FirmaLab™
Bio-Diagnostics

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Patient Name
John Doe

DOB	Gender	Ethnicity
12/11/1954	M	American

Test Ordered	Test Result	Expected (Negative) Value
CYP2C19 Genotype	**Extensive Metabolizer**	Extensive Metabolizer
Result Interpretation: CYP2C19 Extensive Metabolizer (EM): This result is consistent with the normal enzyme activity. Generally, standard dosing of CYP2C19 metabolized medications can be used if no other factors are expected to alter metabolism. Common medications metabolized by CYP2C19 and additional information are attached. See additional information attached.		
CYP2C9 Genotype	**Extensive Metabolizer**	Extensive Metabolizer
Result Interpretation: CYP2C9 Extensive Metabolizer (EM): This result is consistent with the normal enzyme activity. Generally, standard dosing of CYP2C9 metabolized medications can be used if no other factors are expected to alter metabolism. Common medications metabolized by CYP2C9 and additional information are attached. See additional information attached.		
CYP2D6 Genotype	**Extensive Metabolizer**	Extensive Metabolizer
Result Interpretation: CYP2D6 Extensive Metabolizer (EM): This result is consistent with the normal enzyme activity. Generally, standard dosing of CYP2D6 metabolized medications can be used if no other factors are expected to alter metabolism. Common medications metabolized by CYP2D6 and additional information are attached. See additional information attached.		

Electronically signed by: Daniel Darvish, MD, on 12/08/2016 14:35
Report Type: Complete

Specimen ID	Specimen Type	Collection Date Time	Date Received	Report Date
1200507	Buccal Swab	11/30/2016 10:45	12/01/2016 10:00	12/08/2016 13:56

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CYP2C19

The CYP2C19 gene encodes for the metabolic enzyme of Cytochrome P450, family 2, subfamily C, polypeptide 19. Below tables include some of the clinically relevant examples of substrates, inhibitors, and inducers of CYP2C19.

SUBSTRATES

Antidepressants:	**Antiepileptics:**	**Proton-pump inhibitors:**
amitriptyline	diazepam	lansoprazole
citalopram	mephenytoin	omeprazole
clomipramine	nordazepam	pantoprazole
fluvoxamine	phenobarbitone	rabeprazole (E3810)
fluoxetine	phenytoin	esomeprazole
imipramine	primidone	
moclobemide	S-mephenytoin	
sertraline		
venlafaxine		

Others:		
carisoprodol (Soma) **	R-mephobarbital	proguanil
clopidogrel (Plavix) **	nelfinavir	propranolol
cyclophosphamide	nilutamide	teniposide
hexobarbital	progesterone	R-warfarin
indomethacin		

** **Prodrug** that is converted to active form or active intermediate

INHIBITORS & DEGREE OF INHIBITION

fluvoxamine +++	indomethacin ++	probenicid ++
ketoconazole +++	lansoprazole ++	ticlopidine ++
cimetidine ++	omeprazole ++	

+++ **Strong** inhibitor may cause more than 80% decrease in metabolism.
++ **Moderate** inhibitor may cause 50-80% decrease in metabolism.
\+ **Weak** inhibitor may cause 20-50% decrease in metabolism.

INDUCERS

carbamazepine	prednisone	artemisinin
norethindrone	rifampin	

For a more comprehensive list of drug substrate, inducers, and inhibitors, please consult your local pharmacist.

Ultra-rapid or poor metabolizers may benefit from change to other comparable drugs and/or increasing/decreasing doses of current drugs. Carriers of variant alleles exhibit a reduced capacity to produce the active metabolite of ***clopidogrel***, and are at increased risk of adverse cardiovascular events, consider ***prasugrel*** as alternative.

Prodrugs are usually converted to active form by the enzyme, and ultra-rapid metabolizer may be higher at risk of overdose/toxicity.

Inhibitors and inducers should also be considered in determining appropriate treatment course and monitoring response. Inhibitors can decrease the enzyme metabolic rate, and inducers can increase it.

Although DNA testing is highly accurate, it may not predict the effective overall metabolic rate of a patient. Other factors that can alter the rate of metabolism include liver and kidney function, drug-drug and drug-food interactions, smoking, age, gender, race, and/or variations in other genes. The genetic test results can provide adjunctive information to support a more effective and safer treatment decision.

METHOD OF ANALYSIS: DNA is isolated from the *sample* and tested for the variations listed above. Specific regions of the gene are analyzed by Sanger based sequencing. Borderline results are confirmed by repeat sequencing. The assay will test only the variations ordered, alleles *1-8, and 17. This assay was developed and its performance characteristic determined by FirmaLab. It has not been cleared or approved by the U.S. Food and Drug Administration (FDA), or the FDA has determined that such clearance of approval is not needed. The laboratory is accredited by College of American Pathologists (CAP), and regulated by the Clinical Laboratory Improvement Amendments (CLIA) as qualified to perform high complexity molecular testing.

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CYP2C9

The CYP2C9 gene encodes for the metabolic enzyme of Cytochrome P450, family 2, subfamily C, polypeptide 9. Below tables include some of the clinically relevant examples of substrates, inhibitors, and inducers of CYP2C9.

SUBSTRATES

Angiotensin II Blockers: irbesartan losartan	**NSAIDs:** celecoxib ** diclofenac ** ibuprofen meloxicam naproxen piroxicam suprofen	**Others:** fluvastatin ** phenytoin ** rosuvastatin ** sulfamethoxazole tamoxifen ** torsemide
Anticoagulants: acenocoumarol phenprocoumone S-warfarin		
Antidepressants: amitriptyline fluoxetine R-norfluoxetine	**Oral Hypoglycemic/Sulfonylurea Agents:** glimepiride glipizide glybenclamide glyburide	 nateglinide rosiglitazone tolbutamide

** **Prodrug** that is converted to active form or active intermediate

INHIBITORS & DEGREE OF INHIBITION

fluvastatin	+++	probenicid	+
sulfaphenazole	+++	teniposide	+
isoniazid	++	desmethylsertraline	<+
sulfamethoxacole	++	paroxetine	<+
amiodarone	+	sertraline	<+
fluconazole	+	S-norfluoxetine	<+
fluvoxamine	+	zafirlukast	<+
phenylbutazone	+		

+++ **Strong** inhibitor may cause more than 80% decrease in metabolism.
++ **Moderate** inhibitor may cause 50-80% decrease in metabolism.
+ **Weak** inhibitor may cause 20-50% decrease in metabolism.

INDUCERS

Phenobarbital	rifampin	secobarbital

For a more comprehensive list of drug substrate, inducers, and inhibitors, please consult your local pharmacist.

Ultra-rapid or poor metabolizers may benefit from change to other comparable drugs and/or increasing/decreasing doses of current drugs.

Prodrugs are usually converted to active form by the enzyme, and ultra-rapid metabolizer may be higher at risk of overdose/toxicity.

Inhibitors and inducers should also be considered while determining appropriate treatment course and monitoring response. Inhibitors can decrease the enzyme metabolic rate, and inducers can increase it.

Although DNA testing is highly accurate, it may not predict the effective overall metabolic rate of a patient. Other factors that can alter the rate of metabolism include liver and kidney function, drug-drug and drug-food interactions, smoking, age, gender, race, and/or variations in other genes. The genetic test results can provide adjunctive information to support a more effective and safer treatment decision.

METHOD OF ANALYSIS: DNA is isolated from the *sample* and tested for the variations listed above. Specific regions of the gene are analyzed by Sanger based sequencing. Borderline results are confirmed by repeat sequencing. The assay will test only the variations ordered, including alleles *1 (extensive metabolizer) and *2-6 (intermediate and poor metabolizers). This assay was developed and its performance characteristic determined by FirmaLab. It has not been cleared or approved by the U.S. Food and Drug Administration (FDA), or the FDA has determined that such clearance of approval is not needed. The laboratory is accredited by College of American Pathologists (CAP), and regulated by the Clinical Laboratory Improvement Amendments (CLIA) as qualified to perform high complexity molecular testing.

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CYP2D6

The CYP2D6 gene encodes for the metabolic enzyme of Cytochrome P450, family 2, subfamily D, polypeptide 6. Below tables include some of the clinically relevant examples of substrates, inhibitors, and inducers of CYP2D6.

SUBSTRATES

Antidepressants:	**Cardiac & Antihypertensives:**	
amitriptyline	alprenolol	flecainide
clomipramine	carvedilol	s-metoprolol
desipramine	bufuralol	mexiletine
duloxetine	debrisoquine	propafenone
fluoxetine	diltiazem	metoprolol
fluvoxamine	disopyramide	propranolol
imipramine	encainide	timolol
doxepine		
minaprine		
nortriptyline	**Opioids:**	**Chemotherapeutics:**
praxetine	codeine **	tamoxifen **
venlafaxine	methadone	

Antipsychotics:	**Other Examples:**	
aripiprazole	amphetamine	metoclopramide
chlorpromazine	atomoxetine	methoxyamphetamine
haloperidol	chlorpheniramine	ondansetron
perphenazine	dexfenfluramine	oxycodone **
risperidone	dextromethorphan	perhexilene
t-thioridazine	felbamate	phenacetin
zuclopenthixol	hydrocodone**	phenfromin
clozapine	lidocaine	sparteine
olanzapine	mephobarbital	tramadol**

** **Prodrug** that is converted to active form or active intermediate

INHIBITORS & DEGREE OF INHIBITION

cimetidine +++	celecoxib ++	metoclopramide ++
cocaine +++	citalopram ++	methadone ++
fluoxetine +++	clomipramine ++	moclobemide ++
paroxetine +++	desethylamiodarone ++	ritonavir ++
perphenazine +++	desmethylcitalopram ++	sertraline ++
quinidine +++	duloxetine ++	tripelennamide ++
tegaserod +++	escitalopram ++	buproprion +
amiodarone ++	halofantrine ++	chlorpromazine +
biperiden ++	levomepromazine ++	chlorpheniramine +

+++ **Strong** inhibitor may cause more than 80% decrease in metabolism.
++ **Moderate** inhibitor may cause 50-80% decrease in metabolism.
+ **Weak** inhibitor may cause 20-50% decrease in metabolism.

INDUCERS

dexamethasone	rifampin

For a more comprehensive list of drug substrate, inducers, and inhibitors, please consult your local pharmacist.

Ultra-rapid (UM) and poor metabolizers (PM) may benefit from change to other comparable drugs and/or adjusting doses of current drugs.

Prodrugs are usually converted to active form by the enzyme, and ultra-rapid metabolizers (UM) are at higher risk of overdose/toxicity. In UM, cases of life-threatening toxicity have been reported with the prodrugs ***tramadol*** and ***codeine***.

Inhibitors and inducers should also be considered in determining appropriate treatment course and monitoring response. Inhibitors can decrease the metabolic rate, and inducers can increase it.

Although DNA testing is highly accurate, it may not predict the effective overall metabolic rate of a patient. Other factors that can alter the rate of metabolism include liver/kidney dysfunction, smoking, drug/diet interactions, age, gender, race, and/or variations in other genes. The genetic test results can provide adjunctive information in the support of more effective and safer treatment decisions.

METHOD OF ANALYSIS: DNA is isolated from the *sample* and tested for the variations listed above Specific regions of the gene are analyzed by Sanger based sequencing. Borderline results are confirmed by repeat sequencing. The assay will test only the variations ordered, alleles *1-12, 14, 15, 17, 41, and gene duplication. This assay was developed and its performance characteristic determined by FirmaLab. It has not been cleared or approved by the U.S. Food and Drug Administration (FDA), or the FDA has determined that such clearance of approval is not needed. The laboratory is accredited by College of American Pathologists (CAP), and regulated by the Clinical Laboratory Improvement Amendments (CLIA) as qualified to perform high complexity molecular testing.

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