Patient ID	Patient Name		Birth Date	Sex	Age
SA00175251	TESTINGRNV, PGXQP NORMAL		2005-06-06	M	19
Order Number	**Client Order Number**	**Ordering Physician**	**Report Notes**		
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⚠ Pharmacogenomic Interactions

dexlansoprazole *Dexilant*
fosphenytoin *Cerebyx*
lansoprazole *Prevacid*
omeprazole *Prilosec, Zegerid, OmePPi*
pantoprazole *Protonix*
phenytoin *Phenytek, Dilantin*
tacrolimus *Envarsus, Protopic, Astagraf*
warfarin *Coumadin, Jantoven*

✓ Standard Prescription Recommended

amitriptyline *Elavil*
amoxapine *Asendin*
amphetamine
aripiprazole *Abilify*
atomoxetine *Strattera*
atorvastatin *Lipitor*
avatrombopag *Doptelet*
brexpiprazole *Rexulti*
brivaracetam *Briviact*
carisoprodol *Soma*
carvedilol *Coreg*
celecoxib *Celebrex*
cevimeline *Evoxac*
citalopram *Celexa*
clobazam *Onfi*
clomipramine *Anafranil*
clopidogrel *Plavix*
clozapine *Clozaril*
codeine
darifenacin *Enablex*
desipramine *Norpramin*
deutetrabenazine *Austedo*
diazepam *Valium*
donepezil *Aricept*
doxepin *Sinequan*
dronabinol *Marinol, THC*
elagolix *Orilissa*
eliglustat *Cerdelga*
erdafitinib *Balversa*
escitalopram *Lexapro*
esomeprazole *Nexium*
fesoterodine *Toviaz*
flecainide *Tambocor*
flibanserin *Addyi*
fluoxetine *Prozac*
flurbiprofen *Ocufen*
fluvoxamine *Luvox*
galantamine *Razadyne*
gefitinib *Iressa*
haloperidol *Haldol*
ibuprofen
iloperidone *Fanapt*
imipramine *Tofranil*
lofexidine *Lucemyra*
meclizine *Medi-Meclizine, Bonine, Motion Sickness, Verticalm*
meloxicam *Mobic*
metoclopramide *Reglan*
metoprolol *Toprol, Lopressor*
mirabegron *Myrbetriq*
nebivolol *Bystolic*
nortriptyline *Pamelor*
oliceridine *Olinvyk*
ondansetron *Zuplenz, Zofran*
oxycodone
paroxetine *Paxil*
perphenazine *Trilafon*
pimozide *Orap*
piroxicam *Feldene*
propafenone *Rythmol*
propranolol *Inderal, Innopran*
protriptyline *Vivactil*
risperidone *Risperdal*
rosuvastatin *Crestor*
sertraline *Zoloft*
simvastatin *FloLipid, Zocor*
siponimod *Mayzent*
tamoxifen *Nolvadex, Soltamox*
tamsulosin *Flomax*
tenoxicam *Mobiflex*
tetrabenazine *Xenazine*
thioridazine *Mellaril*
tolterodine *Detrol*

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MAYO CLINIC LABORATORIES

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tramadol *Ultram, ConZip*
trimipramine *Surmontil*
tropisetron
valbenazine *Ingrezza*
venlafaxine *Effexor*
voriconazole *Vfend*
vortioxetine *Trintellix*

⚠ Pharmacogenomic Interaction Details

Medication	Comment
dexlansoprazole *Dexilant*	According to the Clinical Pharmacogenetics Implementation Consortium (CPIC) guideline for CYP2C19 and proton pump inhbitors (PPIs), individuals with normal (extensive) CYP2C19 activity maybe at risk for therapeutic failure compared to CYP2C19 poor and intermediate metabolizers. CPIC recommends initiating at the standard starting daily dose, or to consider increasing the dose by 50-100% for treatment of H.pylori infection and erosive esophagitis, and monitoring for efficacy. See the CPIC guideline for more details.
fosphenytoin *Cerebyx*	Consider testing for HLA-B*15:02 prior to prescription. Based on CYP2C9, standard dosing is recommended.
lansoprazole *Prevacid*	According to the Clinical Pharmacogenetics Implementation Consortium (CPIC) guideline for CYP2C19 and proton pump inhbitors (PPIs), individuals with normal (extensive) CYP2C19 activity maybe at risk for therapeutic failure compared to CYP2C19 poor and intermediate metabolizers. CPIC recommends initiating at the standard starting daily dose, or to consider increasing the dose by 50-100% for treatment of H.pylori infection and erosive esophagitis, and monitoring for efficacy. See the CPIC guideline for more details.
omeprazole *Prilosec, Zegerid, OmePPi*	According to the Clinical Pharmacogenetics Implementation Consortium (CPIC) guideline for CYP2C19 and proton pump inhbitors (PPIs), individuals with normal (extensive) CYP2C19 activity maybe at risk for therapeutic failure compared to CYP2C19 poor and intermediate metabolizers. CPIC recommends initiating at the standard starting daily dose, or to consider increasing the dose by 50-100% for treatment of H.pylori infection and erosive esophagitis, and monitoring for efficacy. See the CPIC guideline for more details.
pantoprazole *Protonix*	According to the Clinical Pharmacogenetics Implementation Consortium (CPIC) guideline for CYP2C19 and proton pump inhbitors (PPIs), individuals with normal (extensive) CYP2C19 activity maybe at risk for therapeutic failure compared to CYP2C19 poor and intermediate metabolizers. CPIC recommends initiating at the standard starting daily dose, or to consider increasing the dose by 50-100% for treatment of H.pylori infection and erosive esophagitis, and monitoring for efficacy. See the CPIC guideline for more details.
phenytoin *Phenytek, Dilantin*	Consider testing for HLA-B*15:02 prior to prescription. Based on CYP2C9, standard dosing is recommended.
tacrolimus *Envarsus, Protopic, Astagraf*	Standard dosing is suggested for initiation of therapy. Therapeutic drug monitoring is recommended.
warfarin *Coumadin, Jantoven*	This patient's CYP2C9 and VKORC1 genotype suggests that normal warfarin dosing is most likely appropriate for this patient. Initial warfarin dosing recommendations based on the CYP2C9/ VKORC1 genotype are available in the drug label.

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Genotype Findings

Analyte	Result	Performing Site
CYP1A2 Genotype	*1/*1F	MCR
CYP1A2 Phenotype	Rapid metabolizer This individual is expected to metabolize CYP1A2 substrates at a normal rate, or at a higher than normal rate if CYP1A2 is induced such as when exposed to tobacco smoke or other substances known to induce CYP1A2. If CYP1A2 inducers are stopped or started, a change in phenotype is possible. Note: This is the most common phenotype among Caucasian individuals.	MCR
CYP2C19 Genotype	*1/*1	MCR
CYP2C19 Phenotype	Normal (extensive) metabolizer With prodrugs that are activated by CYP2C19, normal drug activation by CYP2C19 is expected to occur. With drugs that are inactivated by CYP2C19, normal inactivation is expected.	MCR
CYP2C9 Genotype	*1/*1	MCR
CYP2C9 Phenotype	Normal (extensive) metabolizer This patient has a genotype associated with normal CYP2C9 enzymatic activity.	MCR
CYP2C9 Activity Score	2.00	MCR
CYP2D6 Genotype	*1/*1	MCR
CYP2D6 Phenotype	Normal (extensive) metabolizer Prodrugs are converted to their active metabolite at a normal rate and drugs that are inactivated by CYP2D6 are metabolized at a normal rate.	MCR
CYP2D6 Activity Score	2.00	MCR
CYP3A4 Genotype	*1/*1	MCR
CYP3A4 Phenotype	Normal (extensive) metabolizer Normal metabolism of drugs that are inactivated or activated by CYP3A4 is expected.	MCR
CYP3A5 Genotype	*3/*3	MCR
CYP3A5 Phenotype	Poor metabolizer Note: This is the most common phenotype among Caucasian individuals. While this individual is expected to have minimal, if any, CYP3A5-mediated metabolism, standard dosing may be appropriate for many medications metabolized by CYP3A5. Original dosing recommendations for some CYP3A5-metabolized medications were determined based on populations primarily comprised of CYP3A5 poor metabolizers (i.e. CYP3A5*3/*3). Therapeutic drug monitoring is recommended for applicable medications.	MCR

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Analyte	Result	Performing Site
SLCO1B1 Genotype	*1/*1	MCR
SLCO1B1 Phenotype	Normal function SLCO1B1 encodes the organic anion-transporting polypeptide 1B1 (OATP1B1) influx transporter located on the basolateral membrane of hepatocytes. OATP1B1 facilitates the hepatic uptake of statins as well as other endogenous compounds (e.g. bilirubin). This individual is expected to have normal transporter function.	MCR
Warfarin *CYP2C9* Genotype	*1/*1	MCR
Warfarin *VKORC1* Resistance Genotype	No resistance variants detected	MCR
Warfarin *VKORC1* Promoter Genotype	G/G	MCR
Warfarin CYP2C9 and VKORC1 Promoter Phenotype	Normal warfarin sensitivity CYP2C9 is the primary enzyme responsible for metabolism of S-warfarin, while VKORC1 encodes the vitamin K epoxide reductase protein, which is the target of warfarin. Initial warfarin dosing recommendations based on the CYP2C9/VKORC1 genotype are available in the drug label.	MCR
Warfarin *CYP4F2* *3 Genotype	*1/*1 CYP4F2 is a vitamin K oxidase that limits excessive accumulation of vitamin K. For patients who self-identify as being of non-African ancestry, the CYP4F2*3 allele has been demonstrated to affect enzyme activity and to be associated with a modest influence on warfarin dose requirements. Currently, there is no evidence to support a role of this variant on warfarin dosing in patients of African ancestry.	MCR
Warfarin rs12777823 Genotype	G/G The rs12777823 variant is located within the CYP2C cluster, and is associated with significant alterations in warfarin clearance in individuals of African American ancestry. Although this variant is identified in other populations, the association with warfarin dose requirements has only been identified among African Americans.	MCR

Additional Information

MCR

Initial warfarin dosing recommendations based on the CYP2C9/VKORC1 genotype are available in the drug label located online at: www.accessdata.fda.gov/drugsatfda_docs/label/2010/009218s108lbl.pdf . For additional information related to CYP4F2*3 (rs2108622) and rs12777823, please see the Clinical Pharmacogenomics Implementation Consortium Guideline for Pharmacogenetics-Guided Warfarin Dosing: 2017 Update (Clin Pharmacol Ther. 2017 Feb 15. doi: 10.1002/cpt.668). Medications and recommendations included in this report are based on the Clinical Pharmacogenetics Implementation Consortium Guidelines www.cpicpgx.org/guidelines/, information publicly available in PharmGKB www.pharmgkb.org , Dutch Pharmacogenetics

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Working Group Recommendations www.pharmgkb.org , FDA medication labels, and available literature. For additional information regarding pharmacogenomic genes and their associated drugs, please see the Pharmacogenomic Associations Tables on the Mayo Clinic Laboratories webpage,https://www.mayocliniclabs.com/it-mmfiles/Pharmacogenomic_Associations_Tables.pdf . This resource also includes information regarding enzyme inhibitors and inducers, as well as potential alternate drug choices. Please note that the information at this link is educational material intended for health care professionals and may not be comprehensive. This educational material is not intended to supersede the care provider's experience and knowledge of her/his patient to establish a diagnosis or a treatment plan. All medications require careful clinical monitoring. Please contact the laboratory at 1–800–533–1710 for further information about pharmacogenomic testing. For additional information on star allele nomenclature for the Cytochrome P450 enzymes, see the Pharmacogene Variation Consortium website www.pharmvar.org.

Method

MCR

Genotyping is performed using a PCR-based 5'-nuclease assay. Fluorescently labeled detection probes anneal to the target DNA. PCR is used to amplify the segment of DNA that contains the polymorphism. If the detection probe is an exact match to the target DNA, the 5'-nuclease polymerase degrades the probe, the reporter dye is released from the effects of the quencher dye, and a fluorescent signal is detected. Genotypes are assigned based on the allele-specific fluorescent signals that are detected. (TaqMan SNP Genotyping Assays User Guide, Applied Biosystems)

Disclaimer

1 MCR

Targeted variant analysis performed by a polymerase chain reaction (PCR)-based 5'-nuclease assay using fluorescently labeled detection probes was used to test for the presence or absence of specific variants in the following genes. Pharmacogenomic data for these specific variants are reviewed and reported (if present): CYP1A2 (NM_000761.4) *1F, *1K, *6, and *7 CYP2C9 (NM_000771.3) *2, *3, *4, *5, *6, *8, *9, *11, *12, *13, *14, *15, *16, *17, *18, *25, *26, *28, *30, *33, and *35 CYP2C19 (NM_000769.1) *2, *3, *4, *5, *6, *7, *8, *9, *10, *17, and *35 CYP2D6 (NM_000106.4) *2, *3, *4, *4N, *5, *6, *7, *8, *9, *10, *11, *12, *13, *14,*15, *17, *29, *35, *36, *41, *59, *68, *114, and CYP2D6 gene duplication. Additional CYP2D6 variants may be detected through the cascade testing process. CYP3A4 (NM_017460.5) *8, *11, *12, *13, *16, *17, *18, *22, and *26
CYP3A5 (NM_000777.4) *3, *6, *7, *8, and *9
CYP4F2 (NM_001082.4) *3
rs12777823G>A
SLCO1B1 (NM_006446.4) *5
VKORC1 (NM_024006.5) c.−1639G>A, c.85G>T, c.106G>T, c.121G>T, c.134T>C, c.172A>G, c.196G>A, c.358C>T, and c.383T>G

A two-tiered testing approach was used to identify CYP2D6 variants (including copy number variants). Tier 1 (always performed) consists of targeted variant analysis and a test for copy number variation (CNV) using CYP2D6-specific probes for the promoter, intron 6 and exon 9. Detectable CNVs include duplications, multiplications and deletions (*5) of CYP2D6, as well as CYP2D6::CYP2D7 (i.e. *4N, *36, *68) and CYP2D7::CYP2D6 (i.e. *13) hybrid genes. Tier 2, which is only performed when the phenotype in Tier 1 is ambiguous, consists of comprehensive Sanger sequencing of the CYP2D6 gene and/or CYP2D7::CYP2D6 and CYP2D6::CYP2D7 hybrid genes. For additional clinical information, see Cytochrome P450 2D6 (CYP2D6) Comprehensive Cascade (test ID 2D6Q).

For additional information on star allele nomenclature, please see the Pharmacogene Variation Consortium website (www.pharmvar.org). Please contact the laboratory at 1–800–533–1710 for further information about pharmacogenomic testing.

CAUTIONS:

CLINICAL CORRELATIONS

This test is not designed to provide specific dosing recommendations and is to be used only as an aid to clinical decision making. Drug-label guidance should be used when dosing patients with medications, regardless of the predicted phenotype. Test results should be interpreted in the context of clinical findings, family history, and other laboratory data.

TECHNICAL LIMITATIONS

Pharmacological phenotype prediction and interpretation is based on the limited dataset of the specific variants/alleles

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interrogated. This test will not detect all variants that may cause abnormal drug metabolism or drug response. Rare variants may be present that could lead to false negative or positive results. If results obtained do not match the clinical findings (phenotype), additional testing should be considered. Assignment of a *1 allele indicates that none of the alleles of interest were detected, but does not rule out the presence of other variants in the gene. For additional information regarding the standard Human Genome Variation Society (HGVS) nomenclature associated with these variants, please see the Mayo Clinic Laboratories test catalog for this test.

The methods used to genotype may not identify the precise configuration of variants or alleles (in the case of CYP2D6) on a patient's chromosomes; therefore, this lab will report the most likely diplotype based upon reported or observed frequencies. Note that this ambiguity can be clarified by family studies, if desired. Samples may contain donor DNA if obtained from patients who received non-leukoreduced blood transfusions or allogeneic hematopoietic stem cell transplantation. Results from samples obtained under these circumstances may not accurately reflect the recipient's genotype. For individuals who have received blood transfusions, the genotype usually reverts to that of the recipient within 6 weeks. For individuals who have received allogeneic hematopoietic stem cell transplantation, a pre-transplant DNA specimen is recommended for testing. Pharmacogenetic test results in patients who have undergone liver transplantation may not accurately reflect the patient's drug metabolism status.

Reviewed by MCR

Ann Marie Moyer, M.D., Ph.D.

Received: 15 Apr 2025 10:49 **Reported:** 21 Apr 2025 15:04

Laboratory Notes

1 This test was developed and its performance characteristics determined by Mayo Clinic in a manner consistent with CLIA requirements. This test has not been cleared or approved by the U.S. Food and Drug Administration.

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