

What are genes?

Genes are pieces of DNA that have the instructions needed to make our bodies work. DNA stores these instructions in the form of a code. This is the code that you inherit from your parents and that you pass on to your children.

What is pharmacogenomics?

Pharmacogenomics (pharm-a-co-gen-o-mics) is the study of how genes affect the way the body processes, or metabolizes, medicines. It is well-known that the same medicine can work in one person, but not in another. There can be negative side effects in one person, but not in another. Scientists have developed some genetic tests that can help predict who will respond differently to certain medicines. In the future, there will be more of these tests available. The goal of pharmacogenomics is to use genetic information to help make sure patients are prescribed the best medicine for them from the beginning of treatment. This will hopefully prevent or reduce side effects and poor response to medicines.

Why did your doctor order *CYP2C19* testing?


Plavix® (generic name: clopidogrel) is a medicine that prevents blood cells from sticking together and forming a harmful clot. Studies have shown that certain genetic changes in the *CYP2C19* (pronounced "SIP-2-see-19") gene can make clopidogrel not work as well in some people. As a result, they are not protected as well from heart attack and stroke while taking clopidogrel. Knowing if you have these genetic changes in the *CYP2C19* gene may help your doctor decide which medicine and dose is the best for you.

What is your result?

Normal Metabolizer

The test did not find any genetic changes known to affect how *CYP2C19* works. Your predicted response to clopidogrel is normal. Your doctor may choose to give you standard dose clopidogrel.


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 <p>UNIVERSITY of MARYLAND SCHOOL OF MEDICINE</p> <p>Program for Personalized and Genomic Medicine (PPGM) Phone: (410) 706-6140</p> <p style="text-align: center;"><i>CYP2C19</i> Genotyping</p> <p>Name: _____ DOB: _____</p> <p>Test date: _____ <i>CYP2C19</i> Genotype: *1/*1</p> <p style="text-align: center; border: 2px solid red;">Predicted Normal Responder to Clopidogrel</p> <p>Testing performed at Translational Genomics Laboratory (TGL) (410) 706-3339</p>	Fold Here	<p style="text-align: center;"><i>Always speak to a health care provider before starting or stopping any medication</i></p> <p style="text-align: center; background-color: yellow;">Normal Metabolizer</p> <p>Drugs affected by <i>CYP2C19</i> metabolism:</p> <ul style="list-style-type: none">• Clopidogrel/Plavix• Tricyclic antidepressants (amitriptyline, clomipramine, doxepin, imipramine, trimipramine)• Selective serotonin reuptake inhibitors (sertraline, citalopram, escitalopram)• Voriconazole/Vfend
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Intermediate Metabolizer

You are predicted to have a decreased response to clopidogrel. You may have decreased protection from heart attack and stroke while taking clopidogrel. Your doctor may choose to change your medicine based on your genetic information.


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 <p>Program for Personalized and Genomic Medicine (PPGM) Phone: (410) 706-6140</p> <p>CYP2C19 Genotyping</p> <p>Name: _____ DOB: _____</p> <p>Test date: _____ CYP2C19 Genotype: <u>*/*</u></p> <p>Predicted Intermediate Responder to Clopidogrel</p> <p>Testing performed at Translational Genomics Laboratory (TGL) (410) 706-3339</p>	<p><i>Always speak to a health care provider before starting or stopping any medication</i></p> <p>Intermediate Metabolizer (recommendations will vary depending on drug)</p> <p>Drugs affected by CYP2C19 metabolism:</p> <ul style="list-style-type: none"> • Clopidogrel/Plavix • Tricyclic antidepressants (amitriptyline, clomipramine, doxepin, imipramine, trimipramine) • Selective serotonin reuptake inhibitors (sertraline, citalopram, escitalopram) • Voriconazole/Vfend
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Poor Metabolizer

You are predicted to not respond to clopidogrel. You may have decreased protection from heart attack and stroke while taking clopidogrel. Your doctor may choose to change your medicine based on your genetic information.


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 <p>Program for Personalized and Genomic Medicine (PPGM) Phone: (410) 706-6140</p> <p>CYP2C19 Genotyping</p> <p>Name: _____ DOB: _____</p> <p>Test date: _____ CYP2C19 Genotype: <u>*/*</u></p> <p>Predicted Poor Responder to Clopidogrel</p> <p>Testing performed at Translational Genomics Laboratory (TGL) (410) 706-3339</p>	<p><i>Always speak to a health care provider before starting or stopping any medication</i></p> <p>Poor Metabolizer (recommendations will vary depending on drug)</p> <p>Drugs affected by CYP2C19 metabolism:</p> <ul style="list-style-type: none"> • Clopidogrel/Plavix • Tricyclic antidepressants (amitriptyline, clomipramine, doxepin, imipramine, trimipramine) • Selective serotonin reuptake inhibitors (sertraline, citalopram, escitalopram) • Voriconazole/Vfend
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Rapid Metabolizer

You are predicted to have a normal or increased response to clopidogrel. You may be at higher risk for bleeding while taking clopidogrel. Your doctor may choose to give you standard dose clopidogrel.

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 <p>UNIVERSITY of MARYLAND SCHOOL OF MEDICINE</p>	Program for Personalized and Genomic Medicine (PPGM) Phone: (410) 706-6140	CYP2C19 Genotyping	
		Name: _____ DOB: _____	Test date: _____ CYP2C19 Genotype: *1 / *17
		Predicted Normal or Enhanced Responder to Clopidogrel	
Testing performed at Translational Genomics Laboratory (TGL) (410) 706-3339			


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Always speak to a health care provider before starting or stopping any medication
Rapid Metabolizer (recommendations will vary depending on drug)
Drugs affected by CYP2C19 metabolism: <ul style="list-style-type: none">• Clopidogrel/Plavix• Tricyclic antidepressants (amitriptyline, clomipramine, doxepin, imipramine, trimipramine)• Selective serotonin reuptake inhibitors (sertraline, citalopram, escitalopram)• Voriconazole/Vfend

Ultra-rapid Metabolizer

You are predicted to have a normal or increased response to clopidogrel. You may be at higher risk for bleeding while taking clopidogrel. Your doctor may choose to give you standard dose clopidogrel.

Wallet Card- Cut Here

 <p>UNIVERSITY of MARYLAND SCHOOL OF MEDICINE</p>	Program for Personalized and Genomic Medicine (PPGM) Phone: (410) 706-6140	CYP2C19 Genotyping	
		Name: _____ DOB: _____	Test date: _____ CYP2C19 Genotype: *17 / *17
		Predicted Normal or Enhanced Responder to Clopidogrel	
Testing performed at Translational Genomics Laboratory (TGL) (410) 706-3339			

Fold Here

Always speak to a health care provider before starting or stopping any medication
Ultra-Rapid Metabolizer (recommendations will vary depending on drug)
Drugs affected by CYP2C19 metabolism: <ul style="list-style-type: none">• Clopidogrel/Plavix• Tricyclic antidepressants (amitriptyline, clomipramine, doxepin, imipramine, trimipramine)• Selective serotonin reuptake inhibitors (sertraline, citalopram, escitalopram)• Voriconazole/Vfend

Limitations of testing

Genes are just one of the things that can affect how someone responds to clopidogrel. Having type 2 diabetes, kidney failure or taking certain other drugs at the same time as clopidogrel are some of the other factors that can also change how well the drug will work for you. Your doctor will consider all of these factors when deciding on the best treatment for you.

Additionally, this test only looked at the most common changes in *CYP2C19*. Other unknown changes in the gene may change the way clopidogrel is processed in the body. Therefore, a “normal” result does not guarantee that your body will respond to clopidogrel.

How will these results affect your medical care?

CYP2C19 genotype results can affect choice or dosing of multiple medications (see wallet card). If *CYP2C19* test results predict that you are an intermediate or poor metabolizer of clopidogrel, your doctor may recommend that you take a different medicine. If you are prescribed

clopidogrel, YOU SHOULD NOT STOP TAKING IT OR CHANGE YOUR DOSE unless told to do so by your doctor.

Who can you contact if you have questions about the test?

Your test results will be stored in your electronic health record and in MyPortfolio, the University of Maryland's electronic health record patient portal. You can also contact UMMC's medical records department or the Translational Genomics Laboratory to request a hard copy of your results. We encourage you to discuss these results with your cardiologist and other doctors.

Check out the following websites for more information on pharmacogenomics:

<http://ghr.nlm.nih.gov/handbook/genomicresearch/pharmacogenomics>

http://www.nigms.nih.gov/Research/SpecificAreas/PGRN/Background/pages/pgrn_faq.aspx

<http://medschool.umaryland.edu/genetics/CYP2C19.asp>