What is Pharmacogenomics?

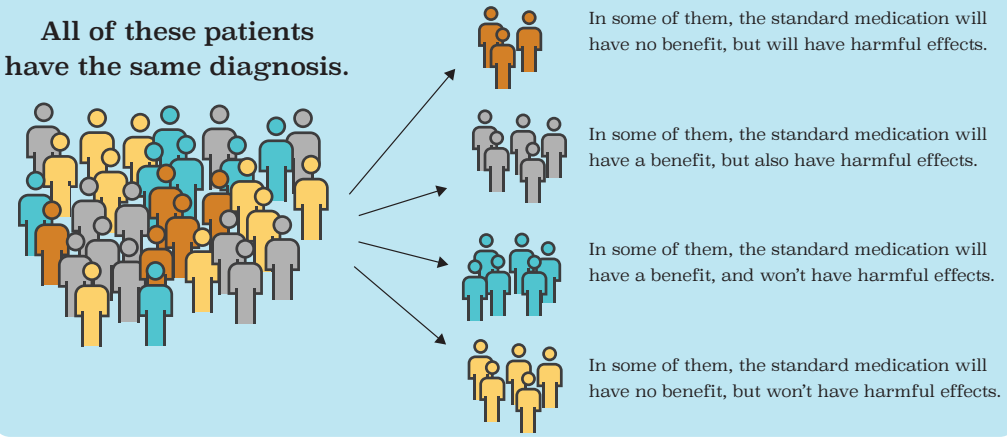
This science looks at how your unique DNA can affect how a particular medicine might work for you.

PGx looks at 3 main ways that medicine works in the body:

How medicine gets broken down in the body—a process known as **METABOLISM**

How medicine gets into the body's cells—an action called **TRANSPORT**

How cells react to medicine's signals using molecules called **RECEPTORS**



How can pharmacogenomics help individual Minnesotans?

- Use of PGx **maximizes medication effectiveness** and can **increase adherence**.
- Use of PGx can **prevent adverse drug reactions** and costly re-admissions.

Case 1.

Patricia has had depression since she was 16. She has tried several anti-depressants over her life, but they've made her feel drowsy and blurred her vision, and she hasn't stayed on any of them. Patricia's company recently transferred her to Minnesota. At her new clinic, her primary care doctor hears her history and orders a pharmacogenomic panel—which reveals that Patricia carries a genetic variant in the CYP2D6 gene, which places her at high risk of antidepressant side effects. Her doctor prescribes a medicine that isn't affected by these gene variants. A year later, Patricia is side-effect free and her depression has improved.

Case 2.

Brad recently had a heart attack. Upon discharge, he was prescribed the anti-platelet medicine clopidogrel, which prevents the formation of new blood clots in the arteries—a life-saving drug when working as intended. But four weeks after his discharge, Brad returned to the ER with a second heart attack. His doctor ordered a pharmacogenomic test that showed Brad has a gene variant in the CYP2C19 gene that reduces the efficacy of clopidogrel. He was placed on another anti-platelet drug that isn't affected by the genetic variant, and has not had any further cardiac events.

Currently, most Minnesotans do not have access to PGx-guided healthcare. This key innovation remains underused due to its slow adoption, the complexity of genetic testing, and a lack of a health workforce trained in its use. A PGx Experts Task Force is needed to evaluate the status of PGx in Minnesota and to develop informed recommendations for making PGx available statewide, while PGx Research Grants will establish evidence to support payer reimbursement and address utilization in underrepresented groups.

Approaching PGx at statewide scale will advance the health of all Minnesotans, promote health equity, reduce health disparities, and support our Minnesota institutions in research and healthcare innovation.

Current Pharmacogenomics (PGx) Bills Before the Legislature

HF81/SF248 is a bill establishing a state expert task force to assess PGx in Minnesota. This task force, on an timely issue of great importance to the public, would be accountable to the Minnesota Legislature. This bill would leverage expertise and work within the University of Minnesota in collaboration with other healthcare organizations across the state toward using this cutting-edge science to equitably improve prescription drug use and reduce health disparities throughout Minnesota.

HF82/SF215 is a bill establishing a grants program for PGx research studies on the evidence needed to support payer reimbursement; determine and validate new PGx variants in diverse populations such as Native Americans and Somali groups; determine ethical, legal, and social implications of PGx; determine technical aspects needed to protect data and privacy related to PGx; and determine the education needed for successful PGx implementation.

Children's Mental Health and PGx-Guided Care

"One of the first patients on whom I was consulted at Children's Minnesota (was) a 19-year-old female (with) a history of struggling with major depression (and) multiple hospital admissions and suicide attempts. Her list of unsuccessful medications over the preceding 8 years was long. Many of the medications caused her intolerable side effects, nausea, diarrhea, excessive sweating and hot flashes.... Additional, supportive medications were added to stabilize her mood and to help her sleep. She underwent pharmacogenomic testing and her results revealed that she had a decreased ability to break down, or metabolize, many of the medications that had caused her side effects. A new medication was selected that was metabolized differently. This new medication did not cause intolerable side effects, and she was able to take the medication as ordered. Within a few weeks, she was showing signs of improvement and eventually her psychiatrist was able to stop one of her supportive medications and greatly decrease the dose of another. Her parents were overjoyed with her response and later that year, she was able to take a full load of classes in college for the first time. She continues to do well on her current medications. **If we had been able to test her earlier, I believe we could have prevented her adverse reactions, as well as getting her on an effective medication earlier."**

—David Gregornik, Pharm.D, Pharmacogenomics Program Director at Children's Minnesota (testimony to House Committee on Higher Education Finance and Policy, 3/11/20)

"My step-son has a developmental disability that includes autism. As is true for many children with autism, he takes medications to reduce anxiety. After high school we noted a significant behavior change and medications were prescribed that were viewed as standard for the treatment of anxiety, and he was given the standard dose. His behaviors deteriorated significantly.... He lost interest in most any activity, and simply sat and stared. He was living in an apartment, but the behaviors were so bad we had to bring him back home.... This experience was ongoing for almost 2 years. Because I am a research geneticist, I asked if pharmacogenomic testing was warranted. The result of that test showed that my step-son has a genetic variation that results in very low metabolism of the drug he was on. The likely consequence was that he was not metabolizing the drug to clear it the way most people do; rather, it was likely building up to levels that were toxic to his system, and a major contributor to his deteriorating behaviors. We slowly decreased the dose and eliminated the drug, replaced it with one that was not dependent on the same liver enzyme for clearance, and all the concerning behaviors resolved. **He is now back in an apartment, with minimal staff support...and is not only a happy guy, but a productive and active member of his community.** This was a clear example of individualized assessment that **exemplifies the power of personalized, pharmacogenomic directed therapies."**

—Brian Van Ness, Ph.D., Professor, University of Minnesota

Adverse Drug Events and PGx

4 in 5 ***Four out of five patients carry at least one genetic variant that may affect safety and effectiveness for commonly prescribed medications.***

Source: Genetic variation in human drug-related genes. Genome Medicine. 2017.

Between 2009 and 2013, Minnesotans with insurance had an average of **12 pharmacy claims** and **three medical claims for prescription drugs** per year.

Source: Pharmaceutical Spending and Use in Minnesota: 2009-2013. Minnesota All Payer Claims Database Issue Brief, November 2016.

Across all commercial, Medicare and Minnesota plans, ***payers spent more than $200 million in pharmacogenomic actionable prescription drugs*** in Minnesota in 2016.

Source: Minnesota's All Payer Claims Database. [https://www.health.state.mn.us/data/apcd/publicusefiles/index.html]

Drug Companies Must Pay Hawaii $834 Million Over Failure to Warn of PGx-Related Plavix Risks

Clopidogrel (Plavix) is an inhibitor of platelet aggregation introduced to the market in 1997 as an alternative to aspirin for preventing heart attacks and stroke. In 2008, researchers reported that some patients, especially those of Asian or Pacific Islander descent, have a genetic variation that makes Plavix less effective. Between roughly 40 and 50 percent of Pacific-Islanders and 40 to 50 percent of East Asians might respond poorly to Plavix due to a genetic predisposition to poorly metabolize the drug.

In 2014, the State of Hawaii filed suit in state court against the pharmaceutical companies that produce Plavix alleging the companies knew that those with a certain genetic variation experience worse clinical outcomes when taking Plavix. The State asserted that the companies had intentionally concealed that fact in violation of Hawaii's statute prohibiting unfair or deceptive acts or practices in commerce.

On February 15, 2021, a state judge concluded the drugmakers misleadingly marketed Plavix and failed to properly warn consumers in the state about its health risks. Bristol-Myers Squibb Co. and Sanofi were ordered to pay the state of Hawaii more than $834 million as a civil penalty.

The proposed legislation (HF81/SF248 and HF82/SF215) has the support of the Minnesota Pharmacists Association (MPhA) and the Minnesota Society of Health-System Pharmacists (MSHP).