data is currently available for the effect of poor metabolism on the elimination and response to ondansetron.
Clinical Dosing Guideline: No theraputic dose recommendation is currently available. Continue with standard dosing and administration guidelines and closely monitor clinical effects of drug.

Standard

Piroxicam (Feldene)

Genotype: CYP2C9 *1/*1
Phenotype: CYP2C9 Normal Metabolizer

Implication: Patient's CYP2C9 genotype predicts normal response to piroxicam.
Clinical Dosing Guideline: Follow standard dosing and administration guidelines for piroxicam.

Standard

Phenobarbital (Luminal)

Genotype: CYP2C19 *1/*2
Phenotype: CYP2C19 Intermediate Metabolizer
Implication: Patient's genotype may lead to decreased clearance of phenobarbital.
Clinical Dosing Guideline: No theraputic dose recommendation is currently available. Continue with standard dosing and administration guidelines and closely monitor clinical effects of drug.

Standard

Pantoprazole (Protonix)

Genotype: CYP2C19 *1/*2
Phenotype: CYP2C19 Intermediate Metabolizer
Implication: Patient's genotype predicts similar rate of clearance of pantoprazole when compared to normal metabolizers due to similar enzyme activity levels.
Clinical Dosing Guideline: Positive clinical effect is expected for patient. Follow standard dosing and administration guidelines.

Standard

Torsemide (Demadex)

Genotype: CYP2C9 *1/*1
Phenotype: CYP2C9 Normal Metabolizer
Implication: Patient's CYP2C9 genotype predicts normal response to torsemide.
Clinical Dosing Guideline: Follow standard dosing and administration guidelines for torsemide

Standard

Palonosetron (Aloxi)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: CYP2D6 is the primary gene involved in metabolizing palonosetron. However, clinical pharmacokinetic parameters are not significantly different between poor and normal metabolizers.
Clinical Dosing Guideline: Follow standard dosing and administration guidelines for palonosetron.

Standard

Zonisamide (Zonegran)

Genotype: CYP2C19 *1/*2
Phenotype: CYP2C19 Intermediate Metabolizer
Implication: Patient's genotype can lead to decreased zonisamide clearance.
Clinical Dosing Guideline: No theraputic dose recommendation is currently available. Continue with standard dosing and administration guidelines and closely monitor clinical effects of drug.

Standard

Duloxetine (Cymbalta)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: Patient's genotype can cause elevated plasma concentrations of duloxetine.
Clinical Dosing Guideline: Because exposure can not be determined by CYP2D6 status alone, dosage adjustment is not necessary.

Standard

Chlorpropamide (Diabinese)

Genotype: CYP2C9 *1/*1
Phenotype: CYP2C9 Normal Metabolizer
Implication: Patient's CYP2C9 genotype predicts normal response to chlorpropamide.
Clinical Dosing Guideline: Follow standard dosing and administration guidelines for chlorpropamide.

Standard

Meloxicam (Mobic)

Genotype: CYP2C9 *1/*1
Phenotype: CYP2C9 Normal Metabolizer
Implication: Patient's CYP2C9 genotype predicts normal response to meloxicam.
Clinical Dosing Guideline: Follow standard dosing and administration guidelines for meloxicam.

Standard

Fosphenytoin (Cerebyx)

Genotype: CYP2C9 *1/*1
Phenotype: CYP2C9 Normal Metabolizer
Implication: Patient's CYP2C9 genotype predicts normal response to fosphenytoin.
Clinical Dosing Guideline: Follow standard dosing and administration guidelines for fosphenytoin.

Standard

Tolbutamide (Orinase)

Genotype: CYP2C9 *1/*1
Phenotype: CYP2C9 Normal Metabolizer
Implication: Patient's CYP2C9 genotype predicts normal response to tolbutamide.
Clinical Dosing Guideline: Follow standard dosing and administration guidelines for tolbutamide.

Standard

Fluoxetine (Prozac)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: Although the individual may experience higher concentrations of some of the active metabolites of fluoxetine, the sum of the four major active metabolites is not significantly different than in normal metabolizers.
Clinical Dosing Guideline: Follow standard dosing and administration guidelines for fluoxetine.

Standard

Tizanidine (Zanaflex)

Genotype: CYP1A2 *1F/*1F
Phenotype: CYP1A2 Increased Metabolism
Implication: Increased function of CYP1A2 enzymes.
Clinical Dosing Guideline: No theraputic dose recommendation is currently available. Use caution. Continue with standard dosing and administration guidelines and closely monitor clinical effects of drug.

Standard

Lorazepam (Ativan)

Genotype: UGT2B15 *1/*2
Phenotype: UGT2B15 Slightly decreased enzymatic activity
Implication: Decreased glucuronidation of lorazepam possibly leading to lower plasma clearance of the drug.
Clinical Dosing Guideline: No theraputic dose recommendation is currently available. The exact clinical effect of lower lorazepam plasma clearance is uknown. Use caution. Continue with standard dosing and administration guidelines and closely monitor clinical effects of drug.

Standard

Warfarin (Coumadin)

Genotype: VKORC1 *1/*2 CYP2C9 *1/*1
Phenotype: VKORC1 Intermediate Metabolizer CYP2C9 Normal Metabolizer
Implication: Patient's CYP2C9 genotype predicts normal response to Warfarin. The VKORC1 *2 allele is associated with reduced expression of the Warfarin target, vitamin K epoxide reductase (VKOR).
Clinical Dosing Guideline: Based on the patient's genotypes for VKORC1 and CYP2C9, the FDA recommends prescribing 5-7 mg/day.

Standard

Moclobemide (Manerix)

Genotype: CYP2C19 *1/*2

Phenotype: CYP2C19 Intermediate Metabolizer
Implication: No clinical data is currently available for the effect of intermediate metabolism on the elimination and response to moclobemide.
Clinical Dosing Guideline: No theraputic dose recommendation is currently available. Continue with standard dosing and administration guidelines and closely monitor clinical effects of drug.

Standard

Lesinurad (Zurampic)

Genotype: CYP2C9 *1/*1
Phenotype: CYP2C9 Normal Metabolizer
Implication: Patient's CYP2C9 genotype predicts normal response to lesinurad.
Clinical Dosing Guideline: Follow standard dosing and administration guidelines for lesinurad.

Standard

Losartan (Cozaar)

Genotype: CYP2C9 *1/*1
Phenotype: CYP2C9 Normal Metabolizer
Implication: Patient's CYP2C9 genotype predicts normal response to losartan.
Clinical Dosing Guideline: Follow standard dosing and administration guidelines for losartan.

Standard

Galantamine (Razadyne)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: Expect a 50% higher drug exposure for this patient when compared to normal metabolizers .
Clinical Dosing Guideline: Although dosage adjustment is unnecessary because the dose is individually titrated based on patient tolerability, slower titration is recommended to improve tolerability.

Standard

Ibuprofen (Motrin)

Genotype: CYP2C9 *1/*1
Phenotype: CYP2C9 Normal Metabolizer
Implication: Patient's CYP2C9 genotype predicts normal response to ibuprofen.
Clinical Dosing Guideline: Follow standard dosing and administration guidelines for ibuprofen.

Standard

Estradiol (Estrace)

Genotype: UGT2B15 *1/*2
Phenotype: UGT2B15 Slightly decreased enzymatic activity
Implication: Decreased glucuronidation of estradiol possibly leading to lower plasma clearance of the drug.
Clinical Dosing Guideline: No theraputic dose recommendation is currently available. The exact clinical effect of lower estradiol plasma clearance is uknown. Use caution. Continue with standard dosing and administration guidelines and closely monitor clinical effects of drug.

Standard

Omeprazole (Prilosec)

Genotype: CYP2C19 *1/*2
Phenotype: CYP2C19 Intermediate Metabolizer
Implication: Patient's genotype can lead to increased exposure to the drug at standard doses.
Clinical Dosing Guideline: No theraputic dose recommendation is currently available. Continue with standard dosing and administration guidelines and closely monitor clinical effects of drug.

Standard

Quinine (Qualaquin)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: CYP2D6 plays a minor role in quinine metabolism; thus, patient's genotype predicts standard response to quinine.
Clinical Dosing Guideline: Follow standard dosing and administration guidelines for quinine.

Standard

Pitavastatin (Livalo)

Genotype: SLCO1B1 *1/*5
Phenotype: SLCO1B1 Intermediate Metabolizer
Implication: To date, there is little evidence that rs4149056 genotype influences symptomatic intolerance or myopathy for pitavastatin.
Clinical Dosing Guideline: Prescribe desired starting dose and adjust doses of pitavastatin based on disease-specific guidelines or consider alternative statin.

Standard

Dronabinol (Marinol)

Genotype: CYP2C9 *1/*1
Phenotype: CYP2C9 Normal Metabolizer
Implication: Patient's CYP2C9 genotype predicts normal response to dronabinol.
Clinical Dosing Guideline: Follow standard dosing and administration guidelines for dronabinol.

Standard

Celecoxib (Celebrex)

Genotype: CYP2C9 *1/*1
Phenotype: CYP2C9 Normal Metabolizer
Implication: Patient's CYP2C9 genotype predicts normal response to celecoxib.
Clinical Dosing Guideline: Follow standard dosing and administration guidelines for celecoxib.

Standard

Rucaparib (Rubraca)

Genotype: CYP1A2 *1F/*1F
Phenotype: CYP1A2 Increased Metabolism
Implication: Patient's genotype predicts increased enzyme activity.
Clinical Dosing Guideline: Evidence suggests that rucaparib concentrations do not differ significantly based on CYP1A2 genotypes. Therefore, follow standard dosing and administration guidelines and closely monitor for clinical effects.

Standard

Glimepiride (Amaryl)

Genotype: CYP2C9 *1/*1
Phenotype: CYP2C9 Normal Metabolizer
Implication: Patient's CYP2C9 genotype predicts normal response to glimepiride.
Clinical Dosing Guideline: Follow standard dosing and administration guidelines for glimepiride.

Standard

Nebivolol (Bystolic)

Genotype: CYP2D6 *4/*4
Phenotype: CYP2D6 Poor Metabolizer
Implication: Although plasma concentration of the active isomer of nebivolol (d-nebivolol) is significantly higher in poor metabolizers, this has less importance than usual because the metabolites contribute to beta-blocking activity.
Clinical Dosing Guideline: Follow standard dosing and administration guidelines for nebivolol.

Disclaimer: