The Importance of Biomarker Testing (Pharmacogenetics) in Health Care

Interim Joint Committee on Health, Welfare and Family Services (10/26/2022)

$4.1 Trillion

U.S. spend on healthcare

$12,424

Spent annually per person (comparable country average : $5,736)[1]

35th

U.S. quality of care global ranking[2]

$10 billion

Per year spent by Kentucky on Medicaid[3]

44th

Kentucky's national healthcare ranking[4]

1 https://www.healthsystemtracker.org/chart-collection/health-spending-u-s-compare-countries2/#Health%20consumption%20expenditures%20per%20capita,%20U.S.%20dollars,%20PPP%20adjusted,%202020%20or%20nearest%20year

2 https://worldpopulationreview.com/country-rankings/healthiest-countries

3 https://kypolicy.org/a-time-to-invest-kentucky-budget-preview-2022-2024/

4 https://www.usnews.com/news/best-states/kentucky

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OUR MISSION

To empower individuals to take charge of their own healthcare destiny.

About Gravity

Gravity Diagnostics is a Covington, KY based state-of-the-art CAP-accredited and CLIA-certified laboratory licensed in all 50 states. We provide innovative diagnostic testing in the areas of toxicology, pharmacogenetics, infectious and upper respiratory diseases, blood, and COVID-19. Our clients include universities, public health organizations, small private practices, Fortune 500 companies, and more.

Pharmacogenetics (PGx)

WHAT IS PGx?

How a person's genes affect how he or she responds to medications. PGx helps doctors and clinicians select the drugs and doses best suited for each person based on their unique genetic makeup.

******Almost 3 in 5 Americans aged 20 years and above take RX drugs every month. The FDA estimates over 1 million adverse drug reactions occur each year.***

WHO IS PGx FOR?

- Those on multiple medications
- Those preparing to switch or start new medications
- Those struggling to find symptom relief
- Those who want a proactive approach to medication management

THE BENEFITS

- May lead to fewer side effects of medicines
- Removes the trial-and-error method of treatment
- High precision testing can identify a variant in a gene often missed
- Reduces frequency of ER & physician visits
- Avoids the "catastrophic miss" leading to adverse patient outcomes

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The Case for PGx

Reduce Medical Spending

- Of the 32 million Americans taking 3 or more prescription drugs, 53% are taking the wrong drug or wrong dose, resulting in 7 million preventable medication errors, 7000 preventable deaths, and $21 billion in direct annual medical costs[1]

Improve Health Outcomes

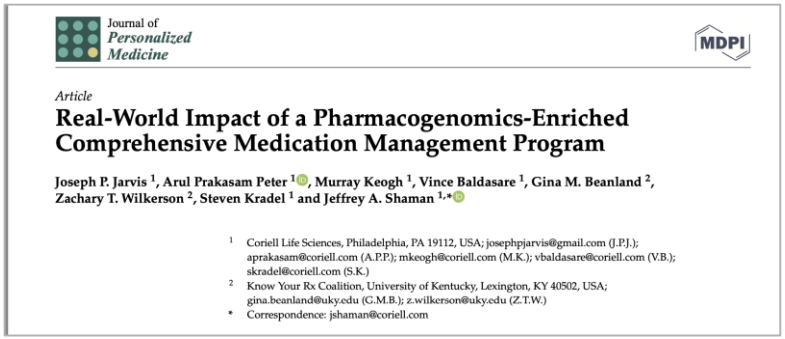
- Adverse drug reactions are the fifth leading cause of death in the US[1]
- PGx-guided therapy for behavioral health showed 40% decrease in ED visits and a cost reduction of $1948/patient[2]
- PGx-guided antiplatelet therapy showed cost avoidance of $42,198 at one year[2]

Improve Employee Satisfaction

- Missed work costs employers an estimated $225.8 billion annually, and this figure does not consider decreased productivity due to depression, pain, and chronic illness[3]

1. https://healthactioncouncil.org/Blog/January-2019-(1)/Members-Need-the-Right-Drug-at-the-Right-Dose
2. https://www.ashp.org/-/media/assets/innovation/docs/PGx-Accelerator-Value-of-PGx-Brief.pdf
3. https://www.translationalsoftware.com/blog/pgx-testing-programs-a-win-win-for-both-employers-and-employees

Supported by Evidence



Journal of *Personalized Medicine*

MDPI

Article

Real-World Impact of a Pharmacogenomics-Enriched Comprehensive Medication Management Program

Joseph P. Jarvis [1], Arul Prakasam Peter [1], Murray Keogh [1], Vince Baldasare [1], Gina M. Beanland [2], Zachary T. Wilkerson [2], Steven Kradel [1] and Jeffrey A. Shaman [1,*]

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In a 2017 study of the Kentucky Teachers Retirement System, it found ***"by deploying pharmacogenomics-enriched comprehensive medication management, the system as a whole benefitted in synergistic ways. The observed reduced costs, meaningful shifts in the patterns of patient healthcare resource utilization, as well as other encouraging trends suggest that wide-spread adoption could significantly advance the goals of the Quadruple Aim in health systems globally."***

"As healthcare focuses on value-based care, pharmacogenomics is poised to improve patient care by optimizing pharmacotherapy, mitigating risk of adverse events, and increasing patient and provider satisfaction through the practice of personalized medicine"- Cleveland Journal of Medicine

REVIEW

CME MOC

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Pharmacogenomics: An evolving clinical tool for precision medicine

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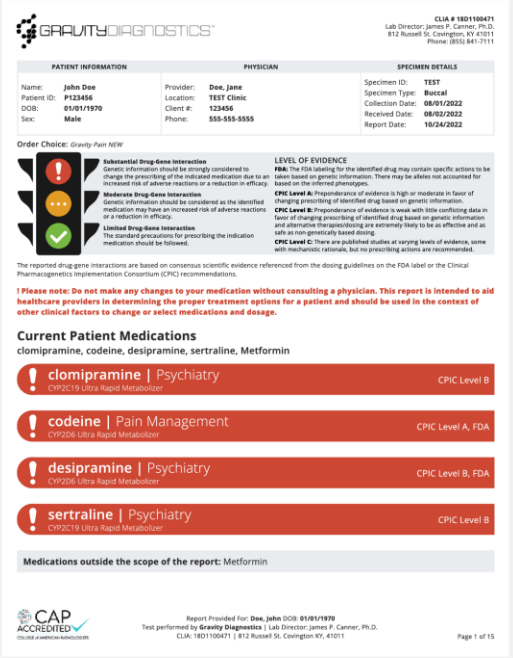
ACTIONABLE RESULTS



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PATIENT INFORMATION		PHYSICIAN		SPECIMEN DETAILS	
Name:	John Doe	Provider:	Doe, Jane	Specimen ID:	TEST
Patient ID:	P123456	Location:	TEST Clinic	Specimen Type:	Buccal
DOB:	01/01/1970	Client #:	123456	Collection Date:	08/01/2022
Sex:	Male	Phone:	555-555-5555	Received Date:	08/02/2022
				Report Date:	10/24/2022

Order Choice: *Gravity Pain NEW*

Substantial Drug-Gene Interaction
Genetic information should be strongly considered to change the prescribing of the indicated medication due to an increased risk of adverse reactions or a reduction in efficacy.

Moderate Drug-Gene Interaction
Genetic information should be considered as the identified medication may have an increased risk of adverse reactions or a reduction in efficacy.

Limited Drug-Gene Interaction
The standard precautions for prescribing the indication medication should be followed.

LEVEL OF EVIDENCE

FDA: The FDA labeling for the identified drug may contain specific actions to be taken based on genetic information. There may be alleles not accounted for based on the inferred phenotypes.

CPIC Level A: Preponderance of evidence is high or moderate in favor of changing prescribing of identified drug based on genetic information.

CPIC Level B: Preponderance of evidence is weak with little conflicting data in favor of changing prescribing of identified drug based on genetic information and alternative therapies/dosing are extremely likely to be as effective and as safe as non-genetically based dosing.

CPIC Level C: There are published studies at varying levels of evidence, some with mechanistic rationale, but no prescribing actions are recommended.

The reported drug-gene interactions are based on consensus scientific evidence referenced from the dosing guidelines on the FDA label or the Clinical Pharmacogenetics Implementation Consortium (CPIC) recommendations.

! Please note: Do not make any changes to your medication without consulting a physician. This report is intended to aid healthcare providers in determining the proper treatment options for a patient and should be used in the context of other clinical factors to change or select medications and dosage.

Current Patient Medications

clomipramine, codeine, desipramine, sertraline, Metformin

- **clomipramine** | Psychiatry — CYP2C19 Ultra Rapid Metabolizer — CPIC Level B
- **codeine** | Pain Management — CYP2D6 Ultra Rapid Metabolizer — CPIC Level A, FDA
- **desipramine** | Psychiatry — CYP2D6 Ultra Rapid Metabolizer — CPIC Level B, FDA
- **sertraline** | Psychiatry — CYP2C19 Ultra Rapid Metabolizer — CPIC Level B

Medications outside the scope of the report: Metformin

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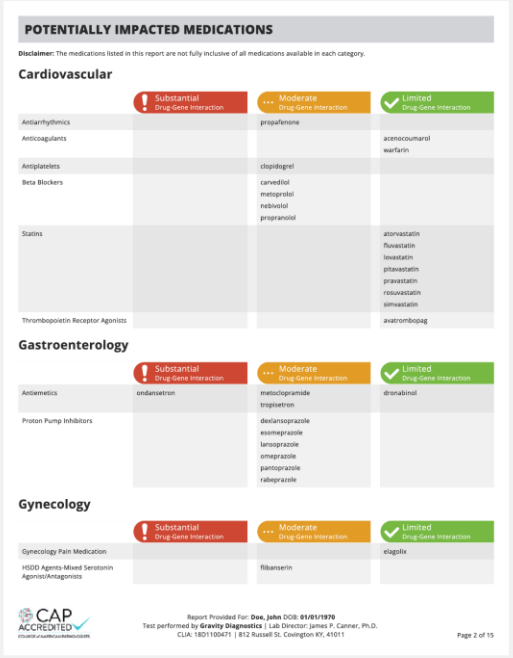

POTENTIALLY IMPACTED MEDICATIONS

Disclaimer: The medications listed in this report are not fully inclusive of all medications available in each category.

Cardiovascular

	Substantial Drug-Gene Interaction	Moderate Drug-Gene Interaction	Limited Drug-Gene Interaction
Antiarrhythmics		propafenone	
Anticoagulants			acenocoumarol warfarin
Antiplatelets		clopidogrel	
Beta Blockers		carvedilol metoprolol nebivolol propranolol	
Statins			atorvastatin fluvastatin lovastatin pitavastatin pravastatin rosuvastatin simvastatin
Thrombopoietin Receptor Agonists			avatrombopag

Gastroenterology

	Substantial Drug-Gene Interaction	Moderate Drug-Gene Interaction	Limited Drug-Gene Interaction
Antiemetics	ondansetron	metoclopramide tropisetron	dronabinol
Proton Pump Inhibitors		dexlansoprazole esomeprazole lansoprazole omeprazole pantoprazole rabeprazole	

Gynecology

	Substantial Drug-Gene Interaction	Moderate Drug-Gene Interaction	Limited Drug-Gene Interaction
Gynecology Pain Medication			elagolix
HSDD Agents-Mixed Serotonin Agonist/Antagonists		flibanserin	

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DOSING GUIDANCE

amitriptyline | Antidepressant — CPIC Level A, FDA

CYP2D6 Ultra Rapid Metabolizer

Implications: Increased metabolism of TCAs to less active compounds compared to Normal (Extensive) Metabolizers. Lower plasma concentrations of active drug will increase probability of pharmacotherapy failure.

Therapeutic Recommendations: Avoid tricyclic use due to potential lack of efficacy. Consider alternative drug not metabolized by CYP2D6. If a TCA is warranted, consider titrating to a higher target dose (compared to Normal (Extensive) Metabolizers). Utilize therapeutic drug monitoring to guide dose adjustments.

amitriptyline | Antidepressant — CPIC Level A

CYP2C19 Ultra Rapid Metabolizer

Implications: Increased metabolism of tertiary amines compared to Normal (Extensive) Metabolizers. Greater conversion of tertiary amines to secondary amines may affect response or side effects.

Therapeutic Recommendations: Avoid tertiary amine use due to potential for sub-optimal response. Consider alternative drug not metabolized by CYP2C19. TCAs without major CYP2C19 metabolism include the secondary amines nortriptyline and desipramine. If a tertiary amine is warranted, utilize therapeutic drug monitoring to guide dose adjustments.

citalopram | Antidepressant — CPIC Level A, FDA

CYP2C19 Ultra Rapid Metabolizer

Implications: Increased metabolism when compared to Normal (Extensive) Metabolizers. Lower plasma concentrations will increase probability of pharmacotherapy failure.

Therapeutic Recommendations: Consider an alternative drug not predominantly metabolized by CYP2C19.

clomipramine | Antidepressant — CPIC Level B

CYP2C19 Ultra Rapid Metabolizer

Implications: Increased metabolism of tertiary amines compared to Normal (Extensive) Metabolizers. Greater conversion of tertiary amines to secondary amines may affect response or side effects.

Therapeutic Recommendations: Avoid tertiary amine use due to potential for sub-optimal response. Consider alternative drug not metabolized by CYP2C19. TCAs without major CYP2C19 metabolism include the secondary amines nortriptyline and desipramine. If a tertiary amine is warranted, utilize therapeutic drug monitoring to guide dose adjustments.

clomipramine | Antidepressant — CPIC Level B, FDA

CYP2D6 Ultra Rapid Metabolizer

Implications: Increased metabolism of TCAs to less active compounds compared to Normal (Extensive) Metabolizers. Lower plasma concentrations of active drug will increase probability of pharmacotherapy failure.

Therapeutic Recommendations: Avoid tricyclic use due to potential lack of efficacy. Consider alternative drug not metabolized by CYP2D6. If a TCA is warranted, consider titrating to a higher target dose (compared to Normal (Extensive) Metabolizers). Utilize therapeutic drug monitoring to guide dose adjustments.

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Care. Compliance. Confidence.

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