Pharmacogenomics: personalizing medications for our patients

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CPFI 2025 Annual Conference & National Student Retreat

Pharmacogenomics BINGO!

B	I	N	G	O
nomenclature	effective	polymorphisms	personalizing	precision
ultrarapid	variant	gene	transport	function
genetic	allele	JESUS	CYP2C9	toxicity
legal	foundational	PGx	FDA	PharmGKB
clopidogrel	normal	testing	pharmacokinetics	CPIC

This is your own unique bingo card.

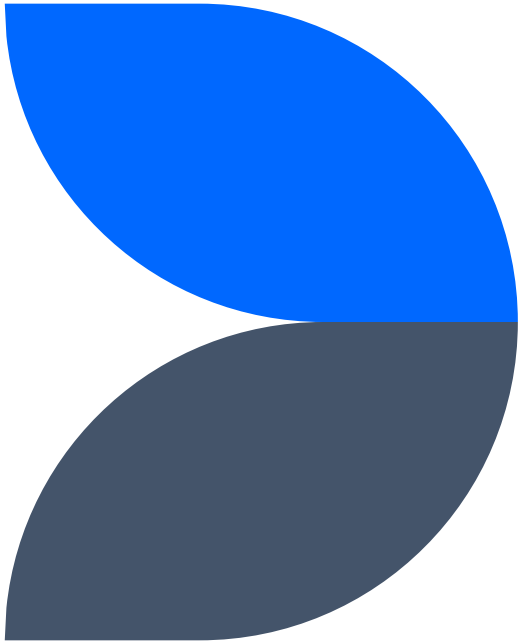
1. Click a box to mark it
2. Click a box again to unmark it
3. If you are playing this game over multiple days, bookmark this page (or email the URL to yourself), so you can get back to this card

OK

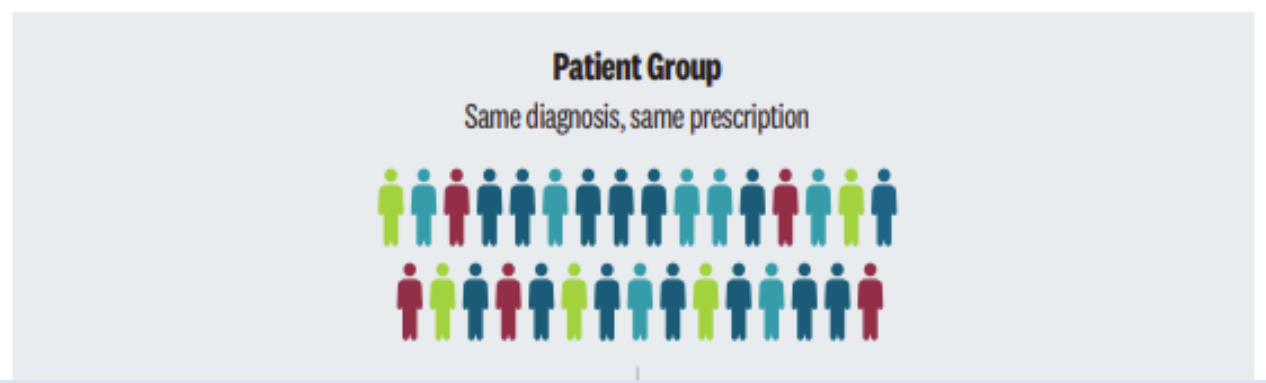
Learning Objectives

1. Explain the terms precision medicine and precision pharmacotherapy
2. Discuss ways that pharmacogenomics affects pharmacodynamics (PD) and pharmacokinetics (PK) and how it can be used to improve prescribing and outcomes
3. Categorize the Core Pharmacists Competencies in Genomics into Foundational Genetic Concepts and Clinical Pharmacogenomics Concepts
4. Given a clinical scenario, formulate an appropriate medication regimen using pharmacogenomics resources

Precision medicine and precision pharmacotherapy



One drug does not fit all



Harvard Business Review Analytic Services. White Paper 2020. Genetic Testing Brings Big Changes to the Health Care System. https://hbr.org/sponsored/2020/03/genetic-testing-brings-big-changes-to-the-health-care-system Accessed 8.5.2024

Precision medicine and pharmacotherapy

Precision Medicine

- An approach to disease treatment and prevention that takes into account individual variability in genes, environment, and lifestyle for each person

Precision Pharmacotherapy

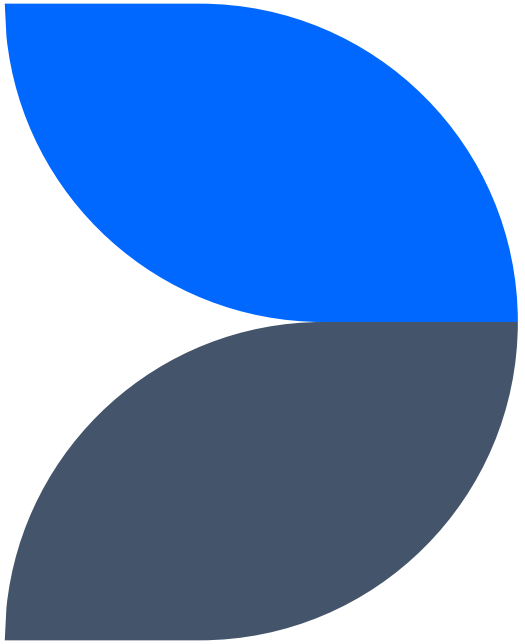
- Customize medications to subgroups of patients, categorized by shared molecular and cellular biomarkers, to improve treatment outcomes

Medication classes impacted by pharmacogenomics

- Cardiology
- Psychiatry
- Neurology
- Oncology
- Pain management
- Infectious disease
- Rheumatology
- Solid organ transplant
- Respiratory
- Immunology

Pharmacogenomics, Pharmacokinetics and Pharmacodynamics

PGx, PK, PD



What is pharmacogenomics (PGx)?

- Combines pharmacology and genomics to determine an individual's response to medications
- Can help healthcare providers better predict if a medication will be effective but not toxic for their patient
- PGx testing can reduce the risk of adverse effects by up to 30%

Pharmacogenomics Fact Sheet. Genome.gov. Published 2023. https://www.genome.gov/about-genomics/educational-resources/fact-sheets/pharmacogenomics
Apted T, Huff A. Pharmacogenomics for improved outcomes and decreased costs in health care. AJMC. Published December 15, 2023. https://www.ajmc.com/view/pharmacogenomics-for-improved-outcomes-and-decreased-costs-in-health-care

PGx, Pharmacokinetics (PK), and Pharmacodynamics (PD)

Pharmacodynamics

- Gene variants
- Adverse effects
- Receptor functions

Pharmacokinetics

- Absorption
  - Acid suppression
- Distribution
  - Bioavailability at target sites
- Metabolism
  - Metabolic rate
  - Hepatic function
  - Drug interactions
- Excretion
  - Renal function

Pharmacokinetics

Types of metabolizer	Description	Example
Ultrarapid metabolizer (UM)	Increased enzyme activity compared to rapid metabolizers	*CYP2C19 *17/*17*
Rapid metabolizer (RM)	Increased enzyme activity compared to normal metabolizers but less than ultra-rapid metabolizers	*CYP2C19 *1/*17*
Normal metabolizer (NM)	Fully functional enzyme activity	*CYP2C19 *1/*1*
Intermediate metabolizer (IM)	Decreased enzyme activity (activity between normal and poor metabolizer)	*CYP2C19 *1/*2*
Poor metabolizer (PM)	Little to no enzyme activity	*CYP2C19 *2/*2*

CPIC SOP for Assigning Allele Function – CPIC. Cpicpgx.org. Published 2025. https://cpicpgx.org/resources/cpic-draft-allele-function-sop/. Accessed April 15, 2025.

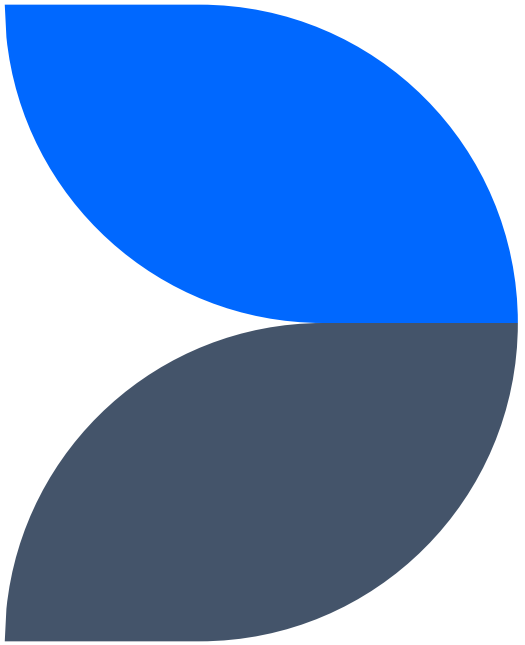
Pharmacodynamics

Transporter function	Description	Example
Increased function	Increased transport function compared to normal function	*SLCO1B1 *1/*14*
Normal function	Fully functional transporter function	*SLCO1B1 *1/*1*
Decreased function	Decreased transporter function (between normal and poor function)	*SLCO1B1 *1/*5*
Poor function	Little to no transporter function	*SLCO1B1 *5/*5*

CPIC SOP for Assigning Allele Function – CPIC. Cpicpgx.org. Published 2025. https://cpicpgx.org/resources/cpic-draft-allele-function-sop/. Accessed April 15, 2025


My face during
Our first pharmacogenomics class

Role of the Pharmacist in Pharmacogenomics



Role of the Pharmacist in PGx

- Foundational Genetic Concepts: 6
- Clinical Pharmacogenomics: 24
- Last updated 2021

Pharmacists Leading the Way to Precision Medicine: Updates to the Core Pharmacist Competencies in Genomics | American Journal of Pharmaceutical Education (ajpe.org) Accessed April 9, 2025.

Foundational Genetic Concepts

1. Explain basic genetics concepts using appropriate nomenclature
2. Recognize the 4 factors in the manifestation of disease and drug response
3. Differentiate between the clinical diagnosis of disease informed by genetics and the identification of genetic predisposition of disease
4. Assess differences in genetic testing technologies
5. Recognize the legal protections against discrimination based on genetic test results

Pharmacists Leading the Way to Precision Medicine: Updates to the Core Pharmacist Competencies in Genomics | American Journal of Pharmaceutical Education (ajpe.org) Accessed April 9, 2025.

Clinical Pharmacogenomics Concepts

1. Identify PGx test results that are relevant to a patient's care
2. Interpret PGx test results
3. Determine the impact of genetic variation on pharmacokinetics and/or pharmacodynamics
4. Understand the influence of ethnicity in genetic polymorphisms and associations of polymorphisms with drug response

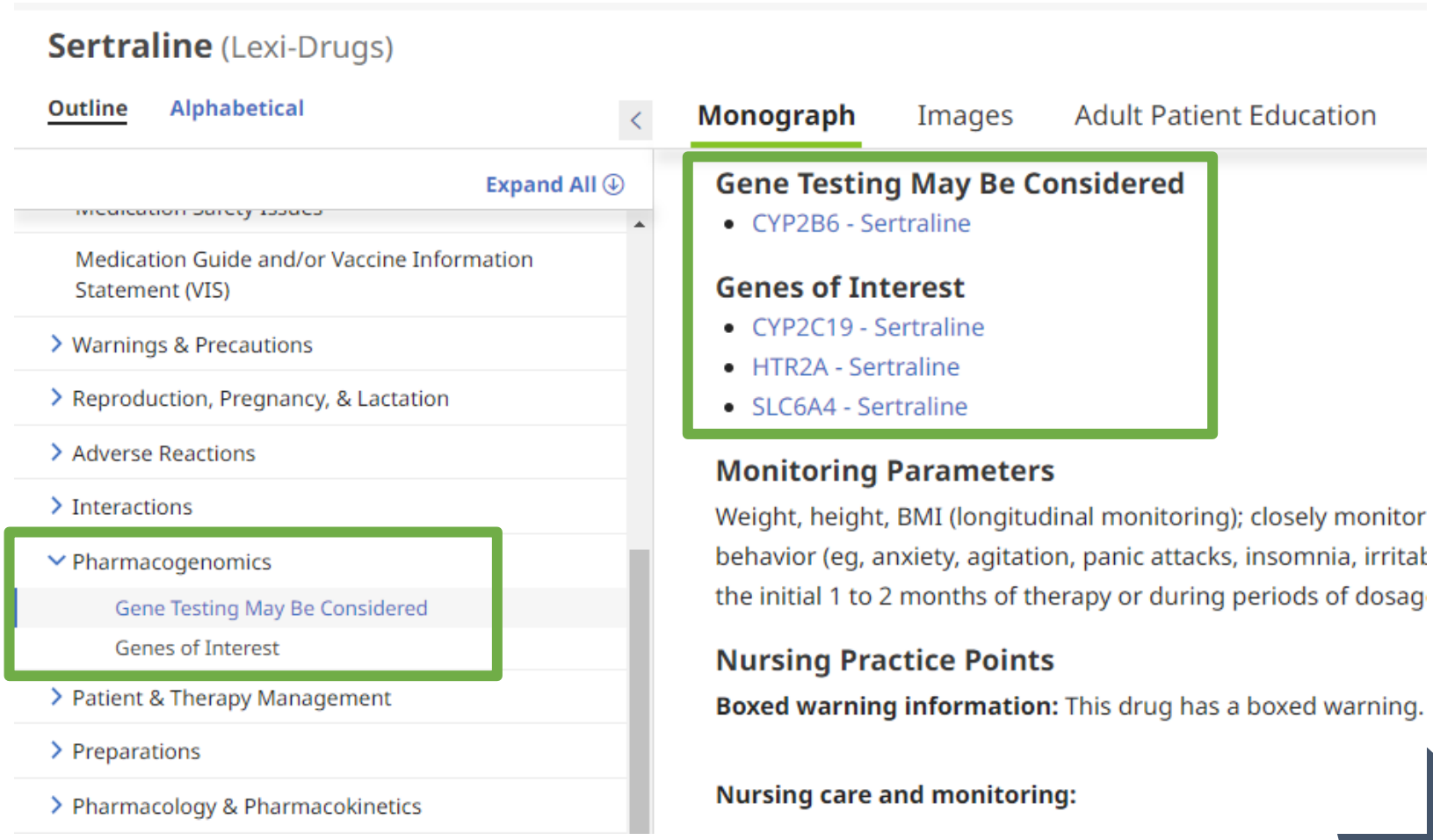
Pharmacists Leading the Way to Precision Medicine: Updates to the Core Pharmacist Competencies in Genomics | American Journal of Pharmaceutical Education (ajpe.org) Accessed April 9, 2025.

Beware that…

- Phenotype can change if a new medication is added = PHENOCONVERSION

PGx Resources

Lexicomp: Pharmacogenomics section



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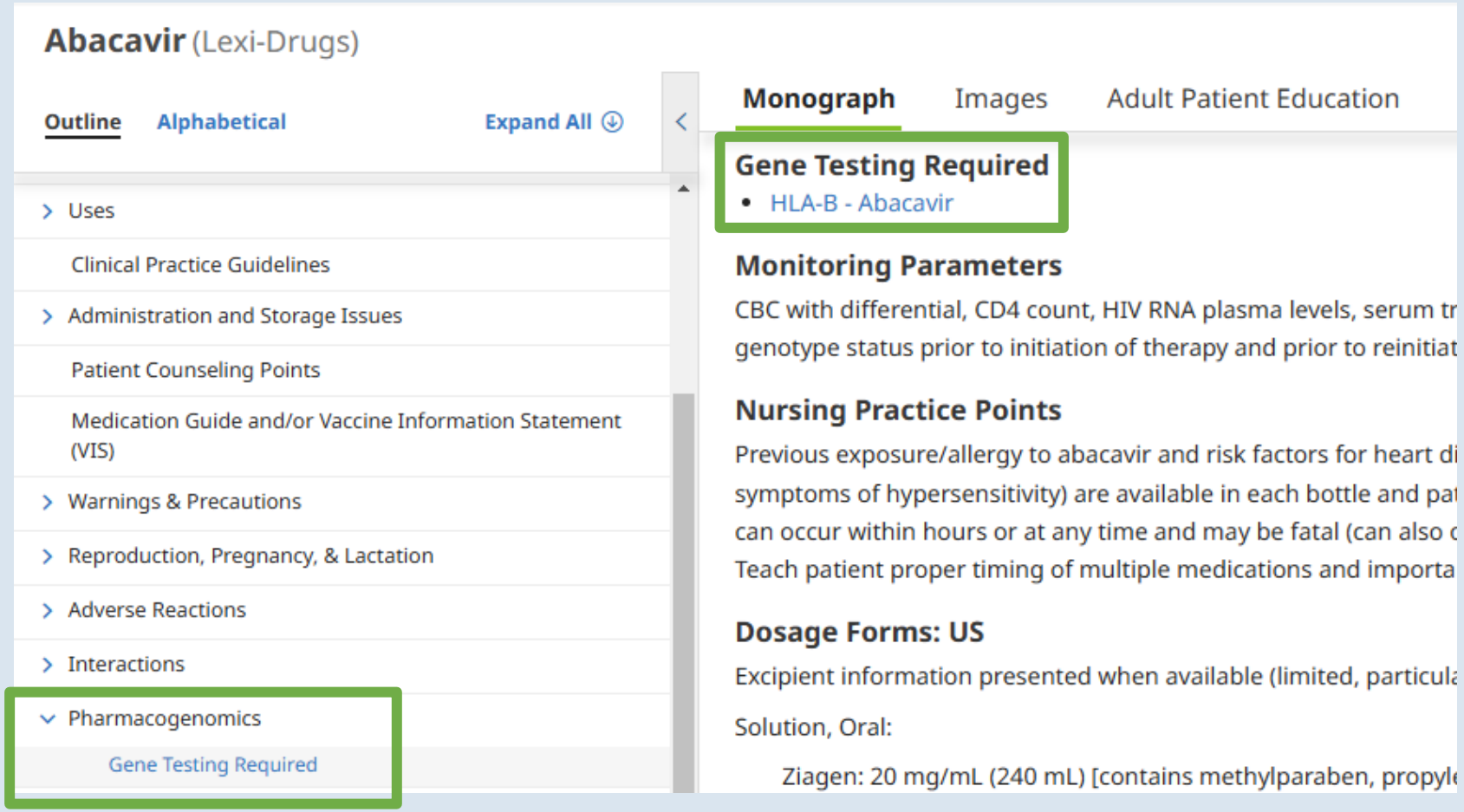

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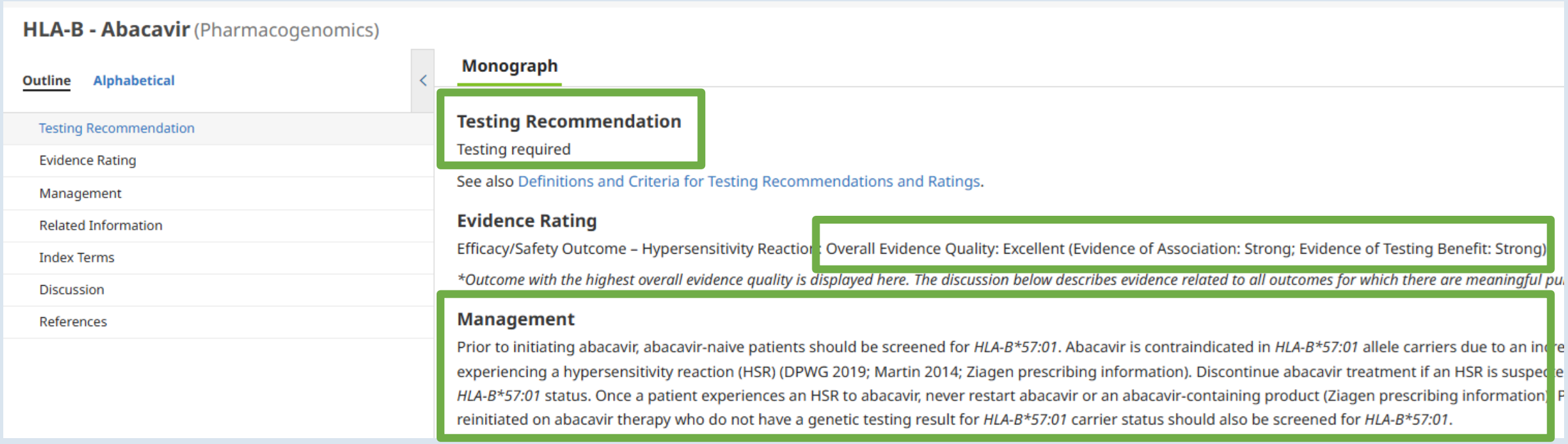

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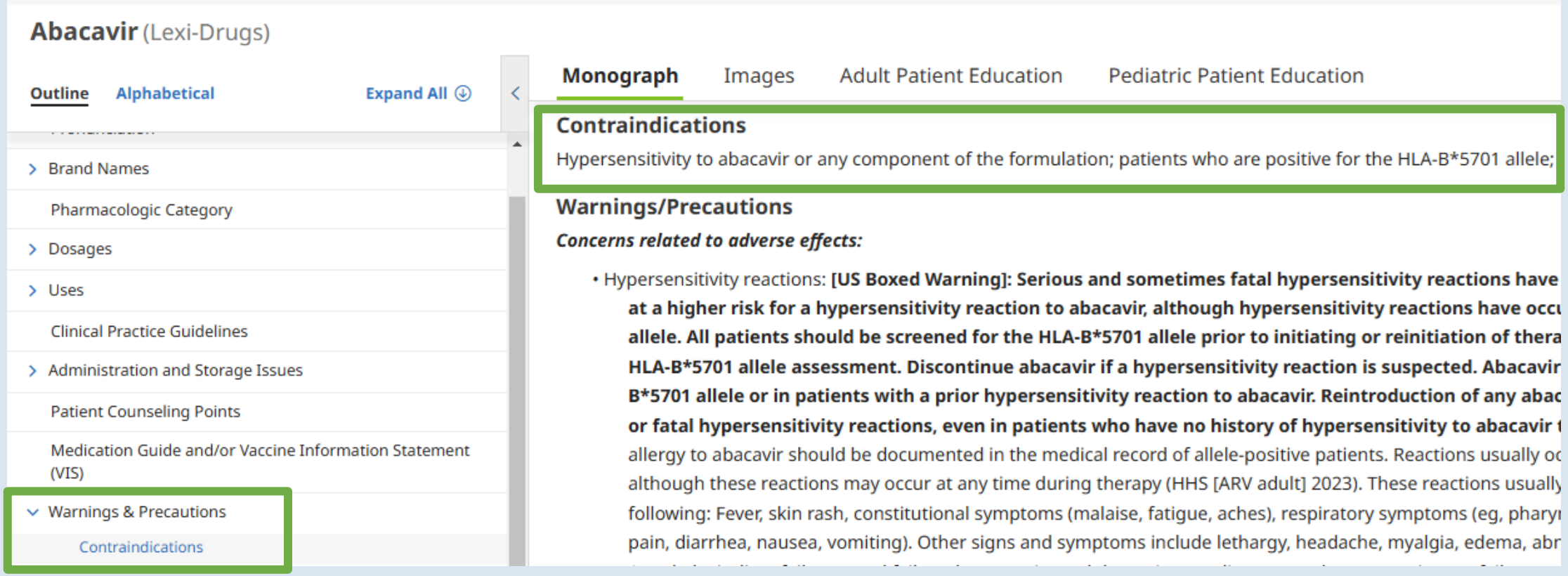

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Pharmacogenomics databases

PharmGKB

- Pharmacogenomics knowledge base
- https://www.pharmgkb.org/

Clinical Pharmacogenetics Implementation Consortium Guidelines (CPIC)

- Guidelines – typically summarized in “Table 2”
- https://cpicpgx.org/

PharmGKB

Search for medications, genes, or specific genetic variants

- FDA Drug label annotations
- Drug label annotations
- Curated pathways
- Clinical guideline annotations

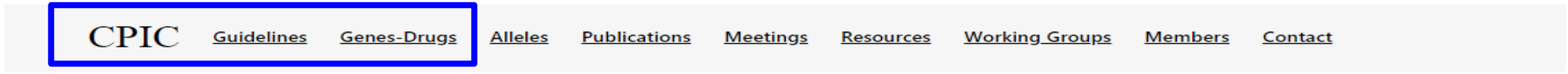
"Comprehensive resource that curates knowledge about the impact of genetic variation on drug response for clinicians and researchers."

https://www.pharmgkb.org/ Accessed 3.4.25

CPIC

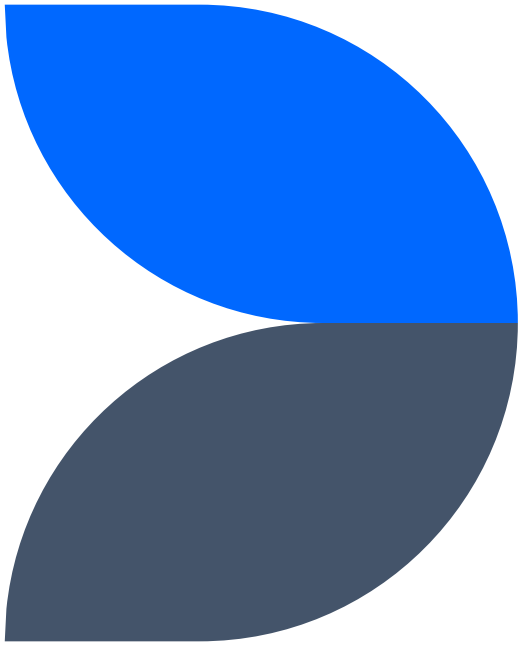
CPIC creates and posts peer-reviewed, evidence-based, updatable, and detailed gene/drug clinical practice guidelines

"CPIC is an international consortium of individual volunteers and a small dedicated staff who are interested in facilitating use of pharmacogenetic tests for patient care."



Active Learning

Case #1



Active Learning - Case #1

LP is a 59-year-old woman with ST segment elevation myocardial infarction (STEMI) who is undergoing percutaneous coronary intervention (PCI). Pharmacogenetic testing reveals that her genotype is *CYP2C19 *17/*17*. Using the information in the next 2 slides, which of the following is the MOST appropriate recommendation regarding clopidogrel use in this patient (assuming no contraindications)?

a. do not administer clopidogrel
b. administer clopidogrel at standard doses
c. increase the clopidogrel dose by 50%
d. decrease the clopidogrel dose by 50%

Active Learning - Case #1

CPIC – Guidelines
Example: clopidogrel and *CYP2C19*

Clinical Pharmacogenetics Implementation Consortium Guideline for *CYP2C19* Genotype and Clopidogrel Therapy: 2022 Update

Craig R. Lee[1], Jasmine A. Luzum[2], Katrin Sangkuhl[3], Roseann S. Gammal[4,5], Marc S. Sabatine[6], Charles Michael Stein[7], David F. Kisor[8], Nita A. Limdi[9], Yee Ming Lee[10], Stuart A. Scott[11,12], Jean-Sébastien Hulot[13], Dan M. Roden[14], Andrea Gaedigk[15], Kelly E. Caudle[5], Teri E. Klein[3], Julie A. Johnson[16] and Alan R. Shuldiner[17,*]

CYP2C19 catalyzes the bioactivation of the antiplatelet prodrug clopidogrel, and *CYP2C19* genotype impacts clopidogrel active metabolite formation. CYP2C19 intermediate and poor metabolizers who receive clopidogrel experience reduced platelet inhibition and increased risk for major adverse cardiovascular and cerebrovascular events. This guideline is an update to the 2013 Clinical Pharmacogenetics Implementation Consortium (CPIC) guideline for the use of clopidogrel based on *CYP2C19* genotype and includes expanded indications for *CYP2C19* genotype-guided antiplatelet therapy, increased strength of recommendation for CYP2C19 intermediate metabolizers, updated *CYP2C19* genotype to phenotype translation, and evidence from an expanded literature review (updates at www.cpicpgx.org).

This document is an update to the 2013 Clinical Pharmacogenetics Implementation Consortium (CPIC) guideline on the clinical use of *CYP2C19* genotype test results for patients requiring antiplatelet therapy.[1] Since the previous update, results from prospective randomized clinical trials, multicenter pragmatic studies, and meta-analyses on *CYP2C19* genotype-guided antiplatelet therapy with clinical outcomes data have demonstrated the utility of this approach.[2–6] The purpose of this guideline is to provide clinicians with information that facilitates the interpretation of clinical *CYP2C19* genotype test results to guide clopidogrel prescribing. As in the previous guideline, recommendations for use of other laboratory tests, such as platelet function monitoring, as well as cost-effectiveness analyses, are beyond the scope of this document. The guideline does not focus on demographic and other clinical variables, such as adherence to therapy, age, diabetes mellitus, obesity, smoking, and concomitant use of other drugs that may influence clopidogrel efficacy and clinical decision making. CPIC guidelines are periodically updated at www.cpicpgx.org/guidelines/.

FOCUSED LITERATURE REVIEW

A systematic literature review focused on *CYP2C19* genotype and clopidogrel response was conducted (see **Supplementary Material** for more details). Evidence is summarized in **Tables S1–S4**.

GENE: *CYP2C19*

Background

The *CYP2C19* gene is highly polymorphic; the Pharmacogene Variation Consortium (PharmVar) has currently defined over 35 star (*) allele haplotypes,[7] including rare gene deletions (https://www.pharmvar.org/gene/CYP2C19; see *CYP2C19* Allele Definition Table online[8,9]). The frequencies of these star (*) alleles significantly differ across ancestrally diverse populations (see *CYP2C19* Allele Frequency Table online[8,9]). Alleles are categorized into functional groups as follows: normal function (e.g., *CYP2C19*1*), decreased function (e.g., *CYP2C19*9*), no function (e.g., *CYP2C19*2* and **3*), and increased function (e.g., *CYP2C19*17*). Clinical allele function, as described in the

Table 1 Assignment of predicted CYP2C19 phenotype based on genotype

Predicted phenotype	Genotype	Examples of *CYP2C19* diplotypes[a]
CYP2C19 ultrarapid metabolizer	An individual carrying two increased function alleles	**17/*17*
CYP2C19 rapid metabolizer	An individual carrying one normal function allele and one increased function allele	**1/*17*
CYP2C19 normal metabolizer	An individual carrying two normal function alleles	**1/*1*
CYP2C19 likely intermediate metabolizer[b]	An individual carrying one normal function allele and one decreased function allele or one increased function allele and one decreased function allele or two decreased function alleles	**1/*9, *9/*17, *9/*9*
CYP2C19 intermediate metabolizer	An individual carrying one normal function allele and one no function allele or one increased function allele and one no function allele	**1/*2, *1/*3, *2/*17, *3/*17*
CYP2C19 likely poor metabolizer[b]	An individual carrying one decreased function allele and one no function allele	**2/*9, *3/*9*
CYP2C19 poor metabolizer	An individual carrying two no function alleles	**2/*2, *3/*3, *2/*3*
Indeterminate metabolizer	An individual carrying one or two uncertain function alleles	**1/*12, *2/*12, *12/*14*

[a]Please refer to the *CYP2C19* Diplotype-Phenotype Table online for a complete list. For allele functions and population-specific allele and phenotype frequencies, please refer to the *CYP2C19* Allele Functionality Table and the *CYP2C19* Allele Frequency Table online.[8,9]
[b]There are limited data to characterize the function of decreased function alleles.

https://files.cpicpgx.org/data/guideline/publication/clopidogrel/2022/35034351.pdf Accessed 3.4.25

Active Learning – Case #1

CPIC – Guidelines Example: clopidogrel and *CYP2C19*

Table 2 Antiplatelet therapy recommendations based on CYP2C19 phenotype when considering clopidogrel for cardiovascular indications

CYP2C19 phenotype[a]	Implications for phenotypic measures	Therapeutic recommendation	Classification of recommendation[b] - ACS and/or PCI[c]	Classification of recommendation[b] - non-ACS, non-PCI cardiovascular indications[d]
CYP2C19 ultrarapid metabolizer	Increased clopidogrel active metabolite formation; lower on-treatment platelet reactivity; no association with higher bleeding risk	If considering clopidogrel, use at standard dose (75 mg/day)	Strong	No recommendation
CYP2C19 rapid metabolizer	Normal or increased clopidogrel active metabolite formation; normal or lower on-treatment platelet reactivity; no association with higher bleeding risk	If considering clopidogrel, use at standard dose (75 mg/day)	Strong	No recommendation
CYP2C19 normal metabolizer	Normal clopidogrel active metabolite formation; normal on-treatment platelet reactivity	If considering clopidogrel, use at standard dose (75 mg/day)	Strong	Strong
CYP2C19 likely intermediate metabolizer	Reduced clopidogrel active metabolite formation; increased on-treatment platelet reactivity; increased risk for adverse cardiac and cerebrovascular events	Avoid standard dose clopidogrel (75 mg) if possible. Use prasugrel or ticagrelor at standard dose if no contraindication	Strong[e]	No recommendation[e]
CYP2C19 intermediate metabolizer	Reduced clopidogrel active metabolite formation; increased on-treatment platelet reactivity; increased risk for adverse cardiac and cerebrovascular events	Avoid standard dose (75 mg) clopidogrel if possible. Use prasugrel or ticagrelor at standard dose if no contraindication	Strong	No recommendation
CYP2C19 likely poor metabolizer	Significantly reduced clopidogrel active metabolite formation; increased on-treatment platelet reactivity; increased risk for adverse cardiac and cerebrovascular events	Avoid clopidogrel if possible. Use prasugrel or ticagrelor at standard dose if no contraindication	Strong[e]	Moderate[e]
CYP2C19 poor metabolizer	Significantly reduced clopidogrel active metabolite formation; increased on-treatment platelet reactivity; increased risk for adverse cardiac and cerebrovascular events	Avoid clopidogrel if possible. Use prasugrel or ticagrelor at standard dose if no contraindication	Strong	Moderate

ACS, acute coronary syndrome; PCI, percutaneous coronary intervention.

[a]The online *CYP2C19* Allele Frequency Table provides phenotype frequencies for major race/ethnic groups, and the online *CYP2C19* Diplotype-Phenotype Table provides a complete list of possible diplotypes and phenotype assignments.[8,9]

[b]Rating scheme described in the **Supplementary Material** online.

[c]ACS and/or PCI includes patients undergoing PCI for an ACS or non-ACS (elective) indication.

[d]Non-ACS, non-PCI cardiovascular indications include peripheral arterial disease and stable coronary artery disease following a recent myocardial infarction outside the setting of PCI.

[e]The strength of recommendation for "likely" phenotypes are the same as their respective confirmed phenotypes. "Likely" indicates the uncertainty in the phenotype assignment, but it is reasonable to apply the recommendation for the confirmed phenotype to the corresponding "likely" phenotype.

https://files.cpicpgx.org/data/guideline/publication/clopidogrel/2022/35034351.pdf Accessed 3.4.25

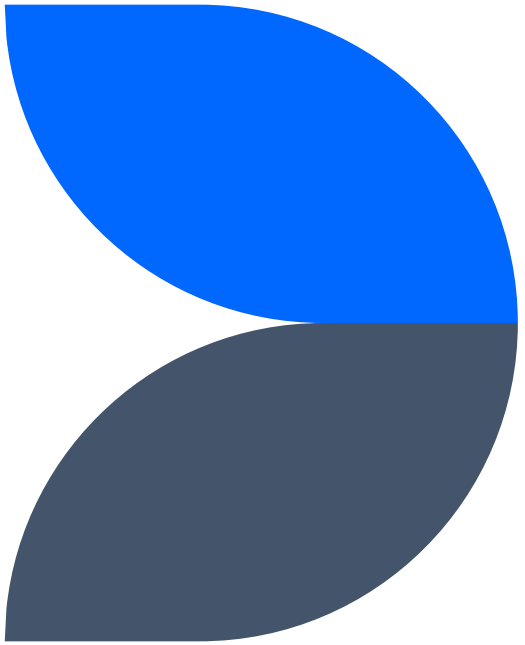
Active Learning - Case #1 - ANSWER

LP is a 59-year-old woman with ST segment elevation myocardial infarction (STEMI) who is undergoing percutaneous coronary intervention (PCI). Pharmacogenetic testing reveals that her genotype is *CYP2C19 *17/*17*. Which of the following is the MOST appropriate recommendation regarding clopidogrel use in this patient (assuming no contraindications)?

a. do not administer clopidogrel
b. ✓ administer clopidogrel at standard doses
c. increase the clopidogrel dose by 50%
d. decrease the clopidogrel dose by 50%

Active Learning

Case #2



Active Learning - Case #2

LC is a 34-year-old African American female who was recently diagnosed with major depressive disorder. She had PGx testing done and the providers asks if paroxetine is still an appropriate option. Her genotype is *CYP2D6 *1/*1x3*. Using the information in the next 2 slides, which of the following is the MOST appropriate recommendation regarding escitalopram use in this patient (assuming no contraindications)?

a. Do not administer paroxetine; select an alternative
b. Administer paroxetine at standard doses
c. Consider a lower starting dose and slower titration
d. Consider a 50% reduction in recommended starting dose, slower titration schedule, and a 50% lower maintenance dose

Active Learning - Case #2

Table 1 Assignment of predicted phenotypes based on diplotypes

Phenotype	Activity score range	Activity score/diplotypes	Examples of *CYP2D6* diplotypes[a]
Assignment of predicted CYP2D6 phenotypes based on diplotypes			
CYP2D6 ultrarapid metabolizer	>2.25	>2.25	**1/*1xN, *1/*2xN, *2/*2xN*
CYP2D6 normal metabolizer	1.25≤*x*≤2.25	1.25 1.5 1.75 2.0 2.25	**1/*10, *1/*9, *1/*41* **1/*17, *1/*29* **1/*10x3* **1/*1, *1/*2* **2x2/*10*
CYP2D6 intermediate metabolizer	0<*x*<1.25	0.25 0.5 0.75 1	**4/*10, *4/*41* **10/*10, *10/*41* **10/*29, *9/*14, *17/*41* **1/*5, *1/*4, *1/*5*
CYP2D6 poor metabolizer	0	0	**3/*4, *4/*4, *5/*5, *5/*6*

https://files.cpicpgx.org/data/guideline/publication/serotonin_reuptake_inhibitor_antidepressants/2023/37032427.pdf. Accessed April 10, 2025

Active Learning - Case #2

Table 2 Dosing recommendations antidepressants based on CYP2D6 phenotype

Phenotype	Implication	Therapeutic recommendation	Classification of recommendation[a]	Considerations
(a) Dosing recommendations for paroxetine based on CYP2D6 phenotype				
CYP2D6 ultrarapid metabolizer	Increased metabolism of paroxetine to less active compounds when compared with CYP2D6 normal metabolizers. Lower plasma concentrations decrease the probability of clinical benefit. The extent to which ultrarapid metabolizers phenoconvert to normal, intermediate, or poor metabolizers due to paroxetine autoinhibition of CYP2D6 is unclear	Select alternative drug not predominantly metabolized by CYP2D6	Moderate	Drug–drug interactions and other patient characteristics (e.g., age, renal function, liver function) should be considered when selecting an alternative therapy
CYP2D6 normal metabolizer	Normal metabolism of paroxetine to less active compounds. Paroxetine-associated phenoconversion of normal metabolizers to intermediate or poor metabolizers due to CYP2D6 autoinhibition may occur and is dose-dependent and greater at steady state concentrations	Initiate therapy with recommended starting dose	Strong	
CYP2D6 intermediate metabolizer	Reduced metabolism of paroxetine to less active compounds when compared with CYP2D6 normal metabolizers when starting treatment or at lower doses. Higher plasma concentrations may increase the probability of side effects. Paroxetine-associated phenoconversion of intermediate metabolizers to poor metabolizers due to CYP2D6 autoinhibition may occur and is dose-dependent and greater at steady-state concentrations	Consider a lower starting dose and slower titration schedule as compared with normal metabolizers	Optional	Drug–drug interactions and other patient characteristics (e.g., age, renal function, liver function) should be considered when adjusting dose or selecting an alternative therapy
CYP2D6 poor metabolizer	Greatly reduced metabolism when compared with CYP2D6 normal metabolizers. Higher plasma concentrations may increase the probability of side effects. The impact of paroxetine-associated autoinhibition of CYP2D6 is minimal in poor metabolizers	Consider a 50% reduction in recommended starting dose, slower titration schedule, and a 50% lower maintenance dose as compared with normal metabolizers	Moderate	Drug–drug interactions and other patient characteristics (e.g., age, renal function, liver function) should be considered when adjusting dose or selecting an alternative therapy

https://files.cpicpgx.org/data/guideline/publication/serotonin_reuptake_inhibitor_antidepressants/2023/37032427.pdf. Accessed April 10, 2025

Active Learning - Case #2 - ANSWER

LC is a 34-year-old African American female who was recently diagnosed with major depressive disorder. She had PGx testing done and the providers asks if paroxetine is still an appropriate option. Her result for *CYP2D6 *1/*1x3*. Which of the following is the MOST appropriate recommendation regarding escitalopram use in this patient (assuming no contraindications)?

a. Do not administer paroxetine; select an alternative
b. Administer paroxetine at standard doses
c. Consider a lower starting dose and slower titration
d. Consider a 50% reduction in recommended starting dose, slower titration schedule, and a 50% lower maintenance dose

Education for pharmacists

- Continuing Education (CE) impact – 1 hour CE, 8-hour certification course
- RxGenomix Clinical Pearls videos
- Books on Amazon
- Join CPIC (free) – monthly meeting on the first Thursday of every month at 11:00 am EST
  - Update on new guidelines or guidelines in progress
  - Presentation – someone who is implementing PGx in clinical practice/ambulatory care/hospital and the results

Summary

- Utilize PGx data to avoid the “trial and error” approach to pharmacotherapy management.
- Include PGx along with PK and PD considerations in your patient monitoring practices
- Recall Core Pharmacists competencies as foundational genetic concepts and clinical pharmacogenomics concepts
- Refer to PGx-specific resources to assist in formulating an appropriate medication regimen

Thank you

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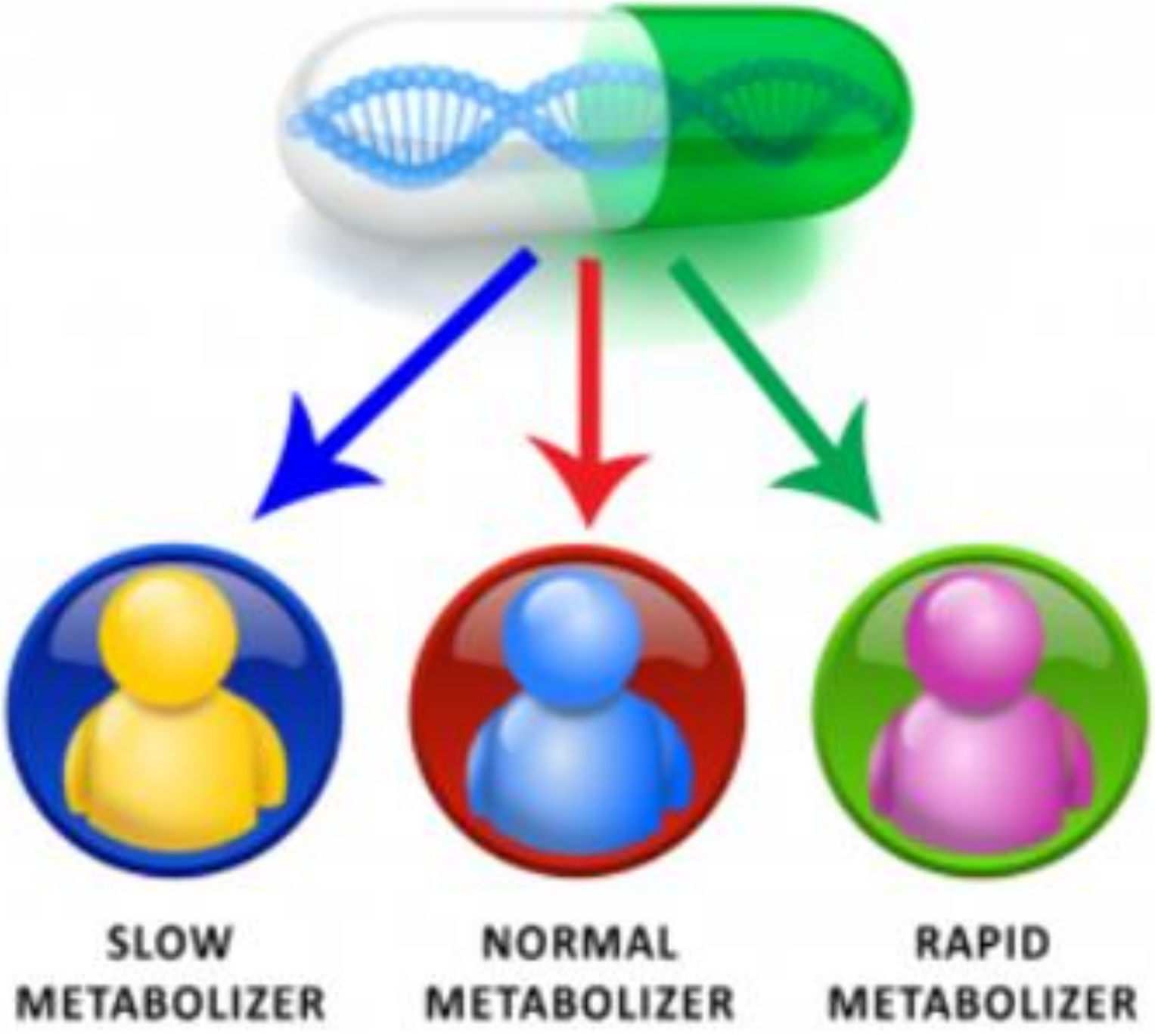

Questions?

References

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Company	Testing Options & Costs	Genes Tested	Purchase Method
ClarityX https://clarityxdna.com/products	**Mindwell ($299.25)**: Evaluates response to depression medications, analyzing 135+ medications **MaxRX ($374.25)**: Assesses response to 275+ medications across 21 therapeutic areas	Mainly *CYP2D6, CYP2C19*, and *MTHFR* for the therapeutic tests Other genes available: *ABCB1, GLP1R, CYP1A2, CYP3A5, CYP3A4, ANKK1, OPRM1, DRD2, COMT, VKORC1, APOE*, etc.	Patients can purchase directly from their website. Providers can order test kits to be sent to their office to test patients
OneOme https://oneome.com/rightmed-test/	**RightMed® Test**: Analyzes a patient's DNA to provide insights on over 100 medications. Self-pay cost is $349, with financial assistance reducing the cost to $199 for eligible patients.	100 alleles that covers 27 genes (*CYP1A2, CYP2B6, CYP2C cluster, CYP2C9, CYP2C19, CYP2D6, CYP3A4, CYP3A5, CYP4F2, COMT, DPYD, DRD2, F2, F5, GRIK4, HLA-A, HLA-B, HTR2A, HTR2C, IL28B, MTHFR, NUDT15, OPRM1, SLC6A4, SLCO1B1, TPMT, UGT1A1, VKROC1*)	Ordered through healthcare providers and pharmacists. Patients can also request the test directly from OneOme.
23andMe https://shorturl.at/SxYFg	**Health + Ancestry Service ($199)**: Includes ancestry and trait reports, health predisposition reports and wellness reports	Tests some alleles through saliva for *CYP2C19, SLCO1B1,* and *DPYD* *Health predisposition reports include those approved and not approved by the FDA *Testing on the pharmacogenetics report should be confirmed by an independent test prescribed by a healthcare provider	Direct-to-consumer; kits can be purchased online
GENETWORx https://genetworx.com/services/effectiverx-comprehensive-tests/	**Comprehensive Panel**: includes all genes listed **Neuro Panel** also available for patients only looking to test genes for mental health medications Medicaid & Medicare Part B- should be $0. Contact for estimated cost for uninsured or commercial insurance	*MTHFR, CYP2C9, CYP2C19, CYP3A4/5, VKORC1, ADRA2A, ANKK1, COMT, CYP1A2, CYP2B6, CYP2D6, OPRM1, SLC6A4, HTR2C/2A, GRIK4, APOE, F2/5, DPYD, IFNL3, ITGB3, OPRK1, UGT1A1, UGT2B15*	Ordered through provider for patient
GeneSight https://shorturl.at/su4hm	**Psychotropic Test** for patients only looking to test genes for mental health medications **MTHFR Test-** only tests for *MTHFR* gene Cost estimated $330 or less. Medicaid and Medicare Part B $0	*MTHFR, CYP2D6, CYP2C19, CYP3A4, CYP2B6, CES1A1, CYP1A2, UGT1A4, UGT2B15, CYP2C9, SLC6A4, HLA-A, HLA-B, ADRA2A, HTR2A, COMT*	Ordered by healthcare providers. Test can be sent to the patient's home or to the healthcare provider's office

Please note that all pricing, available tests, genes, alleles, and ordering options are subject to change. We strive to provide the most accurate and up-to-date information, but changes may occur based on laboratory updates or provider availability. Final details should be confirmed prior to ordering.

QR Code to access testing options