Silent Epidemic

- Each day, 46 people die from an overdose of prescription painkillers in the U.S.
- 2.1 million Americans have a substance abuse disorder involving prescription opioids.
- Abuse of prescription pain relievers by pregnant women increased by almost 300 percent in the United States between 2000 and 2009.

What is Pharmacogenomics

Pharmacogenomics is the study of your unique genetic makeup and how it influences drug effectiveness in order to personalize a patient’s drug therapy. Currently, medications are prescribed based on the patient’s weight, height, gender, condition, and previous drug history resulting in trial and error.

There are many pathways in our body that metabolize drugs and even a small variation in our genetics can contribute to an adverse drug reaction. These risks can be significantly minimized through Pharmacogenomic testing.

Risk Factors and Benefits

Many factors contribute to the likelihood of an adverse drug reaction including:

- Simultaneous use of multiple drugs
- Very young or old age
- Pregnancy and breast feeding
- Hereditary factors

Some of the benefits of Pharmacogenomics are:

- Improved standard of care
- Decrease in the overall cost of health care
- Advanced screening for disease
- Accurate methods of determining drug dosages
- More effective medications

Did you know?...

Migraines are a serious, potentially life-threatening neurological disease that affects nearly 36 million Americans, the majority of whom are women.

The American Migraine Foundation estimates that one in every four American households has at least one member suffering from migraines.

Many migraine medications are ineffective for some patients. Pharmacogenomics testing insures the right medication for your body.
Factors affecting how we metabolize drugs

- Age
- Gender
- Ethnic differences
- Genetic variation
- Diet
- Hormone balance
- Impaired liver
- Kidney function
- Drug to Drug interactions

You are a candidate for Pharmacogenomics Testing if:

- You take one or more medications
- You take pain medications
- You are a patient taking medications to reduce the risk of developing blood clots
- You are taking cardiovascular medications
- You are a person taking certain medications to treat psychiatric or neurological disorders

Variability is the law of Life

Our genetic makeup is complex, not only does it determine our physical attributes but also how we live, breathe, and interact with all of the chemical compounds needed for life. Your genetic factors can account for 20 to 90 percent of variability in how each person responds to drugs.

As our genetics determine our eye and hair color, they also determine how our body metabolizes drugs. Aeon’s Pharmacogenomics test will analyze your DNA to see if the prescribed medications you are taking are safe and effective for you, as well as identifying alternatives that may work better for you.

Same diagnosis, Same medications, Different results

People respond differently to medications. The range of responses is due to genetic changes, or variants. After a simple buccal swab test, you can be given doses of medications that are tailored to your genetic profile.

The Range of Responses

- Most people metabolize drugs quickly. Doses need to be high enough to treat their condition effectively.
- Others metabolize the drug slowly and need lower doses to avoid toxic side effects of the drug.
- A small portion of people metabolize the drug poorly. They have a higher chance to have serious side effects.
Unexpected or dangerous reactions caused by an administered drug is an adverse drug reaction.

Adverse drug reactions are the 4th leading cause of death in America. According to the Federal Drug Administration, about 4.5 million Americans visit their doctor’s office or the emergency room every year because of adverse side effects related to prescription medications.

The use of prescription medications has increased at a steady rate over the last decade. Researchers at The Mayo Clinic and Olmsted Medical Center have shown that nearly 70 percent of Americans are taking at least one prescription drug, and more than half take two. The associated drug interactions between these medications are not always properly identified when prescribed, nor is the way each patient metabolizes each drug.

Taking action - Preventing adverse drug reactions

Pharmacogenomic testing is rapidly being adopted among clinicians as a valuable diagnostic tool to enhance drug safety. This brand of personalized medicine determines optimal patient outcomes by giving your physician the ability to Prescribe With Confidence®.
Stories of Adverse Drug Reactions

**Janet - Adverse Reaction to Levaquin®**
- Exercises Regularly
- Eats Healthy
- Routine Physicals

Recalling her lowest moment within the last six years, 33 year-old Janet said on Friday that she was in pain for a week since taking the antibiotic Levaquin®. She took the medication for a simple urinary tract infection, like thousands of others.

With a Pharmacogenomics test the doctor realized that she experienced a drug interaction between Levaquin® and her Albuterol inhaler. Her doctor put her on a different antibiotic and within a few days she experienced no symptoms at all.

**Derrick - Adverse Reaction to Plavix®**
- Lifts Weights Regularly
- Healthy Heart
- Family Has a History of Heart Problems in Men

Derrick was concerned that his father and grandfather had their first heart attacks at age 45. Derrick went to his doctor and was prescribed Plavix to treat his thrombosis. Two years later he suffered a blood clot to the lungs.

The doctor did a Pharmacogenomics test that confirmed he was a rapid metabolizer of Plavix®. A test beforehand would have saved him from a life threatening blood clot.

**Christine - Adverse Reaction to Oxycontin**
- Suffered a Car Accident in College, Now Has Severe Back Pain
- No Other Health Problems

Christine has had chronic back pain since her car accident. Recently her Vicodin quit working because her body got used to it.

She went to the doctor and was prescribed Oxycontin. She felt pain free the first three days. However, on the fourth day she had to leave work because she was fatigued and nauseous. Shortly after, she experienced temporary paralysis.

After a Pharmacogenomics test, the doctor confirmed she was a slow metabolizer of Oxycontin and was prescribed an alternate medication.
Serious Side Effects of Medications

- Death
- Physical Debilitation
- Heart Disease
- Stroke

Common Side Effects

- Nausea
- Constipation
- Diarrhea
- Drowsiness
- Pain in Extremities
- Skin Reactions
- Dizziness
- Weight Fluctuations
- Fatigue
- Sleep Disorder

Toxicity - Is your medicine making you sick?

Drug toxicity is a common health problem that can go undetected as being the cause of symptoms such as dizziness, memory loss and fatigue. Toxicity can occur when a medication dosage is incorrect, if your ability to metabolize the drug changes due to increased age, or even from a loss of weight.

What can you do?

One way to avoid drug toxicity is to keep a detailed record of all the drugs you are taking, including over the counter medications. Bring this list to every doctor visit so that you can review it with your doctor for potential problems.

Cardiac Risk Factors

Some of the genetic markers found in Aeon’s Pharmacogenomics test indicate whether patients are genetically predisposed to an increased risk of heart disease such as thrombosis, stroke, and other cardiac related conditions. Once these risks are identified, preventative steps can be taken. This can significantly reduce the need for future invasive medical procedures and vastly improve the standard of care.

Heart Disease accounts for 1 in 7 deaths in the U.S.

Many times it takes multiple attempts to find the right cardiac medication. Pharmacogenomic testing gives guidance to your physician, decreasing the possibility of adverse reactions caused by the wrong medication choice or dosage. The genetic markers involved help your physician determine the dosing requirements, risks involved, and/or the utility of prescribing Plavix®, Warfarin, Statins, and Beta Blockers.
Drug Interactions

Five Common Food-Drug Interactions

Calcium and Antibiotics
Antibiotics, such as Tetracycline, can interact with dairy produce like milk, yogurt, and cheese. The body is then unable to effectively absorb the antibiotic as a result of the calcium content.

Vitamin K and Warfarin
Vitamin K is found in green leafy vegetables such as spinach, kale, and broccoli. Given that Warfarin works to inhibit the actions of vitamin K, patients must be counseled to avoid overconsuming these foods.

Alcohol and Stimulants
Though alcohol should be avoided with all drugs, some drugs exert more dangerous effects. Taking alcohol with stimulants, in particular, may lead the user to not realize how intoxicated they are.

Grapefruit juice and Statins
Statins, such as Lipitor® (Atorvastatin), should not be consumed with grapefruit juice, as the juice contains furanocoumarin compounds that increase the drugs potency. This may lead to a condition causing a breakdown of muscle tissue.

What is a drug-drug interaction?
Drug-drug interactions occur when a drug interacts, or interferes, with another drug. This can alter the way one or both of the drugs act in the body, or cause unexpected side effects. The drugs involved can be prescription medications, over-the-counter medicines and even vitamins and herbal products.

Are all drug-drug interactions the same?
Not all drug-drug interactions are equal. Sometimes when two drugs interact, the overall effect of one or both of the drugs may be greater than intended. For example, both aspirin and blood-thinners like Coumadin® (Warfarin) are used to protect against a heart attack - They help to prevent blood clots from forming. Using these medications together, however, may cause excessive bleeding.

Other times, the overall effect of one or both of the drugs may be less than desired. For example, certain antacids can prevent many medications (such as antibiotics, blood-thinners and heart medications) from being absorbed into the blood stream. If this happens, the medication may not work as well - or may not work at all.

Are drug-drug interactions limited to prescription medications?
No. A common misconception is that only prescription medications have the potential to interact with each other. The truth is, over-the-counter medicine may also result in drug-drug interactions when combined with prescription medications or with other over-the-counter medicine.

Source: American Pharmaceutical Association

<table>
<thead>
<tr>
<th>Drug Interaction</th>
<th>Potential Risk</th>
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</thead>
<tbody>
<tr>
<td>Fluoxetine and Phenelzine</td>
<td>Agitation, diaphoresis, tachycardia, and death</td>
</tr>
<tr>
<td>Digoxin and Quinidine</td>
<td>Nausea, vomiting, and death</td>
</tr>
<tr>
<td>Sildenafil and Isosorbide Mononitrate</td>
<td>Obesity and hypertension</td>
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<tr>
<td>Potassium Chloride and Spironolactone</td>
<td>Hyperkalemia</td>
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<tr>
<td>Clonidine and Propranolol</td>
<td>Severe hypertension and vasoconstriction</td>
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<tr>
<td>Warfarin and Diflunisal</td>
<td>GI bleeding and fatal hemorrhaging</td>
</tr>
<tr>
<td>Theophylline and Ciprofloxacin</td>
<td>Headache, dizziness, hypotension, and tachycardia</td>
</tr>
<tr>
<td>Methotrexate and Probenecid</td>
<td>Diarrhea, vomiting, and renal failure</td>
</tr>
</tbody>
</table>
Problems related to the heart, including heart attacks, congestive heart failure, lifelong heart damage and cardiomyopathy, have been linked to many prescription drugs. Source: www.drugwatch.com/side-effects/

Some antipsychotic drugs, including drugs used in Alzheimer’s treatment are linked to strokes. Source: www.alzheimers.org

Although some adverse drug reactions are not very serious, others cause death, hospitalization, or serious injury of more than 2 million people in the United States each year, including more than 100,000 fatalities. http://www.worstpills.org/public/page.cfm?op_id=4

Each year, in hospitals alone, there are 28,000 cases of life-threatening heart toxicity from adverse reactions to digoxin, the most commonly used form of digitalis (drugs that regulate the speed and strength of heart beats) in older adults. http://www.worstpills.org/public/page.cfm?op_id=5

On December 18, 2015, the Precision Medicine Initiative was adopted. This is a participant-engaged, data-driven research effort at the intersection of human biology, behavior, genetics, environment, data science, and computation aimed at developing more effective ways to improve health and treat disease.