WASHINGTON STATE UNIVERSITY
College of Pharmacy and Pharmaceutical Sciences

Interprofessional Clinical Pharmacogenomics Certificate

The Interprofessional Clinical Pharmacogenomics Certificate program is an interactive practice-based program designed to equip physicians and pharmacists with greater readiness, confidence and advocacy for optimizing medication management using pharmacogenomic data. This program will provide learners with a broad knowledge of foundational pharmacogenomic principles and enhance their overall capacity to apply this information across multiple therapeutic areas in various practice settings.

This interactive program includes online self-study and live webinar activities offered over the course of 8 weeks. The self-study modules will consist of videos and readings accessed via CloudCME (https://wsu.cloud-cme.com). The live modules conducted via Zoom will include case studies and active large and small group discussion.

Participants will also have an opportunity to opt for **personal pharmacogenomics testing** for educational purposes at a discounted rate.

CE Credit Hours: 16 hours/12 activities
Target Audience: Pharmacists and physicians seeking to expand their knowledge and skills to optimize medication management using pharmacogenomic data
Activity Fee: $335 (15% discount for WSU faculty, alumni, and preceptors)
Registration: https://wsu.cloud-cme.com/

Certificate Program Learning Objectives:
At the completion of this certificate program the participant will be able to:

- Determine the impact of genetic variation on drug pharmacokinetics, pharmacodynamics, and drug response
- Interpret pharmacogenomic test results by identifying clinically actionable drug-gene pairs using high-quality, evidence-based pharmacogenomic databases and guidelines to formulate therapeutic recommendations
- Recommend pharmacogenomic testing when appropriate and integrate test results with other clinical variables to optimize medication therapy
- Describe the benefits, limitations, and risks of pharmacogenomic information for individuals, family members and communities, and recognize when to refer the patient to a genetic counselor
- Educate health care professionals and patients about the cost, cost-effectiveness, and reimbursement issues relevant to pharmacogenomic tests and services

Activity Schedule and Learning Objectives:

Module	Activity CE Information	Course Description
Week 1 Self-Study Available February 28, 2023	ACPE UAN: 0071-0000-22-001-H01-P Credit Hours: 1 Activity Type: Application *AMA PRA Category 1 Credits™* 1 credit hour	**Fundamentals of Pharmacogenomics (PGx), Genetic Variation in Drug Metabolism, and Interpretation of PGx Testing Results** This self-study session will describe the fundamentals of pharmacogenomics and provide the learner with knowledge of how to use evidence-based pharmacogenomic database resources. In addition, this session will highlight major genetic variants associated with drug metabolism and the impact of these on pharmacokinetic parameters and drug response. Important principles of phenoconversion will be discussed giving the learner greater understanding of drug-drug gene interactions. This session will conclude with a description of FDA resources useful for identifying clinically actionable drug-gene pairs. **Faculty:** Rustin D. Crutchley, PharmD, AAHIVP **Learning Objectives:** • Describe fundamental principles of pharmacogenomics (PGx) • Discuss how to navigate PGx database resources such as Clinical Pharmacogenetics Implementation Consortium (CPIC) and Pharmacogenomics Knowledge Database (PharmGKB) • Illustrate general implications of genetic variants in drug metabolism in context of active parent drug versus inactive prodrug • Outline function of major genetic variants associated with Phase I (CYP2C9, CYP2C19, CYP2D6) and Phase II (UGT1A1, TPMT) drug metabolism and describe potential impact on pharmacokinetics (PK) and drug response • Define phenoconversion and predict CYP2D6 phenotypes by calculation of total activity scores

		• Describe relevant FDA resources used for disseminating PGx-related drug-gene pair information
Week 1 Live Online March 7, 2023 5:00 PM PDT	ACPE UAN: 0071-0000-22-002-L01-P Credit Hours: 1 Activity Type: Application *AMA PRA Category 1 Credits™* 1 credit hour	**Fundamentals of Pharmacogenomics (PGx), Genetic Variation in Drug Metabolism, and Interpretation of PGx Testing Results** This live session will give participants the opportunity to learn first-hand on how to navigate important PGx databases such as CPIC and PharmGKB. Sample educational pharmacogenomic testing reports will be incorporated to help the participant identify the function of major genetic variants associated with drug metabolism. This exercise will set the stage for using pharmacogenomic database resources to determine the impact of these genetic variants on drug concentrations and drug response. Importantly, participants will learn how to identify the prevalence of various drug metabolism phenotypes in different biogeographical groups. Furthermore, this session will give the participant greater knowledge and confidence in identifying clinically actionable drug-gene pairs, concluding with an exercise focused on calculation of total activity scores of CYP2D6 and the impact of drug-drug interactions on these corresponding phenotypes. **Faculty:** Rustin D. Crutchley, PharmD, AAHIVP **Learning Objectives:** • Discuss how to navigate PGx database resources such as Clinical Pharmacogenetics Implementation Consortium (CPIC) and Pharmacogenomics Knowledge Database (PharmGKB) • Outline function of major genetic variants associated with Phase I (CYP2C9, CYP2C19, CYP2D6) and Phase II (UGT1A1, TPMT) drug

		metabolism and describe potential impact on pharmacokinetics (PK) and drug response • Define phenoconversion and predict CYP2D6 phenotypes by calculation of total activity scores • Interpret pharmacogenomic test results by identifying clinically actionable drug-gene pairs using high-quality, evidence-based pharmacogenomic databases and guidelines to formulate therapeutic recommendations
Week 2 Self-Study Available March 8, 2023	ACPE UAN: 0071-0000-22-003-H01-P Credit Hours: 2 Activity Type: Application *AMA PRA Category 1 Credits™* 2 credit hours	**Pharmacogenomics of Cardiovascular Disease** This self-study session will provide an overview of the clinical application and implementation of pharmacogenomics in cardiology, specifically focusing on pharmacogenomic-guided antiplatelet and anticoagulant therapy. The learner will be oriented to the clinically relevant drug-gene pairs and the interpretation of such results. This session will also highlight literature, FDA labeling, and practice guidelines supporting the use of pharmacogenomics. Integrated case examples will help the learner navigate treatment decisions that consider pharmacogenomics and patient-specific clinical factors. **Faculty:** Teresa T. Ho, PharmD, BCPS **Learning Objectives:** • Determine the impact of genetic variation on drug pharmacokinetics, pharmacodynamics, and drug response • Interpret pharmacogenomic test results by identifying clinically actionable drug-gene pairs using high-quality, evidence-based pharmacogenomic databases and guidelines to formulate therapeutic recommendations • Recommend pharmacogenomic testing when appropriate

		• Summarize main findings from the literature supporting the use of pharmacogenomics-guided treatment in cardiology • Demonstrate clinical application of pharmacogenomic testing results in cardiology through case examples
Week 3 Self-Study Available March 14, 2023	ACPE UAN: 0071-0000-22-004-H08-P Credit Hours: 1 Activity Type: Application Topic Designator: Pain Management *AMA PRA Category 1 Credits™* 1 credit hour	**Pharmacogenomics of Pain Management** This self-study session will highlight the impact of major genetic variations associated with the clinical effect and safety of opioids and non-steroidal anti-inflammatory drugs. During this session, the learner will develop greater awareness of which clinical guideline resources to use when formulating therapeutic recommendations based on available patient pharmacogenomic data. This session will include a summary of evidence-based findings from the literature supporting individual genes that are associated with analgesia dose requirements. Finally, this session will conclude with a discussion of case examples reflecting the importance of using pharmacogenomics-guided treatment to individualize a patient's management of pain. **Faculty:** Kristine R. Crews, Pharm.D., FCCP, BCPS **Learning Objectives:** • Determine the impact of genetic variation on drug pharmacokinetics, pharmacodynamics, and drug response • Interpret pharmacogenomic test results by identifying clinically actionable drug-gene pairs using high-quality, evidence-based pharmacogenomic databases and guidelines to formulate therapeutic recommendations • Describe the benefits, limitations, and risks of pharmacogenomic information for individuals, family members and communities, and recognize when to refer the patient to a genetic counselor

Week 3 Live Online March 21, 2023 5:00 PM PDT	ACPE UAN: 0071-0000-22-005-L08-P Credit Hours: 1 Activity Type: Application Topic Designator: Pain Management *AMA PRA Category 1 Credits™* 1 credit hour	**Pharmacogenomics of Pain Management** This live session will include additional application of the information in the week 3 self-study module. **Faculty:** Kristine R. Crews, Pharm.D., FCCP, BCPS **Learning Objectives:** • Determine the impact of genetic variation on drug pharmacokinetics, pharmacodynamics, and drug response • Interpret pharmacogenomic test results by identifying clinically actionable drug-gene pairs using high-quality, evidence-based pharmacogenomic databases and guidelines to formulate therapeutic recommendations • Describe the benefits, limitations, and risks of pharmacogenomic information for individuals, family members and communities, and recognize when to refer the patient to a genetic counselor
Week 4 Self-Study Available March 22, 2023	ACPE UAN: 0071-0000-22-006-H01-P Credit Hours: 2 Activity Type: Application *AMA PRA Category 1 Credits™* 2 credit hours	**Pharmacogenomics of Depression** This self-study session will highlight the impact of major genetic variants in antidepressant metabolism and pharmacodynamics on treatment response. During this session, the learner will develop greater awareness of what PGx guideline resources to use to formulate therapeutic recommendations based on available patient pharmacogenomic data. This session will include a summary of main findings from the literature supporting payor coverage for PGx-guided treatment of depression. Finally, this session will conclude with a discussion of case examples reflecting the importance of using PGx-guided treatment, when necessary, to improve the approach for management of depression.

		Faculty: Rustin D. Crutchley, PharmD, AAHIVP **Learning Objectives:** • Determine the impact of genetic variation on drug pharmacokinetics, pharmacodynamics, and drug response • Interpret pharmacogenomic test results by identifying clinically actionable drug-gene pairs using high-quality, evidence-based pharmacogenomic databases and guidelines to formulate therapeutic recommendations • Recommend pharmacogenomic testing when appropriate and integrate test results with other clinical variables to optimize medication therapy • Summarize main findings from the literature supporting the use of pharmacogenomics-guided treatment for depression • Discuss case examples utilizing various pharmacogenomic testing results to inform appropriate selection of antidepressants for treatment of depression
Week 5 Self-Study Available March 28, 2023	ACPE UAN: 0071-0000-22-007-H01-P Credit Hours: 1 Activity Type: Application *AMA PRA Category 1 Credits™* 1 credit hour	**Pharmacogenomics of Germline and Somatic Oncology** **Faculty:** Howard L. McLeod, Pharm.D., FASCO, FCCP **Learning Objectives:** • Define the impact of pharmacogenomics on a patient's risk:benefit decision • Identify various challenges in implementing pharmacogenomics from research to practice • Explain current approaches to applying pharmacogenomics panel testing in the clinic
Week 5 Live Online April 4, 2023 5:00 PM PDT	ACPE UAN: 0071-0000-22-008-L01-P Credit Hours: 1 Activity Type: Application	**Pharmacogenomics of Germline and Somatic Oncology** **Faculty:** Howard L. McLeod, Pharm.D., FASCO, FCCP

	AMA PRA Category 1 Credits™ 1 credit hour	**Learning Objectives:** • Define the impact of pharmacogenomics on a patient's risk:benefit decision • Identify various challenges in implementing pharmacogenomics from research to practice • Explain current approaches to applying pharmacogenomics panel testing in the clinic
Week 6 Self-Study Available April 5, 2023	ACPE UAN: 0071-0000-22-009-H01-P Credit Hours: 2 Activity Type: Application *AMA PRA Category 1 Credits™* 2 credit hours	**Pharmacogenomics of Drug-Induced Hypersensitivity Reactions** This self-study session will highlight the impact of major genetic variants in the HLA complex on drug-induced hypersensitivity reactions involving neurologic agents (phenytoin, carbamazepine, and oxcarbazepine), allopurinol and abacavir. During this session, the learner will develop greater awareness of what PGx guideline resources to use to formulate therapeutic recommendations based on available patient pharmacogenomic data involving these medications. Importantly, this session will also provide the learner will an appreciation of the diversity in frequency of genetic variants in HLA-A and HLA-B among biogeographical groups and how these relate to PGx testing recommendations involving neurologic agents (phenytoin, carbamazepine, and oxcarbazepine), allopurinol and abacavir. This session will incorporate case examples to demonstrate clinical utility of PGx-guided treatment to mitigate adverse reactions. **Faculty:** Rustin D. Crutchley, PharmD, AAHIVP **Learning Objectives:** • Describe background on the human leukocyte antigen (HLA) complex and its association with drug induced hypersensitivity reactions involving neurologic agents (phenytoin, carbamazepine, and oxcarbazepine), allopurinol and abacavir

		• Determine the impact of genetic variation on drug pharmacokinetics, pharmacodynamics, and drug response • Interpret pharmacogenomic test results by identifying clinically actionable drug-gene pairs using high-quality, evidence-based pharmacogenomic databases and guidelines to formulate therapeutic recommendations • Recommend pharmacogenomic testing when appropriate and integrate test results with other clinical variables to optimize medication therapy • Discuss case examples utilizing various pharmacogenomic testing results to inform appropriate selection of neurologic agents (phenytoin, carbamazepine, and oxcarbazepine), allopurinol and abacavir
Week 7 Self-Study Available April 11, 2023	ACPE UAN: 0071-0000-22-010-H01-P Credit Hours: 1 Activity Type: Application *AMA PRA Category 1 Credits™* 1 credit hour	**Clinical Perspectives of a Genetic Counselor** This self-study session will review the current landscape of pharmacogenomics and describe barriers to successful implementation of pharmacogenomics in clinic. Participants will learn to recognize referral indications and clinical scenarios that may be informed by pharmacogenomic testing, as well as understand the potential barriers to pharmacogenomic testing at the patient and provider level. Specific issues and concerns related to the use of race, ethnicity, and ancestry data in pharmacogenomics will be addressed, and opportunities for improving research and clinical practices to eliminate race-based medicine and resulting health care disparities will be presented. The session will describe specific experiences and lessons learned from the development and operation of a specialty pharmacogenomics clinic at Brigham & Women's Hospital. This will include a review of the multiple provider roles in this clinic model, including that of a genetic counselor, and demonstrate how various skill sets and areas of expertise can be utilized to provide

		collaborative and effective clinical care. Additionally, participants will learn basic genetic counseling principles and techniques, including strategies for collecting family history information that could have broad utility and inform patient care. **Faculty:** Elizabeth Fieg, MS, CGC **Learning Objectives:** • Summarize the benefits, limitations, and obstacles to the implementation of pharmacogenomics in clinical care. • Examine implications and clinical utility of pharmacogenomics results in different specialty areas. • Describe the development and implementation of a multidisciplinary pharmacogenomics clinic. • Highlight genetic counseling roles and indications related to the field of pharmacogenomics.
Week 7 Live Online April 18, 2023 5:00 PM PDT	ACPE UAN: 0071-0000-22-011-L01-P Credit Hours: 1 Activity Type: Application *AMA PRA Category 1 Credits™* 1 credit hour	**Clinical Perspectives of a Genetic Counselor** This session will focus on real-world application and utilization of pharmacogenomics in a clinical care setting. Participants will engage in interactive clinical case discussions and answer polling questions that will assess their knowledge and familiarity with concepts presented in the pre-recording. Participants will practice recognizing and responding to different situations in which pharmacogenomic test results may be available for patients, including direct-to-consumer (ie. 23andMe) and secondary findings related to genomic sequencing (ie. NIH 'All of Us' research program) and consider the utility of indication-based testing compared to broader panel screening. In addition, the session will demonstrate key components of a genetic counseling session (ie. contracting, collecting

		family history, ordering genetic testing, obtaining informed consent) and walk participants through application of these skills in a review of select case examples and clinic vignettes. **Faculty:** Elizabeth Fieg, MS, CGC **Learning Objectives:** • Summarize the benefits, limitations, and obstacles to the implementation of pharmacogenomics in clinical care. • Examine implications and clinical utility of pharmacogenomics results in different specialty areas. • Describe the benefits, limitations, and risks of pharmacogenomic information for individuals, family members and communities, and recognize when to refer the patient to a genetic counselor. • Educate health care professionals and patients about the cost, cost-effectiveness, and reimbursement issues relevant to pharmacogenomic tests and services.
Week 8 Self-Study Available April 19, 2023	ACPE UAN: 0071-0000-22-012-H01-P Credit Hours: 2 Activity Type: Application *AMA PRA Category 1 Credits™* 2 credit hours	**Clinical Implementation of Pharmacogenomics** This session will help the learner to identify the barriers and challenges and solutions to these regarding implementation of pharmacogenomic services in institutional settings. During this session, the learner will develop a greater awareness and understanding of the necessary phases of implementation of PGx services. In addition, various avenues for reimbursement for pharmacogenomic testing will be discussed to give the learner greater confidence of when to recommend pharmacogenomic testing. Given that direct to consumer testing is rapidly increasing, this session will also cover examples of approved pharmacogenomic testing by the FDA.

		Faculty: Rustin D. Crutchley, PharmD, AAHIVP **Learning Objectives:** • Identify barriers, challenges, and solutions for implementation of PGx services in institutional settings • Discuss the necessary phases of implementation of pharmacogenomics services in institutional settings • Educate health care professionals and patients about the cost, cost-effectiveness, and reimbursement issues relevant to pharmacogenomic tests and services • Recommend pharmacogenomic testing when appropriate and integrate test results with other clinical variables to optimize medication therapy • Describe FDA approved examples of direct-to-consumer pharmacogenomics testing

Faculty Information:

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Professor of Pharmacy and Medicine
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Disclosures:
In accordance with our accreditor's Standards of Integrity and Independence in Accredited Continuing Education, WSU CPPS requires that all individuals in control of content disclose all financial relationships with ineligible companies. An individual has a relevant financial relationship if they have had a financial relationship with ineligible company in any dollar amount in the past 24 months and the educational content that the individual controls is related to the business lines or products of the ineligible company.

An ineligible company is any entity producing, marketing, re-selling, or distributing health care goods or services consumed by, or used on, patients. The presence or absence of relevant financial relationships will be disclosed to the activity audience.

- H. McLeod reports consultant, advisory, and/or board member roles with Illumina, Vyant Bio, Clarified Precision Medicine, and EviCORE
- Activity planners, faculty, and reviewers report no financial relationships relevant to this activity.

As required by the Standards of Integrity and Independence in Accredited Continuing Education definition of ineligible company, all relevant financial relationships have been mitigated prior to the CPE activity.

Technical Requirements: Courses and learning activities are delivered via CloudCME and Zoom. A computer with a high-speed internet connection and audio is necessary. A webcam is preferred, but not required.

Methods and CE Requirements:
This activity consists of 8 self-study and 4 live activities. Participants are eligible to receive a total of 16 hours of continuing education credit by completing all 12 activities.

Participants must participate in the entire activity, complete the evaluation and all required components to claim continuing education credit online at the WSU CloudCME® portal (https://wsu.cloud-cme.com). To receive pharmacist CPE credit or *AMA PRA Category 1 Credits*™ for successful completion of each activity within the certificate program, the participant must receive a 70% or better on each of the self-study exercises (two attempts will be given for each graded exercise), complete an attendance form and activity evaluation form, and actively participate in the live session. Completed credits will be documented in CloudCME and in a record of participation.

Verification of pharmacist participation will also be reported to the continuing pharmacy education (CPE) tracking service, CPE Monitor, within 4 weeks after each activity within the certificate program, and will then be accessible to participants at MyCPEMonitor.net. Participants must provide their **NABP e-Profile ID** and **date of birth** (MMDD) within their CloudCME® profile for CPE credits to be submitted. To receive credit for successful completion

of the Certificate program, the participant must complete all of the activities, a program evaluation form, and receive a 70% or better on the post-test (two attempts will be given). Within 4 weeks of completion of all requirements, verification of completion of the certificate program will be reported to CPE Monitor and a Certificate of Completion will be mailed to the participant.

Important Note – ACPE 60 Day Deadline:
Per ACPE requirements, CPE credit must be claimed within 60 days of being earned – no exceptions!

To verify that you have completed the required steps and to ensure your credits have been reported to CPE Monitor, we encourage you to check your NABP eProfile account to validate your credits were transferred successfully before the ACPE 60-day deadline. After the 60-day deadline, the WSU College of Pharmacy and Pharmaceutical Sciences will no longer be able to award credit for this activity.

Accreditation for Pharmacists

The Washington State University College of Pharmacy and Pharmaceutical Sciences is accredited by the Accreditation Council for Pharmacy Education as a provider of continuing pharmacy education.

ACPE Activity Numbers:

0071-0000-22-001-H01-P
0071-0000-22-002-L01-P
0071-0000-22-003-H01-P
0071-0000-22-004-H08-P
0071-0000-22-005-L08-P
0071-0000-22-006-H01-P
0071-0000-22-007-H01-P
0071-0000-22-008-L01-P
0071-0000-22-009-H01-P
0071-0000-22-010-H01-P
0071-0000-22-011-L01-P
0071-0000-22-012-H01-P
0071-22-001-CP

Release Date: March 8, 2022
Expiration Date: March 8, 2025

AMA PRA Category 1 Credits™
This activity has been planned and implemented in accordance with the accreditation requirements of the Washington State Medical Association through the joint providership of Providence Health Care and Elson S. Floyd College of Medicine. Providence Health Care is accredited by the WSMA to provide continuing medical education for physicians.

Providence Health Care designates each activity for a maximum of 1.0 or 2.0 *AMA PRA Category 1 Credits*™, as designated in each activity description. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

These activities meet the criteria for up to 16 hours of Category I CME credit to satisfy the re-licensure requirements of the Washington State Medical Quality Assurance Commission.

Financial Support

Financial support for this activity was provided by registration fees and the Washington State University College of Pharmacy and Pharmaceutical Sciences.

Additional Information:

For questions about the schedule, registration, or continuing education, please email CPE Administrator Terri Levien at pharmacy.ce@wsu.edu