Pharmacogenetics Panel: Psychotropics, with GeneDose Access

Patient [redacted]
DOB: [redacted] Age: 32 Gender: F
Patient Identifiers [redacted]

Visit Number (FIN): [redacted]

Client: [redacted]

Physician: [redacted]

ARUP Test Code: 3006366

Collection Date: 11/18/2024
Received in lab: 11/18/2024
Completion Date: 11/19/2024

PGX PSYCH Specimen Whole Blood

Patient Results

Gene	Genotype	Flag	Phenotype	Flag
CYP2C19	*1/*2		**Intermediate**	**A**
CYP2C9	*1/*5		**Intermediate**	**A**
CYP2D6	*1/*4		**Intermediate**	**A**
CYP3A4	*1/*22		**Intermediate**	**A**
CYP3A5	*1/*3		**Intermediate**	**A**
CYP2B6	*1/*6		**Intermediate**	**A**
OPRM1 Interpretation	**AG**	**A**	See Note	
UGT2B15_1902023	**T/G Hetero**	**A**		
ANKK1 rs1800497	**G/A Hetero**	**A**		
COMT rs4680	**G/A Hetero**	**A**		
DRD2 rs1799978	**A/G Hetero**	**A**		
GRIK4 rs1954787	**T/C Hetero**	**A**		
HTR2A rs6311	**G/A Hetero**	**A**		
HTR2A rs7997012	**T/C Hetero**	**A**		
HTR2C rs3813929	**T Hemizygous**	**A**		
MTHFR rs1801133	**C/T Hetero**	**A**		
MTHFR rs1801131	**A/C Hetero**	**A**		

PGX PSYCH Interpretation

See Note

The following CYP2C19 allele(s) were detected: *1/*2. This result predicts the intermediate metabolizer phenotype.

Recommendation: Guidelines for genotype-based dosing are published by the Clinical Pharmacogenetics Implementation Consortium (CPIC) and other organizations. See : https://www.pharmgkb.org/

The following CYP2C9 allele(s) were detected: *1/*5. This result predicts the intermediate metabolizer phenotype, with an activity score of 1.5 of 2.

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Recommendation: Guidelines for genotype-based dosing are published by the Clinical Pharmacogenetics Implementation Consortium (CPIC) and other organizations. See: https://www.pharmgkb.org/

The following CYP2D6 allele(s) were detected: *1/*4. This result predicts the intermediate metabolizer phenotype with an activity score estimated at 1 of 2.

Recommendation: Guidelines for genotype-based dosing are published by the Clinical Pharmacogenetics Implementation Consortium (CPIC) and other organizations. See: https://www.pharmgkb.org/

The following CYP3A4 allele(s) were detected: *1/*22. This result predicts the intermediate metabolizer phenotype.

The following CYP3A5 allele(s) were detected: *1/*3. This result predicts the intermediate metabolizer phenotype.

Recommendation: Guidelines for genotype-based dosing are published by the Clinical Pharmacogenetics Implementation Consortium (CPIC) and can be found at: https://www.pharmgkb.org/.

The following CYP2B6 alleles were detected: *1/*6. This result predicts the intermediate metabolizer phenotype.

Recommendation: Guidelines for gene-based dosing are published by the Clinical Pharmacogenetics Implementation Consortium (CPIC) and other organizations. See https://www.pharmgkb.org

This test interrogates the UGT2B15 c.253T>G (rs1902023) variant, and the results are T/G. As such, the interpretation is heterozygous.

The UGT2B15 gene codes for the UDP glucuronosyltransferase family 2 member B15 (UGT2B15) that is involved in conjugative metabolism of many medications, such as the anxiolytics oxazepam and lorazepam. See PharmGKB.org for more information.

The following ANKK1 c.2137G>A (rs1800497) alleles were detected: G/A. As such, the interpretation is heterozygous.

The ANKK1 gene codes for the TAQ1A polymorphism that affects the expression of binding sites for dopamine on the dopamine D2 receptor. Variants may influence the likelihood for toxicity and response to drugs that target the dopaminergic system. Variants are also associated with risk of substance use disorders. See PharmGKB.org for more information.

The following COMT c.472G>A (rs4680) alleles were detected: G/A. As such, the interpretation is heterozygous.

The COMT gene codes for the catechol-O-methyltransferase (COMT) enzyme, which is involved in metabolism of catecholamines such

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as dopamine and norepinephrine. Variants are associated with variance in response to many drugs as well as tolerance to pain.

Recommendation: Guidelines for genotype-based dosing are published by the Clinical Pharmacogenetics Implementation Consortium (CPIC) and can be found at: https://cpicpgx.org/ and https://www.pharmgkb.org/.

The following DRD2 c.-585A>G (rs1799978) alleles were detected A/G. As such, the interpretation is heterozygous.

The DRD2 gene codes for the dopamine D2 receptor. Variants may influence likelihood for toxicity and response to drugs that target the dopaminergic system. See PharmGKB.org for more information.

The following GRIK4 c.83-10039T>C (rs1954787) alleles were detected: T/C. As such, the interpretation is heterozygous.

The GRIK4 gene codes for the subunit 4 of the kainite (glutamate) receptor. Variants are associated with variance in response to some antidepressants. See PharmGKB.org for more information.

This test interrogates two variants. For HTR2A c.-998G>A (rs6311) the results are G/A. As such, the interpretation is heterozygous. For HTR2A c.614-2211T>C (rs7997012) the results are T/C. As such, the interpretation is heterozygous.

The HTR2A gene codes for the serotonin receptor 2A. Variants may influence response to some antipsychotics and antidepressants. See PharmGKB.org for more information.

This test interrogates the HTR2C c.-850C>T (rs3813929) variant, and the result is T. As such, the interpretation is hemizygous.

The HTR2C gene codes for the serotonin 2C receptor that is involved in response to psychotropic medications, particularly antipsychotics. See PharmGKB.org for more information.

This test interrogates two variants. For MTHFR c.665C>T (rs1801133, previously designated as C677T) the results are C/T. As such, the interpretation is heterozygous. For MTHFR c.1286A>C (rs1801131, previously designated A1298C) the results are A/C. As such, the interpretation is heterozygous.
The MTHFR gene codes for methylenetetrahydrofolate reductase (MTHFR), an enzyme that metabolizes folate. Variants are associated with variance in response to many drugs as well as symptoms of depression and hyperhomocysteinemia.

Indication for testing: predict opioid sensitivity.

Interpretation: One copy of the OPRM1 A allele and one copy of the G allele (rs1799971) were detected in this sample. Further studies are needed to determine the clinical significance of

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this genotype; however, it is possible this patient may require higher or more frequent doses of opioid receptor agonists (e.g., morphine) to achieve adequate pain control. He/she may also be more likely to respond to opioid antagonists (e.g., naltrexone) in the treatment of alcohol and/or opioid dependency. This association of OPRM1 and drug sensitivity is not definitive and may be different for individual opioids.

Recommendation: Annotations for clinical application of this OPRM1 allele are available through the Pharmacogenomics Knowledge Base at: https://www.pharmgkb.org/gene/PA31945

For ANNK1, DRD2, GRIK4, HTR2A, HTR2C, and UGT2B15, clinical evidence is limited for the drug associations described thus far, and gene-based dosing guidelines are not currently published.

This result has been reviewed and approved by [redacted]

Interpretive Comments

Background Information for Pharmacogenetics Panel:
Psychotropics:

CHARACTERISTICS: Variation in genes affecting pharmacokinetics and/or pharmacodynamics (pharmacogenetics) may influence medication selection and dose planning. For example, variants in genes that code for metabolizing enzymes (CYP2B6, CYP2C19, CYP2C9, CYP2D6, CYP3A4, CYP3A5, and UGT2B15) may be associated with altered (slower or faster) metabolism which would affect the kinetics of medication activation, inactivation, and/or elimination. Other genes in this panel may predict risk of side effects and/or likelihood of response (ANKK1, COMT, DRD2, GRIK4, HTR2A, HTR2C, MTHFR, and OPRM1). This information may guide medication and dose selection for many prescription medications, including medications relevant to psychiatry such as psychostimulants (e.g., ADHD medication), antidepressants, antipsychotics, and anxiolytics.
Inheritance: Autosomal codominant.
Cause: Gene variants affect enzyme or protein function.
Genes Included: ANKK1, COMT, CYP2B6, CYP2C19, CYP2C9, CYP2D6, CYP3A4, CYP3A5, DRD2, GRIK4, HTR2A, HTR2C, MTHFR, OPRM1, and UGT2B15.
Variants Tested:
(Variants are numbered according to the following transcripts: ANKK1 NM_178510, COMT NM_000754, CYP2B6 NM_000767, CYP2C19 NM_000769, CYP2C9 NM_000771, CYP2D6 M33388 sequence, CYP3A4 NM_017460 and CYP3A5 NM_000777, DRD2 NM_000795, GRIK4 NM_014619, HTR2A NM_000621, HTR2C NM_001256760, MTHFR NM_005957, OPRM1 NM_000914, UGT2B15 NM_001076).

*1: Indicative of no detected targeted variants and an assumption of functional allele.

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ANKK1: rs1800497, c.2137G>A

COMT: rs4680, c.472G>A

CYP2B6*4: rs2279343, c.785A>G
CYP2B6*6: rs3745274, c.516G>T; rs2279343, c.785A>G
CYP2B6*7: rs3745274, c.516G>T; rs2279343, c.785A>G; rs3211371, c.1459C>T
CYP2B6*9: rs3745274, c.516G>T
CYP2B6*18: rs28399499, c.983T>C
CYP2B6*22: rs34223104, c.-82T>C
CYP2B6*36: rs34223104, c.-82T>C; rs3745274, c.516G>T; rs2279343, c.785A>G

CYP2C19*2: rs4244285, c.681G>A; rs12769205, c.332-23A>G
CYP2C19*3: rs4986893, c.636G>A
CYP2C19*4A: rs28399504, c.1A>G
CYP2C19*4B: rs28399504, c.1A>G; rs12248560, c.-806C>T
CYP2C19*5: rs56337013, c.1297C>T
CYP2C19*6: rs72552267, c.395G>A
CYP2C19*7: rs72558186, c.819+2T>A
CYP2C19*8: rs41291556, c.358T>C
CYP2C19*9: rs17884712, c.431G>A
CYP2C19*17: rs12248560, c.-806C>T
CYP2C19*35: rs12769205, c.332-23A>G

CYP2C9*2: rs1799853, c.430C>T
CYP2C9*3: rs1057910, c.1075A>C
CYP2C9*4: rs56165452, c.1076T>C
CYP2C9*5: rs28371686, c.1080C>G
CYP2C9*6: rs9332131, c.818del
CYP2C9*8: rs7900194, c.449G>A
CYP2C9*11: rs28371685, c.1003C>T
CYP2C9*12: rs9332239, c.1465C>T

CYP2D6*2: rs16947, g.2850C>T; rs1135840, g.4180G>C
CYP2D6*2A: rs1080985, g.-1584C>G; rs16947, g.2850C>T; rs1135840, g.4180G>C
CYP2D6*3: rs35742686, g.2549del
CYP2D6*4: rs1065852, g.100C>T; rs3892097, g.1846G>A; rs1135840, g.4180G>C
CYP2D6*5: gene deletion
CYP2D6*6: rs5030655, g.1707del
CYP2D6*7: rs5030867, g.2935A>C
CYP2D6*8: rs5030865, g.1758G>T; rs16947, g.2850C>T; rs1135840, g.4180G>C
CYP2D6*9: rs5030656, g.2615_2617del
CYP2D6*10: rs1065852, g.100C>T; rs1135840, g.4180G>C
CYP2D6*11: rs1080985, g.-1584C>G; rs201377835, g.883G>C; rs16947, g.2850C>T; rs1135840, g.4180G>C
CYP2D6*13: a CYP2D7-derived exon 1 conversion
CYP2D6*14: rs5030865, g.1758G>A; rs16947, g.2850C>T; rs1135840, g.4180G>C
CYP2D6*15: rs774671100, g.137_138insT

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CYP2D6*17: rs28371706, g.1023C>T; rs16947, g.2850C>T; rs1135840, g.4180G>C
CYP2D6*29: rs16947, g.2850C>T; rs59421388, g.3183G>A; rs1135840, g.4180G>C
CYP2D6*35: rs769258, g.31G>A; rs16947, g.2850C>T; rs1135840, g.4180G>C; rs1080985, g.-1584C>G
CYP2D6*36: a CYP2D6*10 carrying a CYP2D7-derived exon 9 conversion
CYP2D6*36-*10: a CYP2D6*36 and a CYP2D6*10 in tandem
CYP2D6*40: rs28371706, g.1023C>T, rs16947, g.2850C>T; rs1135840, g.4180G>C; rs72549356, g.1863_1864ins TTTCGCCCCTTTCGCCCC
CYP2D6*41: rs16947, g.2850C>T; rs28371725, g.2988G>A; rs1135840, g.4180G>C
CYP2D6*42: rs16947, g.2850C>T; rs1135840, g.4180G>C; rs72549346, g.3260_3261insGT
CYP2D6*49: rs1065852, g.100C>T; rs1135822, g.1611T>A; rs1135840, g.4180G>C
CYP2D6*69: rs1065852, g.100C>T; rs16947, g.2850C>T; rs28371725, g.2988G>A; rs1135840, g.4180G>C
CYP2D6*114: rs1065852, g.100C>T; rs5030865, g.1758G>A; rs16947, g.2850C>T; rs1135840, g.4180G>C
DUP: complete gene duplications

CYP3A4*1A: rs2740574, c.-392G>A
CYP3A4*22: rs35599367, c.522-191C>T

CYP3A5*3: rs776746, c.219-237A>G
CYP3A5*6: rs10264272, c.624G>A
CYP3A5*7: rs41303343, c.1035dup

DRD2: rs1799978, c.-585A>G

GRIK4: rs1954787, c.83-10039T>C

HTR2A: rs6311, c.-998G>A
HTR2A: rs7997012, c.614-2211T>C

HTR2C: rs3813929, c.-850C>T

MTHFR: rs1801131, c.1286A>C
MTHFR: rs1801133, c.665C>T

OPRM1: rs1799971, c.118A>G

UGT2B15: rs1902023, c.253T>G

Methodology: Polymerase chain reaction (PCR) and fluorescence monitoring. Long-range PCR and Sanger sequencing is only performed if needed to characterize a duplicated CYP2D6 gene.

Analytic Sensitivity and Specificity: Greater than 99 percent.

Limitations: Only the targeted variants will be detected by this panel, and assumptions about phase and content are made to assign alleles. Publicly available sources such as the

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www.pharmvar.org or www.pharmgkb.org provide guidance on phenotype predictions and allele frequencies. A combination of the CYP2D6*5 (gene deletion) and a CYP2D6 gene duplication cannot be specifically identified; however, this combination is not expected to adversely affect the phenotype prediction. The assay used to detect CYP2D6*40 allele, cannot distinguish between insertions of 1 or 2 copies; it also cannot distinguish between heterozygous and homozygous mutant samples due to unavoidable cross reactivity with the wild type sequence. Additional assays will be used to help differentiate the CYP2D6*40 allele from other CYP2D6 star alleles. Diagnostic errors can occur due to rare sequence variations.

Risk of therapeutic failure or adverse reactions with gene substrates may be affected by genetic and nongenetic factors that are not detected by this test.

For ANKK1, DRD2, GRIK4, HTR2A, HTR2C, and UGT2B15, clinical evidence is limited for the drug associations described thus far, and gene-based dosing guidelines are not currently published.
This result does not replace the need for therapeutic drug or clinical monitoring.

Please note the information contained in this report does not contain medication recommendations and should not be interpreted as recommending any specific medications. Any dosage adjustments or other changes to medications should be evaluated in consultation with a medical provider.

This test was developed and its performance characteristics determined by ARUP Laboratories. It has not been cleared or approved by the U.S. Food and Drug Administration. This test was performed in a CLIA-certified laboratory and is intended for clinical purposes.

Counseling and informed consent are recommended for genetic testing. Consent forms are available online.

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Patient: [redacted] | **Date of Birth:** [redacted] | **Gender:** F | **Physician:** [redacted]
Patient Identifiers: [redacted] | **Visit Number (FIN):** [redacted]

PGX PSYCH, GeneDose Link

See Note
To access GeneDose LIVE, visit the URL below and enter the ARUP Accession number to continue:
Interpretive Information: PGX Panel: Psychotropics with GeneDose
GeneDose LIVE content is provided by Coriell Life Sciences and not by ARUP Laboratories.

Any dosage adjustments or other changes to medication should be evaluated in consultation with a medical provider.

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Test Information

The following tables list the available gene-drug pairs and genotype-based dosing published by the Clinical Pharmacogenetics Implementation Consortium (CPIC) and the FDA table of pharmacogenomic biomarkers in drug labeling.

Published CPIC guidelines

GUIDELINES	DRUGS	GENES
CYP2B6 and efavirenz	efavirenz	CYP2B6
CYP2C19 and Clopidogrel	clopidogrel	CYP2C19
CYP2C19 and Proton Pump Inhibitors	dexlansoprazole	CYP2C19
	esomeprazole	
	lansoprazole	
	omeprazole	
	pantoprazole	
	rabeprazole	
CYP2C19 and Voriconazole	voriconazole	CYP2C19
CYP2C9 and NSAIDs	aceclofenac	CYP2C9
	celecoxib	
	diclofenac	
	flurbiprofen	
	ibuprofen	
	indomethacin	
	lornoxicam	
	lumiracoxib	
	meloxicam	
	metamizole	
	nabumetone	
	naproxen	
	piroxicam	
	tenoxicam	
CYP2C9, VKORC1, CYP4F2 and Warfarin	warfarin	CYP2C9, CYP4F2, VKORC1
CYP2D6 and Atomoxetine	atomoxetine	CYP2D6
CYP2D6 and Ondansetron and Tropisetron	ondansetron	CYP2D6
	tropisetron	
CYP2D6 and Tamoxifen	tamoxifen	CYP2D6
	citalopram	
	escitalopram	

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CYP2D6, CYP2C19 and Selective Serotonin Reuptake Inhibitors	fluvoxamine	CYP2C19, CYP2D6
	paroxetine	
	sertraline	
CYP2D6, CYP2C19 and Tricyclic Antidepressants	amitriptyline	CYP2C19, CYP2D6
	clomipramine	
	desipramine	
	doxepin	
	imipramine	
	nortriptyline	
	trimipramine	
CYP2D6, OPRM1, COMT, and Opioids	alfentanil	COMT, CYP2D6, OPRM1
	buprenorphine	
	codeine	
	fentanyl	
	hydrocodone	
	hydromorphone	
	levomethadone	
	methadone	
	morphine	
	naltrexone	
	oxycodone	
	remifentanil	
	sufentanil	
	tramadol	
CYP3A5 and Tacrolimus	tacrolimus	CYP3A5
DPYD and Fluoropyrimidines	capecitabine	DPYD
	fluorouracil	
	tegafur	
SLCO1B1, ABCG2, CYP2C9, and Statins	atorvastatin	ABCG2, CYP2C9, SLCO1B1
	fluvastatin	
	lovastatin	
	pitavastatin	
	pravastatin	
	rosuvastatin	
	simvastatin	
	azathioprine	

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TPMT, NUDT15 and Thiopurines	mercaptopurine	NUDT15, TPMT
	thioguanine	

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FDA Table of Pharmacogenomic Biomarkers in Drug Labeling

Drug	Therapeutic Area*	Biomarker†	Labeling Sections
Abrocitinib	Dermatology	CYP2C19	Dosage and Administration, Use in Specific Populations, Clinical Pharmacology
Amitriptyline	Psychiatry	CYP2D6	Precautions
Amoxapine	Psychiatry	CYP2D6	Precautions
Amphetamine	Psychiatry	CYP2D6	Clinical Pharmacology
Arformoterol	Pulmonary	CYP2D6	Clinical Pharmacology
Aripiprazole	Psychiatry	CYP2D6	Dosage and Administration, Use in Specific Populations, Clinical Pharmacology
Aripiprazole Lauroxil	Psychiatry	CYP2D6	Dosage and Administration, Use in Specific Populations, Clinical Pharmacology
Atomoxetine	Psychiatry	CYP2D6	Dosage and Administration, Warnings and Precautions, Adverse Reactions, Drug Interactions, Use in Specific Populations, Clinical Pharmacology
Avatrombopag	Hematology	CYP2C9	Clinical Pharmacology
Azathioprine	Rheumatology	TPMT	Dosage and Administration, Warnings, Precautions, Drug Interactions, Adverse Reactions, Clinical Pharmacology
Azathioprine	Rheumatology	NUDT15	Dosage and Administration, Warnings, Precautions, Adverse Reactions, Clinical Pharmacology
Belzutifan	Oncology	CYP2C19	Warnings and Precautions, Drug Interactions, Use in Specific Populations, Clinical Pharmacology
Brexpiprazole	Psychiatry	CYP2D6	Dosage and Administration, Use in Specific Populations, Clinical Pharmacology
Brivaracetam	Neurology	CYP2C19	Clinical Pharmacology
Bupropion	Psychiatry	CYP2D6	Clinical Pharmacology
Capecitabine	Oncology	DPYD	Warnings and Precautions, Clinical Pharmacology, Patient Counseling Information
Cariprazine	Psychiatry	CYP2D6	Clinical Pharmacology
Carisoprodol	Rheumatology	CYP2C19	Use in Specific Populations, Clinical Pharmacology
Carvedilol	Cardiology	CYP2D6	Drug Interactions, Clinical Pharmacology
Celecoxib	Rheumatology	CYP2C9	Dosage and Administration, Use in Specific Populations, Clinical Pharmacology
Cevimeline	Dental	CYP2D6	Precautions
Cisplatin	Oncology	TPMT	Adverse Reactions
Citalopram	Psychiatry	CYP2C19	Dosage and Administration, Warnings, Clinical Pharmacology

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Citalopram	Psychiatry	CYP2D6	Clinical Pharmacology
Clobazam	Neurology	CYP2C19	Dosage and Administration, Use in Specific Populations, Clinical Pharmacology
Clomipramine	Psychiatry	CYP2D6	Precautions
Clopidogrel	Cardiology	CYP2C19	Boxed Warning, Warnings and Precautions, Clinical Pharmacology
Clozapine	Psychiatry	CYP2D6	Dosage and Administration, Use in Specific Populations, Clinical Pharmacology
Codeine	Anesthesiology	CYP2D6	Boxed Warning, Warnings and Precautions, Use in Specific Populations, Patient Counseling Information
Darifenacin	Urology	CYP2D6	Clinical Pharmacology
Desipramine	Psychiatry	CYP2D6	Precautions
Desvenlafaxine	Psychiatry	CYP2D6	Clinical Pharmacology
Deutetrabenazine	Neurology	CYP2D6	Dosage and Administration, Warnings and Precautions, Use in Specific Populations, Clinical Pharmacology
Dexlansoprazole	Gastroenterology	CYP2C19	Drug Interactions, Clinical Pharmacology
Dextromethorphan and Quinidine	Neurology	CYP2D6	Warnings and Precautions, Clinical Pharmacology
Diazepam	Neurology	CYP2C19	Clinical Pharmacology
Donepezil	Neurology	CYP2D6	Clinical Pharmacology
Doxepin	Psychiatry	CYP2D6	Clinical Pharmacology
Doxepin	Psychiatry	CYP2C19	Clinical Pharmacology
Dronabinol	Gastroenterology	CYP2C9	Use in Specific Populations, Clinical Pharmacology
Drospirenone and Ethinyl Estradiol	Gynecology	CYP2C19	Clinical Pharmacology
Duloxetine	Psychiatry	CYP2D6	Drug Interactions
Efavirenz	Infectious Diseases	CYP2B6	Clinical Pharmacology
Elagolix	Gynecology	SLCO1B1	Clinical Pharmacology
Eliglustat	Inborn Errors of Metabolism	CYP2D6	Indications and Usage, Dosage and Administration, Contraindications, Warnings and Precautions, Drug Interactions, Use in Specific Populations, Clinical Pharmacology, Clinical Studies
Erdafitinib	Oncology	CYP2C9	Use in Specific Populations, Clinical Pharmacology
Escitalopram	Psychiatry	CYP2D6	Drug Interactions
Escitalopram	Psychiatry	CYP2C19	Adverse Reactions
Esomeprazole	Gastroenterology	CYP2C19	Drug Interactions, Clinical Pharmacology

Fesoterodine	Urology	CYP2D6	Drug Interactions, Clinical Pharmacology
Fosphenytoin	Neurology	CYP2C9	Warnings and Precautions, Use in Specific Populations, Clinical Pharmacology
Flibanserin	Gynecology	CYP2C9	Clinical Pharmacology
Flibanserin	Gynecology	CYP2C19	Adverse Reactions, Use in Specific Populations, Clinical Pharmacology
Flibanserin	Gynecology	CYP2D6	Clinical Pharmacology
Fluorouracil	Dermatology	DPYD	Contraindications, Warnings
Fluorouracil	Oncology	DPYD	Warnings and Precautions, Patient Counseling Information
Fluoxetine	Psychiatry	CYP2D6	Precautions, Clinical Pharmacology
Flurbiprofen	Rheumatology	CYP2C9	Clinical Pharmacology
Fluvoxamine	Psychiatry	CYP2D6	Drug Interactions
Formoterol	Pulmonary	CYP2D6	Clinical Pharmacology
Formoterol	Pulmonary	CYP2C19	Clinical Pharmacology
Galantamine	Neurology	CYP2D6	Clinical Pharmacology
Gefitinib	Oncology	CYP2D6	Clinical Pharmacology
Iloperidone	Psychiatry	CYP2D6	Dosage and Administration, Warnings and Precautions, Drug Interactions, Clinical Pharmacology
Imipramine	Psychiatry	CYP2D6	Precautions
Lacosamide	Neurology	CYP2C19	Clinical Pharmacology
Lansoprazole	Gastroenterology	CYP2C19	Drug Interactions, Clinical Pharmacology
Lesinurad	Rheumatology	CYP2C9	Drug Interactions, Clinical Pharmacology
Lofexidine	Anesthesiology	CYP2D6	Use in Specific Populations
Mavacamten	Cardiology	CYP2C19	Dosage and Administration, Clinical Pharmacology
Meclizine	Neurology	CYP2D6	Warnings and Precautions
Meloxicam	Anesthesiology	CYP2C9	Use in Specific Populations, Clinical Pharmacology
Mercaptopurine	Oncology	TPMT	Dosage and Administration, Warnings and Precautions, Adverse Reactions, Clinical Pharmacology
Mercaptopurine	Oncology	NUDT15	Dosage and Administration, Warnings and Precautions, Clinical Pharmacology
Metoclopramide	Gastroenterology	CYP2D6	Dosage and Administration, Use in Specific Populations, Clinical Pharmacology
Metoprolol	Cardiology	CYP2D6	Clinical Pharmacology
Mirabegron	Urology	CYP2D6	Clinical Pharmacology
Modafinil	Psychiatry	CYP2D6	Clinical Pharmacology

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Chart continues on following page(s)

Nateglinide	Endocrinology	CYP2C9	Drug Interactions
Nebivolol	Cardiology	CYP2D6	Dosage and Administration, Clinical Pharmacology
Nefazodone	Psychiatry	CYP2D6	Precautions
Nortriptyline	Psychiatry	CYP2D6	Precautions
Oliceridine	Anesthesiology	CYP2D6	Warnings and Precautions, Drug Interactions, Use in Specific Populations, Clinical Pharmacology
Omeprazole	Gastroenterology	CYP2C19	Drug Interactions, Clinical Pharmacology
Ondansetron	Gastroenterology	CYP2D6	Clinical Pharmacology
Ospemifene	Gynecology	CYP2C9	Clinical Pharmacology
Ospemifene	Gynecology	CYP2B6	Clinical Pharmacology
Paliperidone	Psychiatry	CYP2D6	Clinical Pharmacology
Palonosetron	Gastroenterology	CYP2D6	Clinical Pharmacology
Pantoprazole	Gastroenterology	CYP2C19	Clinical Pharmacology
Paroxetine	Psychiatry	CYP2D6	Drug Interactions, Clinical Pharmacology
Perphenazine	Psychiatry	CYP2D6	Precautions, Clinical Pharmacology
Phenytoin	Neurology	CYP2C9	Warnings and Precautions, Use in Specific Populations, Clinical Pharmacology
Phenytoin	Neurology	CYP2C19	Clinical Pharmacology
Pimozide	Psychiatry	CYP2D6	Dosage and Administration, Precautions
Piroxicam	Rheumatology	CYP2C9	Clinical Pharmacology
Pitolisant	Psychiatry	CYP2D6	Dosage and Administration, Use in Specific Populations, Clinical Pharmacology
Prasugrel	Cardiology	CYP2C19	Use in Specific Populations, Clinical Pharmacology, Clinical Studies
Prasugrel	Cardiology	CYP2C9	Use in Specific Populations, Clinical Pharmacology, Clinical Studies
Prasugrel	Cardiology	CYP3A5	Use in Specific Populations, Clinical Pharmacology, Clinical Studies
Prasugrel	Cardiology	CYP2B6	Use in Specific Populations, Clinical Pharmacology, Clinical Studies
Propafenone	Cardiology	CYP2D6	Dosage and Administration, Warnings and Precautions, Drug Interactions, Clinical Pharmacology
Propranolol	Cardiology	CYP2D6	Clinical Pharmacology
Protriptyline	Psychiatry	CYP2D6	Precautions
Quinidine	Cardiology	CYP2D6	Precautions
Quinine Sulfate	Infectious Diseases	CYP2D6	Drug Interactions

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Rabeprazole	Gastroenterology	CYP2C19	Drug Interactions, Clinical Pharmacology
Rimegepant	Neurology	CYP2C9	Clinical Pharmacology
Risperidone	Psychiatry	CYP2D6	Clinical Pharmacology
Rosuvastatin	Endocrinology	SLCO1B1	Clinical Pharmacology
Rucaparib (2)	Oncology	CYP2D6	Clinical Pharmacology
Siponimod	Neurology	CYP2C9	Dosage and Administration, Contraindications, Drug Interactions, Use in Specific Populations, Clinical Pharmacology
Tamoxifen	Oncology	CYP2D6	Clinical Pharmacology
Tamsulosin	Urology	CYP2D6	Warnings and Precautions, Adverse Interactions, Clinical Pharmacology
Tetrabenazine	Neurology	CYP2D6	Dosage and Administration, Warnings and Precautions, Use in Specific Populations, Clinical Pharmacology
Thioguanine	Oncology	TPMT	Dosage and Administration, Warnings, Precautions, Clinical Pharmacology
Thioguanine	Oncology	NUDT15	Dosage and Administration, Warnings, Precautions, Clinical Pharmacology
Thioridazine	Psychiatry	CYP2D6	Contraindications, Warnings, Precautions
Ticagrelor	Cardiology	CYP2C19	Clinical Pharmacology
Tolterodine	Urology	CYP2D6	Warnings and Precautions, Drug Interactions, Clinical Pharmacology
Tramadol	Anesthesiology	CYP2D6	Boxed Warning, Warnings and Precautions, Use in Specific Populations, Clinical Pharmacology, Patient Counseling Information
Trimipramine	Psychiatry	CYP2D6	Precautions
Umeclidinium	Pulmonary	CYP2D6	Clinical Pharmacology
Upadacitinib	Rheumatology	CYP2D6	Clinical Pharmacology
Valbenazine	Neurology	CYP2D6	Dosage and Administration, Warnings and Precautions, Use in Specific Populations, Clinical Pharmacology
Venlafaxine	Psychiatry	CYP2D6	Drug Interactions, Use in Specific Populations, Clinical Pharmacology
Viloxazine	Psychiatry	CYP2D6	Clinical Pharmacology
Viloxazine	Psychiatry	SLCO1B1	Clinical Pharmacology
Voriconazole	Infectious Diseases	CYP2C19	Clinical Pharmacology
Vortioxetine	Psychiatry	CYP2D6	Dosage and Administration, Clinical Pharmacology
Warfarin	Hematology	CYP2C9	Dosage and Administration, Drug Interactions, Clinical Pharmacology

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Warfarin	Hematology	VKORC1	Dosage and Administration, Clinical Pharmacology

* Therapeutic areas do not necessarily reflect the CDER review division.
† Representative biomarkers are listed based on standard nomenclature as per the Human Genome Organization (HUGO) symbol and/or simplified descriptors using other common conventions. Listed biomarkers do not necessarily reflect the terminology used in labeling. The term “Nonspecific” is provided when labeling does not explicitly identify the specific biomarker(s) or when the biomarker is represented by a molecular phenotype or gene signature, and in some cases the biomarker was inferred based on the labeling language.

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