Genetics and Medication

How Your Genes Affect the Medications You Take

Mission:Cure

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Mission:Cure

Pioneering a new funding model for curing disease, starting with pancreatitis.

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PRECISION MEDICINE

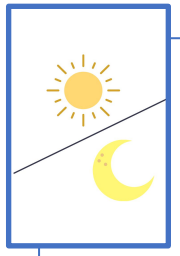
An innovative precision medicine company, transforming genetic and clinical data into new insights for the diagnosis, management and advanced therapeutic development for complex health conditions.

Have you ever taken a medication that did not work the way you expected

Have you ever wondered why your medications don't always work… why?

Wrong Dose

Most drugs started at an 'average' starting dose.



Wrong Administration

Time of day, how often a drug is taken, dosage forms, etc.

Wrong Drug

The ***best*** for you might not be what you try first.

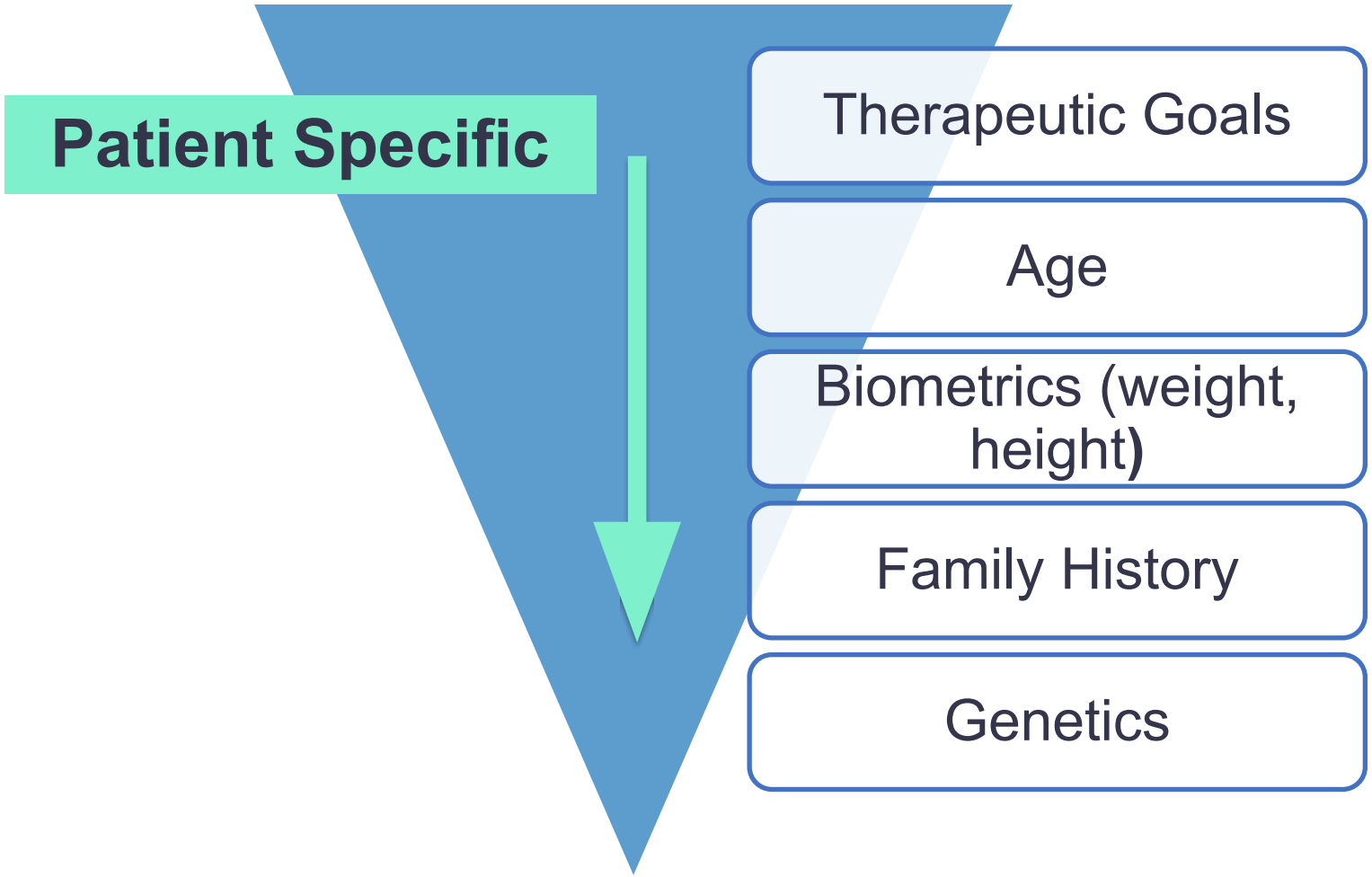
https://health.gov/our-work/health-care-quality/adverse-drug-events

What makes some medication decisions *wrong*?

- Allergies and/or sensitivities
  - Often unaware of allergies until tested or given a medication with an allergy
- Individual variations in drug metabolism?
- Individual variations in drug target?

How do prescribers make medications precise?

Choose drugs, doses, administration based on individual:



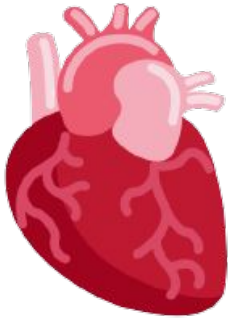
Genetics + Medications = Pharmacogenomics

- Pharmacogenomics (PGx) is a field of research that studies how a person's genes affect how he or she responds to medications

- Genetic variants can help prescribers estimate:
  - Metabolism of a medication
  - Risk for adverse effects
  - Drug actions

- Professional (CPIC) and federal (FDA) organizations help guide and regulate the appropriate use of genetic data for medication use

https://www.nigms.nih.gov/education/fact-sheets/Pages/pharmacogenomics.aspx



High Cholesterol

- Affects more than **30%** of the population of USA, common risk factor for cardiovascular disease
- Zocor (simvastatin) – commonly used for people with high cholesterol
- Side effects – toxic to muscle cells, can be as benign as minor leg cramps to a life-threatening condition
- Genetic variants in *SLCO1B1* gene can predict risk for serious muscle toxicity

https://www.cdc.gov/cholesterol/facts.htm
Ramsey LB, et al. *CPT* 2014. 10.1038/clpt.2014.125

Depression

- Affects more than **7%** of the population of USA, many take several medication trials to find the right drug
- *Metabolizer* type, predicted by genetic variations
  - Poor, Intermediate, Normal, Rapid, Ultra-Rapid
- Predict who might need higher, lower doses, or alternative drugs
- Celexa (citalopram), Effexor (venlafaxine), Brintellix (vortioxetine), tricyclic antidepressants

https://www.nimh.nih.gov/health/statistics/major-depression
Hicks JK, et al. *CPT.* 2015. 10.1002/cpt.147

Pain Management

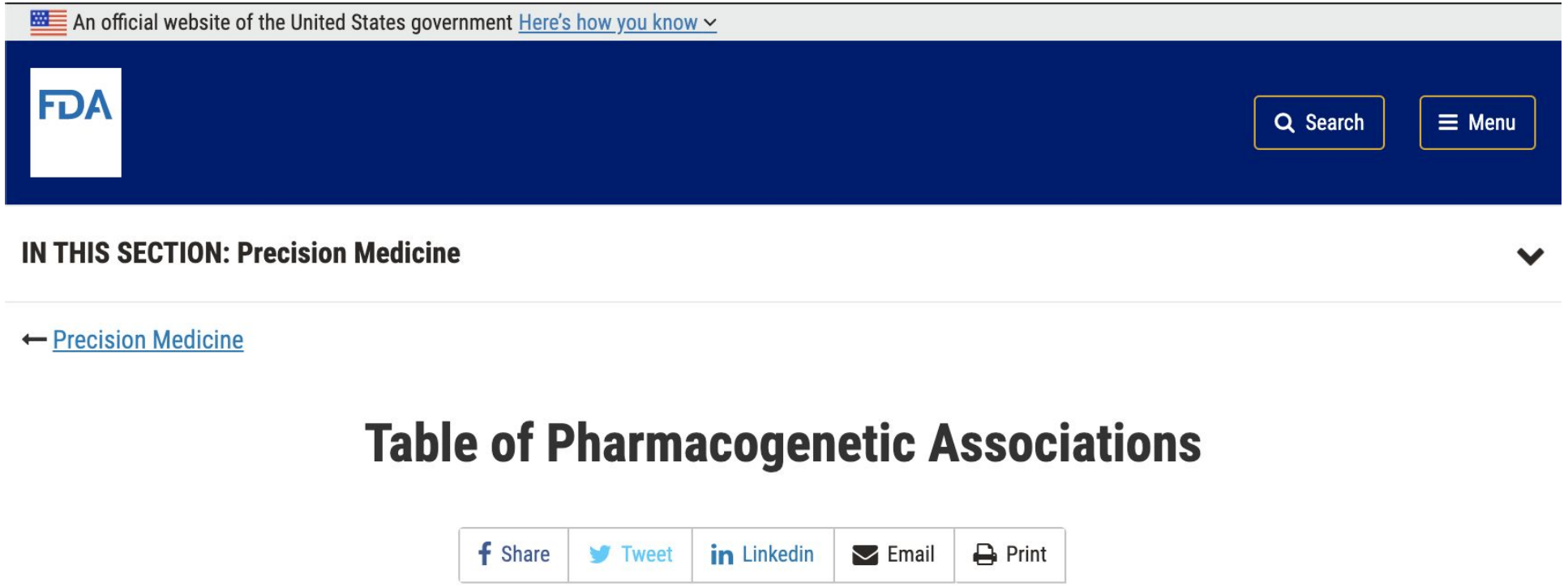
- More than **20%** of USA population suffers from chronic pain, many with high-impact chronic pain
  - Extremely significant challenge for those suffering from chronic pancreatitis

- Metabolizer type might predict who will have minor or serious side effects from opioids and non-steroidal anti-inflammatory drugs
  - Tylenol #3 (codeine), Ultram (tramadol), Olinvyk (oliceridine), Advil (ibuprofen), Celebrex (celecoxib), Mobic (meloxicam), others…

- Rapidly evolving field, likely to grow in the future

https://www.cdc.gov/mmwr/volumes/67/wr/mm6736a2.htm
Crews K, et al. *CPT* 2020. 10.1002/cpt.2149
Theken K, et al. *CPT*. 2020. 10.1002/cpt.1830

More Information and Examples from the FDA



More Information and Examples from the FDA

Section 1: Pharmacogenetic Associations for which the Data Support Therapeutic Management Recommendations

Drug	Gene	Affected Subgroups+	Description of Gene-Drug Interaction
Abacavir	HLA-B	*57:01 allele positive	Results in higher adverse reaction risk (hypersensitivity reactions). Do not use abacavir in patients positive for HLA-B*57:01.
Amifampridine	NAT2	poor metabolizers	Results in higher systemic concentrations and higher adverse reaction risk. Use lowest recommended starting dosage and monitor for adverse reactions. Refer to FDA labeling for specific dosing recommendations.
Amifampridine Phosphate	NAT2	poor metabolizers	Results in higher systemic concentrations. Use lowest recommended starting dosage (15 mg/day) and monitor for adverse reactions.
Amphetamine	CYP2D6	poor metabolizers	May affect systemic concentrations and adverse reaction risk. Consider lower starting dosage or use alternative agent.
Aripiprazole	CYP2D6	poor metabolizers	Results in higher systemic concentrations and higher adverse reaction risk. Dosage adjustment is recommended. Refer to FDA labeling for specific dosing recommendations.
Aripiprazole	CYP2D6	poor	Results in higher systemic concentrations. Dosage adjustment is

Where to get testing?

PGx exclusive tests:

- OneOme, Admera, Genomind, others

Add-on to other genetic tests:

- Ariel Precision Medicine

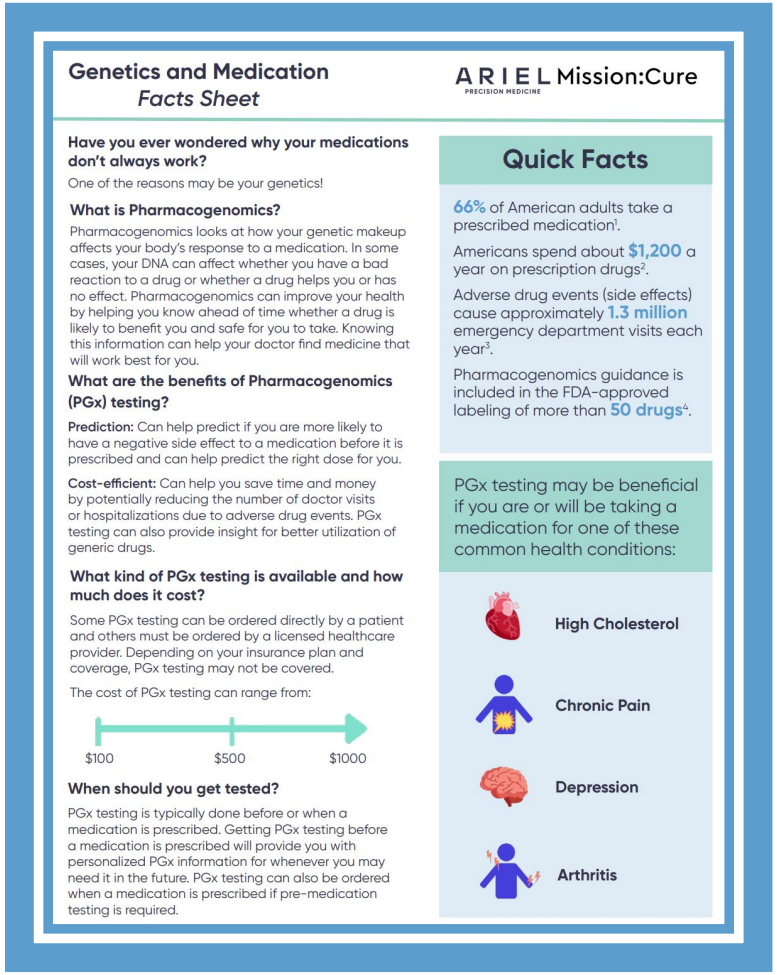
Talk to your health-care provider about your options

https://cpicpgx.org/implementation/

Webinar Takeaway: Facts Sheet/Discussion Guide

It includes:

- Key takeaways from the webinar
- Facts about PGx testing
- Some questions to ask your healthcare provider about PGx testing
- Resources



Genetics and Medication
Facts Sheet

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Have you ever wondered why your medications don't always work?

One of the reasons may be your genetics!

What is Pharmacogenomics?

Pharmacogenomics looks at how your genetic makeup affects your body's response to a medication. In some cases, your DNA can affect whether you have a bad reaction to a drug or whether a drug helps you or has no effect. Pharmacogenomics can improve your health by helping you know ahead of time whether a drug is likely to benefit you and safe for you to take. Knowing this information can help your doctor find medicine that will work best for you.

What are the benefits of Pharmacogenomics (PGx) testing?

Prediction: Can help predict if you are more likely to have a negative side effect to a medication before it is prescribed and can help predict the right dose for you.

Cost-efficient: Can help you save time and money by potentially reducing the number of doctor visits or hospitalizations due to adverse drug events. PGx testing can also provide insight for better utilization of generic drugs.

What kind of PGx testing is available and how much does it cost?

Some PGx testing can be ordered directly by a patient and others must be ordered by a licensed healthcare provider. Depending on your insurance plan and coverage, PGx testing may not be covered.

The cost of PGx testing can range from:

$100 $500 $1000

When should you get tested?

PGx testing is typically done before or when a medication is prescribed. Getting PGx testing before a medication is prescribed will provide you with personalized PGx information for whenever you may need it in the future. PGx testing can also be ordered when a medication is prescribed if pre-medication testing is required.

Quick Facts

66% of American adults take a prescribed medication[1].

Americans spend about **$1,200** a year on prescription drugs[2].

Adverse drug events (side effects) cause approximately **1.3 million** emergency department visits each year[3].

Pharmacogenomics guidance is included in the FDA-approved labeling of more than **50 drugs**[4].

PGx testing may be beneficial if you are or will be taking a medication for one of these common health conditions:

- High Cholesterol
- Chronic Pain
- Depression
- Arthritis

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