A PROPOSAL FOR A PHARMD/DOCTOR OF PHILOSOPHY (PHD) IN PHARMACEUTICAL SCIENCES AND PHARMACOGENOMICS DUAL DEGREE PROGRAM AT UCSF

This proposal was developed by a group of faculty and staff from the School of Pharmacy in the Departments of Clinical Pharmacy and Bioengineering and Therapeutic Sciences. Input was obtained from UCSF faculty and staff and the Graduate Division.

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Section 1. Introduction

This proposal outlines the creation of a PharmD/Doctor of Philosophy (PhD) Dual Program in the rapidly evolving field of Pharmaceutical Sciences and Pharmacogenomics. The proposed new dual degree program will train the next generation of scientists on building core knowledge in science and therapeutics as well as in essential patient care skills, experiencing pharmacy practice in various clinical settings, exploring new ideas and innovations in science and practice, as well as train them on how to develop effective drug therapies for patients that have a minimum of adverse effects with the application of genetics and genomics. The establishment of this program will lead to transformational changes occurring in the field of precision medicine and individualized patient care. This program will give students the competitive edge for the most desirable careers in academia, as faculty members in schools and colleges of pharmacy, government, leaders in drug discovery and development in the pharmaceutical industry, or other health settings where they will engage in academic instruction, clinical care, and research. In addition, students in the PharmD-PhD program will meet all requirements for licensure as a pharmacist in the State of California.

The proposed PharmD/PhD in Pharmaceutical Sciences and Pharmacogenomics (PSPG) Dual Degree Program supports UCSF's Academic Mission statement: "…to attract and educate the nation's most promising students to future careers in the health sciences and healthcare professions…"; "to encourage and support research and scholarly activities to improve our basic understanding of the mechanisms of disease…and "to serve the community at large through educational and service programs that take advantage of the knowledge and skills of UCSF faculty, staff and students".

1.1 Aims and objectives

The UCSF School of Pharmacy has been number one in research funding from the National Institutes of Health (NIH) every year for over four decades. Our research encompasses the entire spectrum from understanding molecules to ensuring patients receive the right medications. With three departments focused on bioengineering and drug development sciences, pharmaceutical chemistry, and clinical pharmacy, along with a world-class faculty, our school is uniquely poised to educate the next generation of scientists focused on basic and clinical research and translating the research results to clinical practice. Within UCSF, both PharmD and PhD in PSPG are mature programs, with faculty who are leaders in academia and have a track record of successful graduates. We will be utilizing two world-class educational programs to provide a streamlined (6.75-year) program, culminating in PharmD/PhD Dual Degree Program. The proposed PharmD/PhD is dedicated to developing the next generation of clinical translational scientists by integrating rigorous pharmacy education with advanced training in pharmaceutical sciences and pharmacogenomics. We propose to matriculate the first students into the PharmD/PhD PSPG dual degree program in Summer 2027.

Students admitted to this dual program will be uniquely qualified to translate basic pharmaceutical sciences and pharmacogenomics research to clinical applications. The PharmD portion will consist of core didactic courses, clinical skills courses, and Introductory Pharmacy Practice Experiences (IPPEs) to be completed in the first two years, followed by clinical practice experience in the third through sixth years, and five Advanced Pharmacy Practice Experiences (APPE) in the seventh year. The PhD portion will begin with the student's first research rotation in the Spring of the second year, and a second research

rotation to be completed in fall of the third year, followed by didactic coursework in years three and four, as well as dissertation research in the third through sixth years. The third through sixth years will be spent primarily in a mentored PhD dissertation research project in pharmacogenomics and functional genomics, quantitative and systems pharmacology, computational genomics, molecular pharmacology, drug development sciences, or therapeutic bioengineering. The expectation is that at least one first-author paper is “in press” before the PhD thesis is signed. For details, see Core competencies and a graphic depiction of the PharmD/PhD Timeline in Section 2.3.2, and the detailed Curriculum in Section 5.

1.2 Historical development of the field

The History of Dual PharmD-PhD Degrees

The field of pharmacy continues to evolve and expand each year. Changes to pharmacy education and training have allowed pharmacists to assume increasingly diverse roles beyond medication dispensing and management of therapy to providing healthcare and conducting research in academia and industry. The rapid advancements in pharmaceutical sciences, including pharmacokinetics, pharmacodynamics, pharmacogenomics, and molecular pharmacology, highlighted a critical gap: the need for experts who could bridge clinical practice and research.

Based on these needs, the dual PharmD-PhD degree program has been developed, with the first program established in the 1980s. The dual PharmD-PhD degree program represents a unique educational pathway, which combines the clinical training of the PharmD with the rigorous scientific research training of the PhD.

Initially, these dual degree programs were small, enrolling only a few highly motivated students, who demonstrated exceptional clinical practice and research aptitude. The programs typically required 7 to 9 years of intensive study, integrating the core curriculum and clinical training of the PharmD program, along with the research-focused coursework and dissertation requirements of the PhD. Early graduates of these programs played significant roles in advancing pharmaceutical research, particularly in the areas of drug delivery systems, pharmacogenomics, and translational pharmacology.

The 1990s and 2000s saw a significant expansion of dual PharmD-PhD programs across the United States. This was driven by both increased funding for biomedical research and a growing recognition of the value of clinician-scientists. The National Institutes of Health (NIH) and other funding agencies began prioritizing translational research, further underscoring the need for clinician-scientists. During this period, programs also started to become more structured. Many institutions started to implement more efficient educational pathways to reduce the time to degree completion. This included integrating coursework and research rotations early in the degree training process. Additionally, the rise of interdisciplinary research allowed collaborations between pharmacy schools and other departments, which enriched the training experience for dual-degree students.

Despite their growth, dual PharmD-PhD programs face several challenges. Recruitment remains a significant hurdle due to the lengthy and demanding nature of the program. Financial support is another key issue, as many students require funding for tuition and living expenses throughout the extended training period. Nonetheless, the opportunities for dual-degree graduates are substantial. Along with the

extensive clinical training, they can lead research efforts in areas such as precision medicine, drug discovery, and health outcomes, contributing to potential innovations that directly impact patient care.

The role of dual PharmD-PhD programs is likely to expand further as healthcare and pharmaceutical research become increasingly complex and interdisciplinary. As expanded below, emerging fields such as pharmacogenomics, systems pharmacology, and artificial intelligence in drug development will require professionals with both clinical and research insights.

The Pressing Need for Clinician-Scientists

Prior studies and clinical experience suggest that patient complexity, influenced by comorbidities, polypharmacy, and various environmental factors, has increased in health systems worldwide. As a result, revolutionary advances in healthcare have developed over the years. An example of that is applying novel treatments that target specific subsets of patients to better address certain underlying genetic factors. Additionally, this has led to the development of the innovative field of precision medicine, in which personalized treatment approaches that consider patient's genes and other environmental factors are applied. Evidence suggests that implementing these personalized approaches improves treatment efficacy and safety, as well as the patient's quality of life. Personalized medicine also has the potential to decrease overall healthcare costs, by minimizing unnecessary treatments and reducing the need for further medical interventions due to decreased drug side effects and complications.

Drug discovery and development have also advanced over the past few decades. The increased understanding of biology and chemistry has led to advancements in drug design strategies. The adoption of artificial intelligence, genomics, and high-throughput screening is also accelerating drug discovery, requiring more experts in these areas. For example, genomics and proteomics identified vast arrays of novel drug targets, structure-based drug design involving X-ray crystallography, and molecular modeling. This allowed the rational design of new and improved therapeutics, recombinant DNA technology, gene therapy, and more.

A growing number of diseases (specifically, rare diseases) with limited treatment options are pushing the need for new drug candidates, which creates the need for leaders who can identify potential targets and develop effective targeted therapies. Additionally, developing new therapeutic agents continues to be an expensive, complex, arduous, and risky process; less than one percent of candidate drugs progress from conception to market with current costs soaring over $1B per drug. Many strategic approaches have been proposed to improve the success in drug discovery and development including integrating computational, bioinformatic, pharmacogenomic, and artificial intelligence/machine learning methods. Importantly, pharmacogenomics has a tremendous role in drug discovery and development through target identification, patient stratification in clinical trials, adverse drug reaction prediction, and drug efficacy prediction. Additionally, the first in human dose is increasingly determined using computational Physiologic Based Pharmacokinetic Models, which exploit drug transporter and drug-metabolizing enzyme data to predict in vivo pharmacokinetics, doses, efficacy, and safety. Moreover, artificial intelligence/machine learning approaches are increasingly employed in drug discovery and development to help in target identification and validation, virtual screening, drug repurposing, and prediction of clinical trial outcomes, which can all improve the success rate and reduce costs.

The field has also seen large advances in clinical trials with new techniques such as adaptive clinical trials, applying more pharmacometric analysis, model-informed drug development approaches, real-world data (RWD), real-world evidence (RWE), and equitable trial design to traditional healthcare. One method that has gained traction post-COVID pandemic is the decentralized clinical trials, bringing trials to patients, rather than patients to trial sites. In these trials, incorporating telemedicine and decentralization increases trial access to larger and more diverse applicant pools. Additionally, it decreases the workload for trial investigators, with novel electronic tools. Not only are the preclinical and clinical portions of drug development rapidly transforming, but post-clinical strategies for commercialization, marketing, and post-marketing surveillance and vigilance are also evolving.

Given the wide range of disciplines and techniques that are required for effectively treating patients with complex needs and for cutting-edge drug discovery and development, it is clear that a multi-disciplinary approach involving collaboration and integration of computational and pharmacological disciplines along with clinical training is essential. Training a new generation of clinician-scientists in pharmaceutical sciences and pharmacogenomics will lead to the next stages of innovation and advances for the future of clinical practice as well as drug discovery and development.

Below is a review of the different fields involved in this novel approach to pharmaceutical sciences and pharmacogenomics.

1-Functional Genomics

The goal of genomic analysis, which focuses on analysis of the human genome, is to discover genetic variants that are associated with human traits including physical traits as well as susceptibility to disease.

Pharmacogenomics applies genetics and genomics to investigate the causes of individual variations in drug response and how mutations in the genome can influence a patient's response to drug therapy. Application of pharmacogenomic methods helps predict the action and predisposition of drugs and optimize therapeutic regimens. Pharmacogenomic methods include functional, computational, and clinical genomics.

Functional genomics explores the functions and interactions of genes and proteins by studying the effects of genetic mutations and polymorphisms on gene function. Functional genomics can range from studies of single variants to complex deep mutational scanning studies in which every amino acid residue is mutated to every other amino acid and the resultant proteins are functionally characterized. These high throughput methods require sophisticated data analyses to interpret the results and apply these results to predicting risk for disease or interindividual variation in drug response. Other methods combine data derived from the genome and its products (RNAs and proteins) and their intricate regulation and interactions. These studies aim to understand disease risk or variation in drug response as well as to investigate the fundamental mechanisms of transcriptional control underlying cellular function. Together, these data may be used to model interactive and dynamic networks that regulate gene expression (epigenetics), cell differentiation, and cell cycle progression. Moreover, metagenomics is a new emerging research area, which aims at studying the genetic material (individual genes and genetic mutations) of the human microbiome and other microbial communities.

Genetic epidemiology focuses on the population-level study of how genetic variations influence human traits, such as human health and disease. This field brings together genetics, epidemiology, and biostatistics to identify genetic factors, which contribute to complex and heterogeneous diseases. In this field, large genomic and epidemiologic/phenotypic datasets are mined to discover genetic and environmental factors that predispose to disease, which may differ between genetic ancestries.

2-Computational Genomics, Bioinformatics, and Machine Learning-based Analyses

Genome-wide association analyses interrogate the entire genome of a patient to discover genetic variants that confer risk for disease, disease progression, or interindividual variation in drug response. With the increasing transition from genotyping platforms that identify 500,000 to 1 million polymorphisms to NextGen sequencing methods such as whole genome sequencing, the data analysis methods have become highly computational, requiring large computational power and methods. Computational genomics and bioinformatics address critical problems at the intersection of genomics and computer science. Advances in technologies such as sequencers and microarrays generate high-volume, high-velocity, and high-variety datasets that hinge on computational methods for processing.

Computational genomics employs statistical analysis and machine learning tools to: (1) Analyze the huge datasets from DNA sequencers and microarrays, (2) model biological phenomena and make predictions, (3) combine data from disparate datasets to reach new conclusions in the presence of error and systematic bias, (4) manage and store huge quantities of data economically and securely while also allowing it to be queried, (5) visualize large and complicated datasets, (6) study the interplay between human evolutionary history and environmental contributions to complex diseases, (7) integrate, leverage, and reason over genomic and other molecular and clinical datasets to yield tools for physicians and patients.

3-Systems Pharmacology

Systems pharmacology seeks to understand how the human body as a complex biological system interacts with drugs. Instead of considering the effect of a drug to be the result of one specific drug-protein interaction, systems pharmacology considers the effect of a drug to be the outcome of a network or combination of interactions a drug may have. Networks of interactions encompass microscopic and macroscopic levels and include chemical-protein, protein-protein, genetic, signaling, and physiological (cellular, tissue, organ, and whole body) interactions. While experiments will always play an essential role in systems pharmacology, advances in the field leverage bioinformatics, statistical, and computational approaches to integrate and interpret these complex biological networks.

Combining a systems-pharmacology perspective with computational methodologies to predict, model, and simulate potential therapeutic agents and their interactions with target molecules is a powerful new approach in the drug discovery process. This integrative approach streamlines the years-long complex, laborious, and costly process of identifying and testing new compounds for targeted therapy and greatly impacts medical science. Additionally, computational approaches can be used to study the dynamic interplay between disease progression, treatment regimen, drug, and biomarker response to determine causal links underlying variability in safety and efficacy outcomes.

4- Pharmacokinetic/Pharmacodynamic (PK/PD) Modeling

PK/PD modeling is a mathematical technique that combines the two classical pharmacologic disciplines of pharmacokinetics and pharmacodynamics to predict the effect and efficacy of drug dosing over time. Pharmacokinetic models describe the absorption, distribution, metabolism, and excretion of a drug while pharmacodynamic models quantify the relationship between drug concentration and therapeutic effects of drugs, with the consideration of the mechanism of drug action and major rate-limiting steps in the biology of the system.

A standard PK modeling tool is non-compartmental analysis (NCA). The NCA model estimates PK parameters (absorption, distribution, metabolism, elimination) assuming a dose of an administered drug distributes uniformly in the body and the elimination of the drug is defined by a rate constant, but it does not account for any physiological or biological processes that alter PK.

In contrast, a Physiologic Based Pharmacokinetic (PBPK) model employs computational methodologies to integrate physiological and biological processes such as organ function, enzyme/transporter abundance and function, and blood flow to quantitate and predict PK parameters in patients. The effect of physiological and biological processes on PK parameters can be extensive and translate into varying therapeutic outcomes. Thus, the application of PBPK models can significantly improve and innovate drug development.

Population PK/PD modeling provides estimates of drug concentrations and drug effects (PK or PK/PD parameters) within a patient population receiving a drug of interest by identifying sources of variability (covariates) in the population and then quantifying the impact of each covariate through a modeling system.

Population PK/PD uses pharmacometric or mathematical models to interpret and describe pharmacology in a quantitative method. Pharmacometric approaches in population PK/PD enable the integration of data collected from different sources (covariate information such as weight, age, renal/hepatic function, and concomitant medications) to explain PK variability within a population and draw conclusions.

The statistical methodology, nonlinear mixed effects modeling (NONMEM), is routinely used for population PK/PD analysis to:

- Estimate typical PK or PK/PD parameters for a specific population
- Investigate PK or PK/PD variability
- Identify significant intrinsic and/or extrinsic factors (covariates) affecting PK or PD and
- Define dose-concentration-effect relationships

The application of pharmacometrics has enormous potential to improve and advance drug development and pharmacotherapy. The pharmaceutical industry is increasingly integrating pharmacometrics into its development program, but there is a lack of and need for experienced pharmacometricians since few academic programs exist to train them.

5-Molecular Biology and Cancer Biology

Molecular biology studies the molecular basis of biological activity, including the biological molecules' structure, function, and evolution. These molecules include proteins and nucleic acids. The following are examples of research areas in the molecular biology field:

-Studying the G protein-coupled receptors to develop new safe and effective medicines

-Studying membrane trafficking of ligand-gated ion channels to elucidate specific mechanisms of receptor membrane trafficking

-Elucidating cellular and molecular mechanisms that can be targeted to halt the aging process

-Studying how intracellular and extracellular factors in tissue microenvironment can affect HIV infection and mucosal immunity

-Understanding the molecular principles of signal transduction events under physiological conditions and human diseases

Cancer biology studies the biological processes that lead to cancer, metastasis, and treatment resistance. In this field, computational and experimental strategies can be integrated to identify and characterize key regulatory programs that underlie tumor initiation and progression. This is to understand the molecular basis underlying cell signaling pathways, oncogene signaling, cancer growth, and metastasis. This can lead to improving cancer therapy and patient survival through the identification of novel therapeutic approaches that target genetic mutations and altered signaling networks that are specific to cancer cells.

6-Real-world Data (RWD) Analyses

Real-world data (RWD) is defined as the data relating to patient health status and/or the delivery of health care routinely collected from a variety of sources. Sources of RWD include but are not limited to electronic health records (EHR), medical and health insurance billing claims, patient surveys, product and disease registries, data gathered from mobile and wearable devices, and molecular data (biobanks). RWD is used throughout the drug development process. For example, clinical trials may include RWD together with prospective clinical trials to interpret the effects of new drugs in the context of routine medical care. During post-marketing surveillance, RWD has become routinely used to monitor drug safety and efficacy. RWD can be a powerful resource in scientific research when used alone or concurrently with biological or biomedical research to give additional insights into the efficacy and safety of therapeutic regimens. Challenges now lie in developing methods beyond traditional statistical techniques to process and analyze the massive influx of RWD generated daily at an increased rate from various sources. Computational approaches including AI-powered platforms can be used to better analyze and visualize these resources and extract insights to improve and accelerate the development of therapeutic treatments. Additionally, computational approaches in pharmacogenomics and pharmacoepidemiology can be leveraged to use the HER-linked biobanks from diverse populations.

The proposed dual degree program will provide education in the different fields outlined above in the PhD portion along with building the student's core knowledge in essential patient care skills and practicing pharmacy in the PharmD portion. The graduates of the proposed dual degree program will be clinician-scientists who are capable of translating research results into clinical practices. This program

will prepare graduates for careers in academia (as faculty members in schools and colleges of pharmacy), government, leaders in drug discovery and development in the pharmaceutical industry, or other health settings where they will engage in academic instruction, clinical care, and research.

1.3 Strengths at UCSF

UCSF is the leading university exclusively focused on health and is a world-renowned biomedical research institution. It consistently ranks in the top group of higher learning institutions in total federal funding for research and training. In 2023, and for the 44th consecutive year, the UCSF School of Pharmacy received more research funding from the National Institutes of Health than any other pharmacy school nationwide. The culture of innovation and multidisciplinary collaboration has resulted in faculty winning nearly every leading prize in the health sciences and countless discoveries in the treatment and prevention of disease. Among faculty members are 7 Nobel laureates, 53 National Academy of Sciences members, 100 National Academy of Medicine members, 18 Howard Hughes Medical Institute investigators, 65 American Academy of Arts and Sciences members, and 68 fellows of the American Association for the Advancement of Science members. It is evident that UCSF exceeds the intellectual capital and programmatic resources needed to initiate a PharmD/PhD dual degree program in pharmaceutical sciences and pharmacogenomics, along with the stature to attract the most competitive students at UCSF, in the UC system, and internationally.

The proposed PharmD/PhD in pharmaceutical sciences and pharmacogenomics Dual Degree Program will draw on faculty resources, programs, institutes, centers, and research areas uniquely available at UCSF. A review of UCSF programs and resources are outlined below, starting with the three departments in the School of Pharmacy.

1.3.1 Department of Clinical Pharmacy

The Department of Clinical Pharmacy is involved in educating Doctor of Pharmacy (PharmD) students and other health professional students at UCSF. It is also involved in the training of the postdoctoral PharmD residents to ensure they develop the skills needed for clinical practice through the pharmacy residency program. The department also provides fellowship opportunities for PharmD, PhD, and MD graduates with specialized training ranging from the lab to the clinic, company, and government agencies. These fellowship programs include the UCSF-Genetech Clinical Development Fellowship Program, Program for Outcomes, Pharmaceutical Economics, and Policy Studies (PrOPEPS) Pharmacoeconomic Fellowship, and the UCSF Center for Translational and Policy Research on Precision Medicine (TRANSPERS). Overall, the department provides innovative, interprofessional experiences to students and pharmacists, and educates them to apply evidence-based approaches to practice. It also optimizes health outcomes through partnerships with patients, caregivers, healthcare professionals, policymakers, and health plans. Moreover, the Department of Clinical Pharmacy shares its expertise nationally and internationally through courses, offered to professionals in industry, regulatory agencies, academia, and healthcare. An example of these courses is (Rx for Change: Clinician-assisted Tobacco Cessation), a comprehensive tobacco cessation training program that equips health professional students and practicing clinicians, of all disciplines, with evidence-based knowledge and skills for assisting patients with quitting.

As for research, the department generates and disseminates knowledge to advance patient care, medication safety, disease prevention and treatment, health care cost-effectiveness and quality, and pharmacy education. The department supports scholars whose work is critical to the research mission of

UCSF. Research in the Department of Clinical Pharmacy focuses on the precise, personalized relationship between patients and their medications. It also examines broader relationships between patients and the health care and public policy environments that influence factors, such as medication cost and access, health disparities, and pharmacy practice models. The fundamental goal of the department's research is to ensure the safest, most effective use of affordable, accessible medications for all patients. This goal might be accomplished via a clinical study on the genetic response of a patient group to a drug, or through a practice study that looks at a new way to ensure patients are taking their medications as prescribed and reporting any medical problems or lifestyle challenges with their regimens. The department's research areas mainly focus on clinical research, education research, and health services and policy research. Within the clinical research area, the department researchers seek to determine the safest, most effective use of medications for a given patient or population with a specific disease, focusing on medication outcomes and comparative effectiveness, pharmacoepidemiology, pharmacogenomics, as well as pharmacodynamics and pharmacokinetics. Within the education research area, the department researchers determine, develop, and implement the most effective means of teaching how to deliver pharmacy care by creating and evaluating training programs and curricula. Within the health services and policy research area, the department researchers study broad medication-related factors that affect the health of patients and populations, focusing on global health, health disparities, health policy analyses, health delivery education, pharmacoeconomics, personalized medicine, and pharmacy practice research.

Faculty in the Department of Clinical Pharmacy rank among the elite pharmacy educators and practitioners, and their research explores the safest, most effective use of medicines as well as non-clinical factors that affect the health of patients and populations, such as health policies and the cost-effectiveness of medication therapies. They prepare PharmD students to become leaders of the profession, train pharmacy residents as therapeutics specialists, teach healthcare professionals about safe and effective medication use, share their expertise beyond UCSF, and continually educate themselves about new developments in their field. Many faculty pharmacists practice in acute and ambulatory care settings at UCSF Health as well as in hospitals, clinics, community pharmacies, and physician group practices throughout California. Additionally, faculty pharmacists regularly apply medication therapy management (MTM), working with patients, families, and physicians toward a safe, effective, and cost-conscious medication therapy plan. In MTM, the pharmacist reviews the patient's medication history, creates a personal medication record, creates a medication-related action plan, intervenes to address medication-related problems, and documents and tracks MTM services. The Department of Clinical Pharmacy and the UCSF Health Pharmacy Enterprise have worked together since the 1960s to improve the pharmacy care of patients. The vision of the Department of Clinical Pharmacy is to change the face of pharmacy through innovation to improve health.

1.3.2 Department of Bioengineering and Therapeutic Sciences (BTS)

The UCSF Department of Bioengineering and Therapeutic Sciences (BTS) trains students to study the complex processes of biology and apply their knowledge to the development and rational use of therapeutics to improve health. BTS research ranges from how an individual's genetic profile affects drug response to how nanotechnology can be used to build devices and drive the development of new medicines, medical devices, and diagnostic tests. The BTS faculty are experts in fields of microelectromechanical systems to drug metabolism and transport, and from computational biology to personalized medicine. The scientist-educators who advance research in the BTS department are closely involved with 5 PhD programs administered by the School of Pharmacy: PhD in Bioengineering, PhD in

Biological and Medical Informatics, PhD in Biophysics, PhD in Chemistry and Chemical Biology, and PhD in Pharmaceutical Sciences and Pharmacogenomics.

The BTS faculty are also engaged in other programs such as teaching students in the UCSF PharmD program how and why medications act in patients. They work jointly with the Department of Bioengineering at UC Berkeley and administer the Master of Translational Medicine (MTM) program which imparts students with the knowledge and skills necessary to bring medical innovation from the engineer's bench to the patient's bedside. BTS houses the UCSF-UC Berkeley Joint Graduate Group in Bioengineering, offering a joint PhD program for students who are interested in pursuing academic or research-focused careers along with a Master of Engineering (MEng), a professional degree program with a strong emphasis on engineering and entrepreneurship, that is designed for students planning to move directly into industry after completing the program. The BTS also offers the Master of Science in Artificial Intelligence and Computational Drug Discovery and Development (AICD3), which trains students to apply computer science, data science, statistical analysis, machine learning, and other data-driven methods to redefine the discovery and development of new drugs and therapies.

The BTS department's vision is to have discovery and development of astute therapeutics flow freely from continuous innovations in research in computational biology, precision medicine, and therapeutic bioengineering and in graduate-level science and health professions education.

1.3.3 Department of Pharmaceutical Chemistry

The Department of Pharmaceutical Chemistry research areas include chemical biology and medicinal chemistry, computational chemistry and biology, physical biology and protein and cellular engineering. Its research explores fundamental biological mechanisms and molecules of therapeutic relevance for better health, empowered by novel technologies at the interface of chemistry, physics, and computational sciences. Pharmaceutical Chemistry research into new molecular treatment targets, new and more precise ways to therapeutically alter target activity, and new biomarkers to track disease and treatment efficacy helps elucidate the biological principles of small molecules, proteins, and cellular design and allows the application of these principles to positively impact the therapeutic outcome of patients. The Pharmaceutical Chemistry faculty help train students in many PhD programs at UCSF. The department is involved with 5 PhD programs administered by the School of Pharmacy, together call the Quantitative Biosciences Consortium (QBC): PhD in Bioengineering, PhD in Biological and Medical Informatics, PhD in Biophysics, PhD in Chemistry and Chemical Biology, and PhD in Pharmaceutical Sciences and Pharmacogenomics. It is also engaged in teaching students in the Doctor of Pharmacy (PharmD) and professional degree programs in other UCSF schools.

1.3.4 Quantitative Biosciences Institute (QBI)

Quantitative Biosciences Institute (QBI) is an organized research unit within UCSF's School of Pharmacy focused on quantitative biology and collaborations around it. At the heart of their collaborative efforts is technology and the data derived from it. QBI scientists are experts in developing experimental and computational tools that can be applied to many biological or biomedical problems. These tools play a key role in bridging discovery research and clinical worlds resulting in novel therapies for disease. Its technologies include cryo-electron microscopy (CryoEM), microfluidics, docking, mass spectrometry, x-ray crystallography, and modeling protein structure.

In addition to the UCSF School of Pharmacy departments and resources, the PharmD/PhD Dual Degree Program in Pharmaceutical Sciences and Pharmacogenomics will draw from the strengths of the School of Medicine and other related UCSF-affiliated programs. These groups are outlined below.

1.3.5 The UCSF Institute for Human Genetics (IHG)

The Institute for Human Genetics (IHG) is an Organized Research Unit within the School of Medicine, serving as the hub for all activities related to human genetics at UCSF. It is composed of over 80 faculty members from all four schools, Medicine, Pharmacy, Nursing, and Dentistry, all who share a passion for human genetics. Led by director Nadav Ahituv, the Institute provides a focal point for genetics and genomics research, industry partnerships, technologies, training, and education. IHG's Genomics Core Facility also provides state-of-the-art technology to the UCSF campus, including DNA extraction, genotyping, sequencing, and data analysis.

The IHG focuses on several research areas, including bioethics, cancer and cardiovascular genetics, functional genomics, genetic epidemiology, immunogenetics, metabolic genetics, neurogenetics, pharmacogenetics, population genetics, reproductive genetics, and statistical genetics. Members of IHG actively participate in several PhD training programs through teaching and mentoring. These programs are PSPG, Biomedical Informatics (BMI), Biomedical Sciences Graduate Program (BMS), Developmental & Stem Cell Biology Graduate Program (DSCB), Epidemiology and Translational Sciences (ETS), Graduate Program in Bioengineering (BioE), Herbert W. Boyer Program in Biological Sciences (PIBS), Integrative Program in Quantitative Biology (iPQB), Neuroscience Program, Oral and Craniofacial Sciences Graduate Program (OCS), and Tetrad Program. The BMS track in genomics and genetics was converted specifically to human genetics, and the PSPG and BMI graduate programs were infused with a large number of new faculty in the areas of pharmacogenetics and computational genomics, greatly strengthening offerings for graduate students. The IHG also provides several professional schools and training programs within the School of Medicine, Nursing, and Pharmacy, as well as the genetic counseling. It provides bioinformatics workshops, including DNA variant analysis and RNA-seq analysis. The IHG additionally offers the Genomics & Precision Medicine Online Course, which aims to provide participants with baseline knowledge of genomics, an overview of the clinical applications of genomic medicine, the clinical validity and utility of new tests, and the ethical and social issues inherent in this field. The IHG provides the UCSF community with key services for genetic and genomic research, including research Illumina sequencing, whole genome sequencing, SNP genotyping, and DNA extraction. It also provides High Performance Computing & Data Storage services.

1.3.5 Clinical and Translational Science Institute (CTSI)

Established in 2006, the Clinical and Translational Science Institute at UCSF was one of the first 12 academic institutions selected to be part of the NIH's national Clinical & Translational Science Consortium. UCSF's CTSI has a charter to transform clinical and translational research to ensure that the best health solutions get to patients as quickly as possible. CTSI is a cross-campus institute, with scientist leaders at its helm. The CTSI is a tremendously important part of the training environment at UCSF. The CTSI Clinical Research Centers provide an array of adult and pediatric services and translate promising clinical research ideas into successful clinical protocols. UCSF's CTSI is involved in national committees and activities in all major areas identified as necessary to support clinical and translational research.

1.3.6 The Chan Zuckerberg Biohub Network (CZ Biohub Network)

The Chan Zuckerberg Biohub Network is a group of non-profit research institutes that bring together scientists, engineers, physicians and other translational scientists, and technologists with the goal of

pursuing grand scientific challenges on 10- to 15-year time horizons. Established in 2016 in collaboration with Stanford University, UCSF, and the University of California, Berkeley (UCB) to promote fundamental research that elucidates the mechanisms underlying disease and to develop new technologies that will lead to actionable diagnostics and effective therapies. To achieve these goals, CZ Biohub Network has established an in-house research program focused on infectious disease, cell biology, and technology platform development in areas including genomics, genome engineering, advanced optical microscopy, data science, and bioengineering. One of CZ Biohub Network's goals is to enhance collaboration between researchers and clinicians at Stanford, UCSF, and UCB. The extramural award program will draw on the strengths of all three institutions to carry out innovative, high-risk research that is likely to have high impact and would otherwise not be funded by conventional sources. San Francisco-based research efforts are currently focused on understanding dynamic cell systems, mapping changes in cell behavior in response to disease and infection to define underlying mechanisms and to identify potential targets for therapeutic intervention and diagnostic tools.

CZ Biohub Network welcomes applications from faculty teams representing diverse disciplines such as engineering, computer science, informatics, the physical sciences, the clinical sciences, and the biomedical sciences. The scope of proposals is open to all areas of biology, biomedical research, and technology development, including areas that are well outside the current CZ Biohub Network's Human Cell Atlas, Infectious Diseases Initiative, and Neurodegeneration Challenge Network. CZ Biohub Network wants teams to pursue ideas that excite them most and to address the questions or opportunities that team members consider to be fundamentally important based on their shared insights, expertise, and vision.

1.3.7 The UCSF-Stanford Center of Excellence in Regulatory Science and Innovation (UCSF-Stanford CERSI)

Regulatory science is the science of developing new tools, standards, and approaches to assess the safety, efficacy, quality, and performance of all FDA-regulated products. The UCSF-Stanford Center of Excellence in Regulatory Science and Innovation (CERSI) – the first regulatory science center on the West Coast – supports FDA's mission of protecting public health and advancing regulatory science through collaborative research projects, education/training, and outreach. Launched in 2014, UCSF-Stanford CERSI brings together a world-class team of scientists from two outstanding academic institutions to focus on innovative regulatory science research and training in collaboration with FDA scientists—generating new knowledge, tools and standards that help FDA in its regulatory decision-making. The center promotes interaction and collaboration between FDA scientists and the UCSF/Stanford community through an FDA Visiting Scientist Program as well as co-sponsored workshops and scientific meetings. In addition, UCSF-Stanford CERSI organizes courses and events on various aspects of regulatory science for UCSF and Stanford graduate students, postdoctoral fellows, industry scientists and FDA staff. CERSI research projects often result in scientific publications and contribute to FDA guidance documents. Several UCSF-Stanford CERSI research projects are with FDA Office of Clinical Pharmacology scientists.

The center aims to meet scientific challenges in issues of critical importance in the development and evaluation of FDA-regulated products and at a time of rapid technological progress by: 1) advancing regulatory science through the development and application of quantitative and systems-level methodologies, 2) creating a West Coast presence of the FDA to enhance its interactions with academia and the pharmaceutical, biotechnology, and high-tech industries around regulatory science, and 3) recruiting trainees into industry-partnered fellowships with local pharmaceutical companies, Genentech

and Gilead. The UCSF-Stanford CERSI builds on the enormous strengths of UCSF and Stanford University in the quantitative sciences and pharmacology to provide novel education, exchange, and collaborative research programs that focus on three key FDA priority areas as described in the FDA Strategic Plan for Regulatory Sciences: 1) improving preclinical safety and efficacy tests, 2) improving clinical trials and evaluation, and 3) harnessing diverse data sets through information sciences to accelerate and improve new drug development.

1.3.8 Pharmacogenomics Research Network (PGRN)

For over 25 years, NIH has supported the Pharmacogenomics Research Network, now including over 450 members worldwide. The PGRN is the premier pharmacogenomics network in the world and has a major goal of supporting research and implementation of pharmacogenomic discovery and clinical testing. Kathleen Giacomini, current Dean of the UCSF SOP and Professor in the Department of Bioengineering and Therapeutic Sciences, is the Co-PI of the NIH-PGRN Hub, which is the central coordinating body of the PGRN. Faculty members in PSPG program Drs. Bani Tamraz, Pharm.D., Ph.D., Janel-Long-Boyle, Pharm.D., Ph.D., Kathy Giacomini, Ph.D., Ron Krauss, M.D., and Akin Oni-Orisan, PharmD., Ph.D., are actively involved in the PGRN to enhance scientific exchange and to expand the boundaries of understanding drug response within the context of precision medicine – within the PGRN and between the PGRN and the scientific community at large. The PGRN-Hub organizes and sponsors semi-annual scientific meetings, often associated with annual meetings of major scientific societies such as the American Society for Clinical Pharmacology and Therapeutics (ASCPT), and monthly research in progress seminars. The PGRN-Hub and its activities play a major role in this proposed dual degree program and stimulating research in pharmacogenomics.

1.3.9 UCSF School of Medicine Department of Epidemiology and Biostatistics (DEB)

The Department of Epidemiology and Biostatistics (DEB) and its faculty provides a broad range of expertise in research areas ranging from aging and global health to biostatistics, cancer and cardiovascular disease, methods and analysis. The program offers courses in 17 areas of concentration including bioinformatics, biostatistics, data science, machine learning, and precision public health and computational epidemiology. The department also provides specific services in biostatistical and bioinformatics consultations through the Clinical and Translational Science Institute as well as support for complex, large-scale, high-volume research through its Data Systems Services group. Additional services through the Center for Bioinformatics & Molecular Biostatics include providing data, analytic and statistical support including training for UCSF students and faculty.

1.3.10 The UCSF Bakar Computational Health Sciences Institute (BCHSI)

The UCSF Bakar Computational Health Sciences Institute (BCHSI) headed by Atul Butte, MD, PhD, serves as a cornerstone of UCSF's efforts to harness the power of innovative computational technologies and "big data" to impact human health. BCHSI in collaboration with the UCSF Library, the Gladstone Institute, and the UC Berkeley D-Lab works to provide computational tools and other educational resources for UCSF students, faculty and staff. Additionally, BCHSI has built an infrastructure that provides UCSF scientists with the tools and training to advance the knowledge and application of machine learning and graphical network-based analytics across the spectrum of scientific research including basic science, clinical, translational and population health. BCHSI assets and resources include Wynton HPC, which is a large, shared high-performance compute (HPC) cluster; other data and tools, including Natural Language Processing (NLP), radiological images, and meta-data extracted from

DICOM (Digital Imaging and Communications in Medicine) headers; and the Scalable Precision Medicine Open Knowledge Engine (SPOKE). The SPOKE is a database containing multiple types of biological data, which allows the identification of new connections, with implications for biomedical applications like personalized medicine.

1.3.11 The UCSF Helen Diller Family Comprehensive Cancer Center

As a National Cancer Institute (NCI)-designated "comprehensive cancer center," the highest status given, The Cancer Center aims to shepherd new approaches to cancer prevention, detection, and treatment into clinical and population settings. The Center combines basic science, clinical research, epidemiology and cancer control, and patient care. From scientific research into molecular and genetic causes of cancer to clinical research into the safety and efficacy of innovations in cancer diagnosis and prognosis, the Cancer Center is also home to three of the five prestigious Specialized Programs of Research Excellence (SPORE) grants, sponsored by the National Cancer Institute.

Research themes include cancer disparities, hereditary cancers, precision medicine, population health, and immunotherapy, with key initiatives materializing through the Center for BRCA (BReast CAncer) Research, Global Cancer Program, Molecular Oncology Initiative, Precision Cancer Medicine Building, San Francisco Cancer Initiative, UC Cancer Consortium, and UCSF Cancer Research Strategic Plan.

The Center is affiliated with numerous hospitals and clinics as part of UCSF Health (Section 1.3.9) with the goal of increasing accessibility to clinical research trials and express referrals to cancer specialists in the Northern California region. The Cancer Center also collaborates closely with the Lawrence Berkeley National Laboratory, the oldest U.S. Department of Energy National Laboratory.

1.3.12 UCSF Health

Ranking among the best hospitals in the nation by U.S. News & World Report, UCSF Health/Medical Center provides convenient, award-winning, highly-specialized care with over 100 locations throughout Northern California. Services range from primary care to organ and bone marrow transplants to intensive newborn care.

UCSF Health brings together a vast range of specialists to drive breakthroughs and advancements in medical technologies and treatments with 750,000 patient visits annually. Not only does UCSF Health provide world-class care to patients, it has also earned a perfect score on the LGBT Healthcare Equality Index for eight consecutive years, Magnet designation from the American Nurses Credentialing Center (<7% designation rate), and six quality and patient safety awards from HealthGrades. As a leading health sciences university, UCSF is actively involved in more than 1,700 clinical trials. All trials are conducted in coordination with UCSF Medical Center.

1.3.13 The Center for Data-driven Insights and Innovation (CDI2)

The Center for Data-driven Insights and Innovation (CDI2) oversees the University of California Health Data Warehouse (UCHDW), a unique data asset created by electronic health records (EHR) as well as claims data from UC's six health centers, its self-funded health plans, and other external sources.

UCHDW currently holds modern data from over six million patients seen at a UC facility since 2012. These patients received care from nearly 150,000 health care providers in over 200 million encounters, with over 600 million diagnosis records, with over 400 million procedures, more than 600 million medication records, and with over two billion vital signs measurements and test results. Over 650,000 of these patients are primary care patients.

Current activities include, but are not limited to, Pharmacy Initiatives, enabling a system-wide pharmacy work group to identify areas of opportunity in the self-funded plan drug spend. Analyses included comparator lists of brand and generic drugs, system-wide trends for drugs prescribed as "dispense as written," and data for UC Care patients' diabetes treatment pathways. In 2018, this initial work started with four specific drugs in the areas of diabetes, cardiovascular disease, and psychiatry.

As detailed above, UCSF possesses superior scholarship and its faculty, research, and graduate programs are world-renowned. Building on the strengths of UCSF, the proposed PharmD/PhD Program will provide students the opportunity to train and become leaders in the field of pharmaceutical sciences and pharmacogenomics.

1.3.14 Gladstone Research Institutes

The J. David Gladstone Institutes occupy a ~200,000 sq. ft. research facility on the UCSF Mission Bay campus. The Gladstone organization is composed of three institutes: the Gladstone Institute of Neurological Diseases (GINO), the Gladstone Institute of Cardiovascular Disease (GICD), and Gladstone Institute of Virology and Immunology (GIVI). The Gladstone Institutes benefit from state-of-the-art facilities collectively equipped for all bacteriological, biochemical, immunological, neurological, and molecular and cellular biology techniques. Supporting units include a microscopy core, a blastocyst injection core, a behavioral assessment core, a genomics core, a biosafety level 3 laboratory, a flow cytometry core, a histology core, and a transgenic core.

The Gladstone Center for Translational Research facilitates interactions between Gladstone scientists and the biomedical industry—including venture capitalists, biotech firms, and large corporations. The Center's primary goal is to translate the results of Gladstone's basic science into therapeutics that help patients with cardiovascular, viral, or neurological diseases. Working in concert with the Gladstone intellectual property department, the Center engages with companies interested in licensing patented technology, collaborating on research goals, or launching startups. For example, the molecule-to-marketplace business unit facilitates technology transfer through collaborations with partners such as Lundbeck, Bristol-Myers Squibb, and Takeda.

1.3.15 California Institute for Quantitative Biosciences (QB3)

Governor Gray Davis created QB3 - which spans UC Berkeley, UCSF, and UC Santa Cruz - to support basic research in quantitative biosciences and to ensure that this work is commercialized as quickly as possible. QB3 has grown to over 220 research labs with 40 members of the National Academies and two Nobel laureates, helped launch 65 companies, and formed three major industry partnerships—each of which has succeeded as measured by growth and renewal. QB3 founded the first startup incubator in the UC system, the QB3 Garage, at UCSF in 2006. The QB3 incubator network now includes three campus sites and two private partners; 105 companies currently rent space in the network. Companies in the network have created more than 500 jobs and raised over $529M in venture financing.

1.4 Timetable for development of the program

We have developed a new overall curriculum for the PharmD/PhD Dual Degree Program in Pharmaceutical Sciences and Pharmacogenomics (PSPG). Our target matriculation time is Summer of 2027. The program anticipates an initial enrollment of two-three students each year.

The proposed timeline is for developing the dual degree program is shown in Table 1.

Table 1. Proposed Timeline for PharmD/PhD Dual Degree Program Development.

Date	Action	Proposal review step	Status
02/25/2025	Proposal to be submitted to the PharmD Curriculum & Educational Policy Committee (CEPC) 1 week in advance for review at the 03/04/2025 meeting	CEPC	CEPC review
03/01/2025	Send a letter & proposal to the chair of comparable UCSD program		Anticipated response in 4 weeks
03/04/2025	Proposed program to be presented to CEPC	CEPC	Anticipated CEPC review and approval by 03/25/2025
03/26/2025	Proposal to be submitted to Budget & Resource Management (BRM)	BRM	Anticipated BRM review and approval by 04/25/2025
04/26/2025	Proposal to be sent to the SOP Faculty Council (SOP FC) at least 1 week in advance of 05/08/2025 (Give the SOP FC at least 3 weeks' notice that the proposal will be submitted at the 05/08/2025 meeting)	SOP FC	Anticipated SOP FC review and approval at the 05/08/2025 meeting
05/08/2025	Proposal to be submitted to Graduate Division	Graduate Division	Anticipated Graduate Division one month review SOP-wide full faculty vote (2 weeks; by 05/22/2025)
05/25/2025	Proposal to be submitted to Grad Council & Academic Planning and Budget (APB)	Grad Council	Grad Council & APB concurrent review

06/19/2025	Proposed program to be presented at the Grad Council meeting	Grad Council	Anticipated Grad Council approval
06/20/2025	Proposal to be submitted to the Academic Senate Executive Council	Academic Senate Executive Council	Anticipated Academic Senate Executive Council review
07/23/2025	Proposed program to be presented to the Academic Senate Executive Council	Academic Senate Executive Council	Anticipated Academic Senate Executive Council approval
07/24/2025	Proposal to be submitted to Executive Vice Chancellor & Provost (EVCP) & Chancellor	EVCP & Chancellor	Anticipated EVCP & Chancellor one month review
08/25/2025		EVCP & Chancellor	Anticipated EVCP & Chancellor approval
08/26/2025	Proposal to be submitted to Coordinating Committee on Graduate Affairs (CCGA)	CCGA	Anticipated CCGA review (4-6 months)
01/26/2026		CCGA & UCEP	Anticipated CCGA & UCEP approval
12/01/2026	UCSF application deadline		
12/01/2026 - 01/2027	Applications review		
02/2026	Candidate interviews (Final decisions are made in late 02/2026)		
07/2027	First cohort of students matriculates		

1.5 Relationship of the proposed program to existing programs at UCSF

The proposed seven-year PharmD/PhD Dual Degree Program in Pharmaceutical Sciences and Pharmacogenomics is a unique joint effort between the UCSF School of Pharmacy's PharmD program and the Pharmaceutical Sciences and Pharmacogenomics PhD program from the UCSF Graduate

Division. The proposed program will include three-year PharmD program and four-year PhD program. Below we describe the overlap in course content between the proposed program and the existing PharmD and PhD programs.

PharmD program at UCSF: this program prepares students academically for a wide-open future in pharmacy practice while supporting their professional growth. This three-year, year-round PharmD curriculum is science-based, tightly integrated, and experiential. Scientific thinking underlies all coursework. Students actively engage in their learning as they build core knowledge, experience pharmacy practice firsthand from the first day of class, and explore new ideas and innovations in science and practice. The proposed dual degree program curriculum will draw from the PharmD program, and will additionally include a PhD portion in pharmaceutical sciences and pharmacogenomics. This will include integration of the PharmD curriculum and IPPEs in the first two years of the PharmD portion of the proposed dual degree program, clinical experience throughout the four years of the PhD portion, and APPEs as well as studying for the North American Pharmacist Licensure Examination (NAPLEX) in the last (seventh) year of the proposed dual degree program. In this dual degree program, the PhD dissertation research will count towards the PharmD discovery project (the PharmD discovery project will be waived), one APPE will be substituted by clinical practice during the PhD years (the third through the sixth year) that is composed of either one clinic day every other week or half clinic day weekly, and 240 hourse of APPEs spent in a pharmacogenomics clinical service.

PhD program in Pharmaceutical Sciences and Pharmacogenomics (PSPG): focuses on how to develop effective drug therapies for patients that have a minimum of adverse effects. In this program, graduate students are given solid training in the pharmaceutical-related basic sciences and develop into independent and creative scientific problem-solvers. This multidisciplinary graduate program has a dual focus: 1) pharmaceutical sciences and drug development, and 2) pharmacogenomics, which applies of genetics and genomics to drug action and disposition. The result of this dual focus is that it trains the next generation of scientists to explore new drugs in novel ways. This program focuses on six research areas: pharmacogenomics and functional genomics, quantitative and systems pharmacology, computational genomics, molecular pharmacology, drug development sciences, and therapeutic bioengineering. Within the PSPG curriculum, core courses provide training in the principles of pharmaceutical sciences, systems pharmacology and pharmacogenomics, biostatistics, and the ethical conduct of science.

The proposed dual degree program curriculum will draw from PSPG, and will additionally include a PharmD portion. The following PSPG coursework will be included in the proposed dual degree program: Systems Pharmacology (PSPG 245B.1), Systems Pharmacogenomics (PSPG 245B.2); Ethics and the Responsible Conduct of Research (GRAD 214); Biostat 272 – Foundations in Biostats; Racism in Science (GRAD 202);Grant Writing (BP 297);Pizza Talks (PSPG 225A); a Dissertation Research (PSPG 250); Student Research Seminar (PSPG 220); QBC Journal Club (PSPG 297); Formal Seminars (PSPG 223); and a PSPG Core Elective course

For the dual degree, Principles of Pharmaceutical Sciences – Pharmacokinetics, Drug Metabolism and Transport (PSPG 245A) will be waived and replaced by a self-study module, and Pharmacogenomics (PSPG 245C) will be replaced by a pharmacogenomics APPE with the UCSF Heath's pharmacogenomics clinical service. Additionally, the proposed dual degree program will include two instead of the traditional three lab/research rotations in the PhD program in the second and third year. Two mini courses will be also waived from the proposed dual degree program. The PhD coursework including PSPG 297, will be

delivered in the third and fourth years of the proposed dual degree program, while the PSPG 250, PSPG 220, and PSPG 223 will be delivered the third through the sixth year of the proposed dual degree program. Qualifying exams will occur in the fourth year of the program and thesis research will t span the third through the sixth year of the proposed program. This program prepares independent, creative leaders in the pharmaceutical sciences and in the application of genetics and genomics to the development of safe, effective drugs for patients. The dual degree program curriculum will draw from both PharmD and PSPG, thus no new courses are required to be developed.

PharmD-PhD in Pharmaceutical Sciences and Pharmacogenomics Sequential Degree Program: the overall goal of this program is to attract outstanding students who are committed to earning the PharmD degree and a PhD degree in Pharmaceutical Sciences and Pharmacogenomics (https://pharm.ucsf.edu/pharmd-phd). This career path meets the pressing need of translating basic science research into clinical application within a unique university that is devoted solely to the health sciences, including the core functions of discovery, translational science, and patient care. It is possible for the students to complete the requirements for both the PharmD and PhD degrees in a shorter time (7 years) than would be expected if the two degrees were obtained separately (8 years). However, the proposed dual degree program will allow the students to complete both the PharmD and the PhD portions in an even shorter time (6.5-7 years). This is because of the changes made in the proposed dual degree compared to the sequential degree program. The first change is the reduced number of PhD research rotations from three in the sequential degree to two in the dual degree program, by removing the Extended Discovery Project. Second, the PSPG 245C administered in the sequential degree program will be replaced with a pharmacogenomics APPE (240 hours) (with UCSF Health's Pharmacogenomics Clinical Service). Third, the PSPG 245A administered in the sequential degree program will be waived and replaced by a self-study module in the proposed dual degree program. Additionally, the two PSPG mini-courses administered in the sequential degree will be waived in the dual degree program. In the sequential degree program, a total of six APPEs are administered during the third year of the program, in addition to clinical experience included during the PhD years. Regarding the APPEs in the proposed dual degree program, the PhD dissertation research project program will count as two non-clinical APPEs, the clinical practice (one clinic day every other week or half clinic day weekly) included in the PhD years (year 3-6) will count as one APPE, in addition to the five last APPEs administered in the last seventh year of the PharmD/PhD dual degree program. This allows for a better and a more efficient integration of the two degree programs, advancing the student's both clinical and research skills at the same time, with a shorter expected time to completion.

Medical Scientist Training Program (MSTP): This dual degree program aims to train the next-generation physician-investigators by offering a rigorous, integrated, and supportive educational experience leading to both the MD and PhD degrees. The UCSF MSTP offers the combination of an outstanding public medical school with an innovative curriculum, committed and renowned faculty, and a collection of premier graduate training programs over 7-8 years. The MSTP students may join one of the following nine affiliated graduate programs: bioengineering, bioinformatics, biomedical sciences, biophysics, chemistry and chemical biology, developmental and stem cell biology, medical anthropology, neuroscience, or tetrad (biochemistry and molecular biology, cellular biology, developmental biology and genetics). Although there is some overlap between the MSTP and our proposed PharmD/PhD dual degree program, there are some important differences. Our proposed program mainly focuses on pharmaceutical sciences and pharmacogenomics with an overall goal of the administration of the safest and most effective drug therapies, whereas the MSTP mainly focuses on medical and biomedical sciences. Moreover, scientists from both pharmaceutical and medical backgrounds are integral to patient care and

drug discovery and development process. Therefore, it is essential to create PharmD/PhD programs that provide graduates with both clinical and pharmaceutical training as well as extensive research work. Once the PharmD/PhD dual degree program has been formalized and running successfully for 1-2 years, we plan to engage with School of Medicine leadership to explore options for having our PharmD/PhD students interact with students in the MSTP program through select activities where programmatic overlap exists and where interprofessional interactions would be highly beneficial for the learners. These may include research ethics training, inquiry-based mini-courses, clinical/research seminar series, professional development activities, and more.

Masters' Program in Artificial Intelligence and Computational Drug Discovery and Development (AICD3): This graduate program is 1.5 years (5 quarters). Students complete 38 units of didactic courses in the first three quarters, then complete a capstone project in the following two quarters (20 weeks). The program trains students to apply computer science, data science, statistical analysis, machine learning, and other data-driven methods to bolster the discovery and development of new drugs and therapies. The curriculum focuses on computational approaches spanning systems pharmacology, bioinformatics, physiologic-based pharmacokinetic/pharmacodynamic modeling, and pharmacogenomics, that will pave the way to transformational changes and innovation of drug discovery (e.g., identification of novel targets) and drug development (e.g., virtual human trials). Didactic courses provide students with in-depth foundational computer science knowledge and advanced computational skills, and cover the latest technological advancements while emphasizing the ethical implications and societal impacts of AI in healthcare. Some AICD3 coursework (TBD) will be open as electives to the students of our proposed PharmD/PhD program with permission of the instructor.

Coursework details for the PharmD/PhD Dual Degree Program in Pharmaceutical Sciences and Pharmacogenomics can be found in Section 5.

1.5.1 Alignment with Campus Academic Plan and Priorities

The proposed PharmD/PhD Dual Degree Program in PSPG is also well aligned with UCSF's current academic plan and priorities. First, we see resonance with the School of Medicine's 2025 Strategic Plan to Advance and Harness Technology of "pushing the boundaries of technology, its human interface, and data-driven applications in all areas of education, research, and healthcare." With a specific emphasis on computational genomics, the PharmD/PhD Dual Degree Program in PSPG aims to help expand this technological frontier. Second, the proposed program is well aligned with the School's of Medicine's 2025 Strategic Plan to Lead Innovation and Discovery of "continuing to promote curiosity-driven research to further our understanding of fundamental science; support excellence and innovation in education to meet the needs of society; and join with our community to use discovery to improve health locally and globally". With a specific emphasis on a molecular understanding of target and off-target effects of clinically used drugs and identification of genetic markers related to drug response along with the clinical experience gained, the PharmD/PhD Dual Degree Program in PSPG aims to help expand this pillar.

PharmD/PhD Dual Degree Program in PSPG also satisfies multiple points in the School of Pharmacy's 2022-2027 Strategic Plan for Education. Integrating the PharmD and PhD programs aligns with goal 2.3.1 "Promoting and supporting in-depth training in basic and clinical science and practice through sustainable expansion and enhancement of degree, fellowship, and residency programs"

The program is also consonant with the broader UCSF Health's Vision 2025 strategic plan, following one of its top priorities to "discover, develop, and embrace digital technology to deliver value to patients and referring physicians, and redesign our institution on a robust digital foundation." Keeping patient-centered care at the forefront of focus and aligning with the School of Pharmacy's recent appointment of Ryan Hernandez as a co-vice dean of diversity, equity, and inclusion (DEI), the PharmD/PhD Dual Degree Program in PSPG will embrace UCSF's core commitment to improving DEI.

1.6 Relationship of the proposed program to other UC programs

PharmD/PhD Dual Degree Program in Pharmaceutical Sciences and Pharmacogenomics is unique and will be the only program in pharmacogenomics in the University of California system, except for our programs mentioned in Section 1.5 (PhD in PSPG, and PharmD/PhD in PSPG Sequential Degree Program).

Outside of the previously mentioned QBC programs at UCSF, the next most similar is UC Berkeley's PhD in Molecular and Cell Biology. This program is focused on the molecular mechanisms inherent to life, including Genetics, Genomics, Evolution, and Development. However, there is no emphasis or special training in genomics in relation to drug response. The UC Berkeley's PhD in Computational Biology teaches mastery of computational science and traditional biology, but also does not provide training in drug discovery or development. Both PhD programs do not include PharmD program.

UC San Diego is also home to similar programs. The first similar program to our proposed dual degree program is the UCSD's PhD in in Biomedical Sciences (BMS). The goal of this program is to develop a diverse and highly trained biomedical workforce that will create new knowledge, solve problems, and contribute to the health and wellbeing of the mankind. Although the program faculty expanded to include research interests in cell and molecular biology, genetics, genomics, infectious disease, immunology, and cancer biology, there is no emphasis on genomics related to drug response. It does not also include the PharmD portion.

The most similar to the proposed the PharmD/PhD Dual Degree Program in PSPG would be the UCSD's Dual PharmD/PhD Program. This program aims to provide students with a visionary perspective on pharmaceutical sciences and drug discovery and development process. Students who complete this program will be uniquely suited to perform basic and clinical research and to translate the results of the research into clinical practice. This program has two different options: a preferred option A (2+PhD+2 structure) and an alternative option B (3+PhD+1 structure). In the preferred option A (which is very similar to the structure of our proposed dual degree program), the students complete all required coursework in the first two years of the PharmD program. During the Summers between the first and the second year as well as the second and the third year, the students are expected to complete the three required PhD lab/research rotations. After that, the students will engage full-time in their PhD dissertation research (the third through the fifth year). In the sixth and the seventh years, students return to complete their preclinical PharmD curriculum and the APPEs, respectively. In the alternative option B, the students complete all the required PharmD coursework and the three required PhD rotations in the first three years. Once the students complete their PhD dissertation research work over the fourth through the sixth years, they return to complete their PharmD APPEs in the seventh year. In the UCSD's dual degree program, the PhD coursework is equivalent to that of MD/PhD (MSTP) program. Specifically, students are exempt

from the core courses BIOM 200A and B, “Molecules to Organisms: Concepts” and “Molecules to Organisms: Approaches”. However, PharmD/PhD students are required to take the seminar course (BIOM 201) and to complete all Biomedical Sciences advanced coursework (electives) as required of other categorical PhD graduate students in the program. Research areas within the PhD portion of the UCSD’s dual degree program focuses on cancer biology, cell and developmental biology, computational biology and data science, genetics and genomics, immunology, microbiome and microbial sciences, molecular pharmacology and drug discovery, and neurobiology. Although there is some overlap between the two dual degree programs, the PhD coursework of the UCSD’ dual degree program is different than the PhD coursework of the proposed dual degree program. The PhD portion of the UCSD program mainly focuses on advanced and multidisciplinary training in basic and disease-oriented research, whereas the PhD portion in the proposed dual degree program mainly focuses on the interdisciplinary scientific areas encompassed by modern pharmaceutical sciences. The PhD coursework of the USCD program is mainly focused on biomedical research, ethics in scientific research, statistical inference, and grant writing skills. On the other hand, the PhD coursework of the proposed dual degree program is mainly focused on systems pharmacology, pharmacogenomics, responsible conduct of research, racism in science, foundations in biostatistics, and grant writing. Additionally, in our proposed dual degree program, one of 240 hours of APPE will be spent in a pharmacogenomics clinical service and one of the APPEs is substituted by clinical practice during the PhD years (one clinic day weekly), which are not present in the UCSD’s dual degree program. Moreover, due to the reasons explained in section 1.2 regarding the rapid advancements in pharmaceutical sciences, there has been an overall increased market demand for more leaders in drug discovery and development in academia, pharmaceutical industry, and other healthcare settings. This justifies the need for creation of more PharmD/PhD dual degree programs with more graduates who are competitive as leaders and researchers in biotechnology and pharmaceutical companies.

1.7 Contributions to diversity

UCSF is committed to diversity and strives to build a broadly diverse and inclusive community. The UCSF School of Pharmacy excels thanks to the contributions of people of all backgrounds, and is aligned with UCSF’s PRIDE (Professionalism, Respect, Integrity, Diversity and Excellence) values and strive to embody these values in everything the School does. One of the main themes of the School of Pharmacy current strategic plan is Diversity, Equity, and Inclusion (DEI), which aims to cultivate a culture of DEI among trainees, faculty, and staff; establish the infrastructure, programs, and events to support DEI efforts; and increase recruitment and retention of diverse trainees, faculty, and staff. The PharmD/PhD Dual Degree Program in Pharmaceutical Sciences and Pharmacogenomics will be built with a commitment to diversity, equity, inclusion, belonging, and justice in all its forms at all levels of operation. We will create a community where students, faculty and staff are chosen based on their qualifications and not by race, ethnicity, gender, religion, political views, disability, economic circumstances, sexual preference, or age. We will strive to establish a collaborative environment where people from diverse backgrounds learn from one another and work together to solve problems and make new discoveries in the field.

As part of the PSPG PhD Program, the PSPG DEI Committee was formed in 2020. The DEI Committee consists of at least four faculty members of the Group and at least four PSPG students. The goals of this committee are to combat intolerance and implicit bias and create a more equitable, inclusive and supportive environment for graduate students within the program and across UCSF. The PSPG DEI

Committee focuses on Transparency and Community Building, which focuses on inclusivity training and accountability within the PSPG community and raising awareness of structural racism by organizing events such as DEI-focused panel discussions and Juneteenth celebrations.

Commitment to diversity outreach and equity

We will follow the guidance and best practices of the UCSF Office of Diversity and Outreach to identify, recruit, and retain diverse students, faculty, and staff.

1. Student Recruitment: Considerable attention will be paid to recruiting underrepresented students including underrepresented ethnic minority students. We plan to actively recruit for a diverse and highly qualified pool of applicants via these guidelines:
    - Members of the Admissions Committee will be composed of at least 50% women and underrepresented minorities to ensure that women and underrepresented minorities have an equal opportunity to serve on the Admissions Committee.
    - Members of the Admissions Committee will review and use UCSF institutional guidelines and best practices on unconscious bias, and will employ a holistic approach to evaluation of applicants.
    - The program application will not allow submission of GRE scores.
    - A Diversity, Equity and Inclusion (DEI) officer (or "Equity Advisor") will serve in addition to the faculty representatives on the Admissions Committee.
    - Advertisements for the program will include the following language: "UCSF seeks candidates whose experience, teaching, research, or community service has prepared them to contribute to our commitment to diversity and excellence."
    - Recruitment and advertising events will target programs promoting diversity in pharmaceutical and biological sciences. These events will also focus on programs and institutions that serve underrepresented groups and women.
    - Direct Pipeline Programs: Three programs housed in UCSF School of Pharmacy include Pharmacy Post-Baccalaureate Program, Pharm Tech to PharmD Pathway, and UC Merced – UCSF BS to PharmD Program.
    - Annual ongoing presence at CSU campuses, many of which are designated as Hispanic Serving Institutions (i.e. CSU Dominguez Hills, CSU Long Beach, CSU Pomona).
    - Heavy Presence in the Central Valley, a designated healthcare desert with a large population of underrepresented students (CSU Fresno, CSU Bakersfield, UC Merced, etc.)
    - Active participation by faculty in the Summer Undergraduate Research Program sponsored by the Graduate Division.
    - UCSF faculty visits to minority institutions and institutions with significant minority student populations.
    - Advertisements and special mailings to minority institutions and institutions with significant minority student populations
    - Participation in the MARC program.
    - The program will engage and participate in outreach programs aimed at underrepresented groups, including the AI4ALL summer program at UCSF. The AI4ALL program provides high school students from underrepresented groups

access to educational, research, mentorship and grant funding opportunities in computer science disciplines including Artificial Intelligence and Machine Learning.

- To extend our reach for potential candidates outside of UCSF, we will expand our recruitment activities. These activities will include scheduling direct outreach activities at the American Society for Clinical Pharmacology and Therapeutics annual meeting; and a partnership with Historically Black Colleagues/Universities (HBCUs) with our presence at Atlanta University Center Consortium's (AUCC) annual recruitment event. AUCC members include Clark Atlanta University, Spelman College, and Morehouse College.

2. Faculty Recruitment: faculty from the PharmD and PhD in PSPG programs will engage in this proposed dual degree program. Additionally, the program will actively work to identify and recruit diverse and highly qualified faculty via these guidelines:
    - Search committee members will be of diverse background and experiences and have demonstrated commitment to advancing Diversity, Equity, Inclusion, and Belonging.
    - The search committee will include a Diversity, Equity and Inclusion (DEI) officer (or "Equity Advisor")
    - Recruitment and advertising will emphasize promotion of diversity in the mathematical, computer, health, and biological sciences, and that target professional organizations for underrepresented groups.

1.8 Administration of the program

The School of Pharmacy at UCSF will house and administer academic aspects of the PharmD/PhD Dual Degree Program in both the PharmD and Pharmaceutical Sciences and Pharmacogenomics graduate programs. The School of Pharmacy will provide administrative space and support for program faculty, and access to workspaces for students, as well as access to conference and meeting rooms for seminars at the UCSF Mission Bay and Parnassus campuses. The School of Pharmacy will also provide the students with the clinical practice experience for the PharmD program in community pharmacies, health systems, medical centers and hospitals, ambulatory care clinics, managed care, and industry within San Francisco Bay Area.

Faculty members from the both the PharmD program and the PhD program in Pharmaceutical Sciences and Pharmacogenomics will participate. The PharmD faculty members are expected to participate in teach and mentor students in the PharmD curriculum including integrated clinical sciences, clinical skills, inquiry, and/or experiential education (i.e., Introductory Pharmacy Practice Experiences [IPPEs] and/or Advanced Pharmacy Practice Experiences [APPEs]). Depending on each faculty member's series, they may also be required to provide clinical services and/or conduct research. PSPG PhD faculty members are expected to teach and mentor students, accept rotation students, serve on program committees, and attend seminars and retreats. Each faculty member must have an active research program, which includes publishing regularly as a senior author in peer-reviewed journals and securing peer-reviewed extramural support sufficient to maintain research program. In mentoring students, faculty research advisors are expected to provide a supportive and ethical environment for students to pursue their studies. The research advisor is expected to provide laboratory space for the student's research as well as salary

support (including fee remission) at the current graduate stipend level. This financial obligation should be taken into account before the faculty research advisor accepts a student into their group. A research advisor can have no more than six PSPG students in their mentorship at any period of time. In the case of exceptional circumstances, the faculty research advisor can petition the Steering Committee for an exception to the above obligations.
The PharmD/PhD Dual Degree Program in Pharmaceutical Sciences and Pharmacogenomics is granted by the UCSF Graduate Division. The budget will be overseen by the School of Pharmacy.

1.9 Governance of the program

The School of Pharmacy at UCSF will create the PharmD/PhD (in Pharmaceutical Sciences and Pharmacogenomics) Dual Degree Program. The PharmD/PhD dual degree program will be governed by five committees and associated faculty and members. The four committees are the 1) Steering Committee, 2) Curriculum Committee, 3) Admissions Committee, 4) Diversity Committee, and 5) External Advisory Committee.

1) The Steering Committee is the governing body of the PharmD/PhD Dual Degree Program in Pharmaceutical Sciences and Pharmacogenomics (PharmD/PhD in PSPG) Group, which will represent and provide overall leadership for the program and be responsible for its implementation. The Steering Committee will include Pharm.D. and Ph.D. scientists, reflecting the multidisciplinary nature of our training program. The Steering Committee will include Joanne Chun, PharmD, PhD, Director of Postgraduate Education Programs; Kathy Giacomini, PhD, BSPharm, Dean-School of Pharmacy; as well as the PharmD/PhD dual degree program co-Directors, Drs. Leslie Carstensen Floren, PharmD, PhD, MAEd, Associate Dean for Fellowships and Brian Shoichet, PhD. The Steering Committee will be responsible for the recruitment, assessment, and will convene with the Admissions Committee (see 3 below) to approve the final selection of the PharmD/PSPG PhD students, focusing on women and members of underrepresented groups. The Steering Committee will also define the skills, attributes, and knowledge of the program graduates. It will be also responsible for the ongoing review of the program effectiveness, including regular feedback from the students and program faculty. Other responsibilities of the Steering Committee include establishing relationships and maintaining liaison with other departments, organizations, programs, and students within and outside UCSF; ensuring timely and accurate communication with instructional faculty; and overseeing funding and resources of the program.

2) The Curriculum Committee will be composed of four members serving renewable 2-year terms. The committee shall meet yearly and as needed. The Curriculum Committee will consist of the program co-Director Dr. Floren, Dr. Joanne Chun, PharmD, PhD, Director of Postgraduate Education Programs, and Drs. Su Guo, PhD and Aparna Lakkaraju, PhD, co-Directors of the PSPG graduate program. Additionally, the curriculum committee will call upon experts of varied backgrounds including academia, industry, and clinical care on an ad hoc basis to assist in the review of the curriculum. Once the program is established, the Curriculum Committee will be responsible for reviewing and evaluating the existing curriculum and any proposed changes. Curriculum effectiveness will be assessed through student performance (competency-based assessments in the PharmD didactics, preceptor evaluations during the IPPE and APPE rotations), course grades (during the PhD didactics), course evaluations and faculty assessment. The Curriculum Committee will propose guidelines for student support including advising

and mentoring. Additionally, the Curriculum Committee will identify and evaluate new instructional faculty.

3) The Admissions Committee will be composed of six members. The committee will be drawn from members of the Pharm D program and PSPG faculty as well as 1-2 student members and shall meet yearly and as needed. Faculty and student members will serve for one-year renewable terms. The Admissions Committee will be responsible for the review, evaluation, and selection of applicants for interviews. The committee will interview selected applicants and/or nominate interviewers, and then rank and admit students to the Program. The Admissions Committee will also make recommendations regarding recruitment strategies that will result in successful recruitment of a high quality, diverse student population.

4) The Diversity Committee will be composed of four members serving renewable 2-year terms. The committee shall meet yearly and as needed. They are responsible for 1) reviewing integration of training on health equity, systemic racism, ethics, and health disparities in the curriculum, 2) soliciting feedback from matriculated students and from faculty, in particular those identifying with groups and communities underrepresented in the STEM fields, using both online anonymous surveys and focus groups, 3) conducting Town Hall meetings, at which the results of both surveys and focus groups will be presented and discussed and feedback on means to improvement will be actively solicited, and 4) reviewing recruitment practices, admissions outcomes, and climate survey and focus group feedback, and presenting a formal evaluation with concrete recommended next steps to the faculty and student body. Formal benchmarks will include absolute numbers and proportions of student applicants, accepted students, and matriculated students, who identify as members of marginalized or underrepresented groups.

5) External Advisory Committee: A group of external advisors drawn from local pharmaceutical industry, from similar PharmD-PhD programs, and from the FDA will be selected over the next six months with the help of stakeholders from the PharmD and PhD programs. Letter of support from the members of this committee will be obtained. The members of this committee will convene yearly to review the program and report the results of their assessment to the Steering Committee in order to guide program improvements.

All committee members will be selected by the Steering Committee in accordance with the recruitment guidelines covered in Section 1.7 and in consultation with other program committee members and faculty from the UCSF School of Pharmacy.

1.10 Program evaluation

The School of Pharmacy will establish a review process to ensure continuous, timely and thorough outcomes assessment of the program in its initial phase and as it develops and grows. The process includes meetings of the Steering, Curriculum, and Admissions Committees. In the first two years of student enrollment the committees will meet every 6 months. The Steering Committee will meet to review assessments and proposals from the Curriculum and Admissions Committee and discuss topics including but not limited to:

- Curriculum content
- Student number, diversity, and quality
- Student performance (evaluations)
- Student support
- Student feedback through experience surveys
- Faculty feedback through experience surveys

After the first 2 years of student enrollment, the Curriculum and the Admission Committees will continue to meet annually.

The program will employ the following outcome measures as part of the evaluation process:

- Course evaluations: After each quarter of instruction, students will provide feedback for each course through standardized course evaluations. The Curriculum Committee and faculty for the respective course will review the evaluations and submit findings and propose actions/changes to the Steering Committee.
- Faculty evaluations: After each quarter of instruction, students will provide feedback and evaluate the performance of the instructional faculty. This evaluation will include an assessment of teaching methods and effectiveness in teaching course materials. Any concerns will be noted and addressed by the Curriculum and Steering Committees. The Curriculum and Steering Committees will meet with the instructional faculty to discuss outcomes of the faculty evaluations and address any areas that necessitate change or improvement. These changes will be documented and maintained in the Program records.
- PhD Dissertation Project evaluations: Students will evaluate and provide feedback on their PhD Dissertation Project experience. Students will provide feedback on the PhD Dissertation Project Advisor and whether they are receiving adequate supervision and mentoring. The Program leadership will also evaluate the PhD Dissertation Project experience using the same evaluation criteria.
- Exit interview: At completion of the program, students will participate in a 1-on-1, 45-minute exit interview conducted by a member of the Curriculum Committee. Students will be asked to provide feedback on their education along with ideas on how to improve the student experience. This will allow students to reassess curriculum and their research experiences following the completion of the program. It will also allow students to provide feedback on topics not captured in the above evaluations. To supplement exit interviews, an exit survey will also be distributed by the Curriculum Committee to graduating students to provide a platform for those who feel more comfortable sharing their experiences anonymously.

- Career Outcomes evaluations: Graduates of the PharmD/PSPG PhD Program will be asked to complete a survey two- and five-years post-graduation that assesses the impact of the program on their skills and expertise, career path, ability to get a job in their desired area (current position), and career satisfaction. The key metrics will include: 1) transition to academic positions, research positions, and healthcare settings; 2) number of abstracts and manuscripts submitted; 3) presentations at national and international meetings; 4) awards, and other forms of recognition.

In addition to program review, a peer evaluation system is in place at UCSF as well as regular performance reviews of deans, departmental chairs, and faculty for purposes of promotion and advancement.

To ensure the financial soundness, viability, and sustainability, the PharmD/PSPG PhD Program will go through annual standard financial reviews with the UCSF Budget and Resource Management department. The PharmD/PSPG PhD Program will undergo an Academic Program Review every eight years with the UCSF Graduate Council and Graduate Division.

The Program Director will be responsible for keeping records of the above outlined evaluations and data that will establish the basis for annual reports of program performance. The evaluations and data will be reviewed by the Coordinating Program committee annually. This information will also be used for the Academic Program Review conducted by the UCSF Graduate Council and Graduate Division.

1.10.1 Student Performance Evaluation

Student performance during the PharmD (primarily in years 1, 2, and 6) will be assessed through integrated, summative assessments (generally 2 per integrated theme), participation in required learning activities, and evaluations of performance during experiential courses (i.e., IPPEs and APPEs). Students are expected to pass all coursework with a grade of "P" (passing).

During the PhD (primarily in years 3-6), student performance will be evaluated by homework, class participation, written tests, laboratory tests, oral and written presentations (through research seminars and journal clubs), and advisor/mentor evaluation of the PhD Dissertation Project. After each quarter of instruction, students will be asked to give feedback and evaluate each course in terms of content as well as faculty teaching effectiveness. At the completion of the program, students will also be asked to self-evaluate as well as evaluate the overall program.

For the PhD qualifying examination, students prepare a dissertation proposal, which is presented at an oral examination. The purpose is to determine whether the candidate is properly prepared to conduct independent research leading to the completion of a doctoral dissertation. It is not to be regarded as a test of the student's knowledge of a particular field of interest, though such knowledge must be demonstrated. The student must also demonstrate that they:

-Understand how to pose a scientific question.
-Are able to develop a systematic approach to its solution that incorporates rigorous study design and statistical analysis.
-Can interpret the results of that approach concisely and rigorously.
-Are able to frame that interpretation both within the context of the system in question and of other related biological systems.
-Can apply their knowledge of pharmaceutical sciences, pharmacogenomics, and statistics to address significant problems in the field.

Within three months of passing the oral examination, a student must form his or her thesis committee and file an application for Advancement to Candidacy. The thesis committee has a distinct role from the qualifying committee, such that their responsibility is to facilitate and ensure that all students receive rigorous training and that they complete a body of novel research in an appropriate amount of time. It is also their responsibility to ensure that the student is considering career options and preparing for life after

graduate school. The thesis committee is expected to be comprised of two or more PSPG Program faculty members in addition to the thesis advisor. Non-PSPG faculty members can serve on the committee subject to approval by PSPG program director. Committee members must be Academic Senate members. However, students can petition the Graduate Division to include members outside of the Academic Senate, add additional members to the committee, reconstitute the committee, and change the original thesis title. It is the student responsibility to create the thesis committee along with their PhD mentor, which should be composed of researchers who can understand and assist the student with their research.

At least one thesis committee meeting is required every 6-9 months, with the first meeting taking place within six months of the oral qualifying examination. In these meetings, both scientific and career goals are discussed. For the scientific goals, research progress, challenges, and potential shifts in direction are discussed. For the career goals, the student's updated version of the individual development plan (IDP) including a summary of activities related to career exploration are discussed. The committee members are responsible for following up on any significant issues with the student's advisor and/or the graduate program director, with the student's knowledge.

Obtaining a PhD from UCSF signifies that a student has demonstrated the ability to perform and complete high-quality research that makes an original contribution to their field. In practice, the expectation is that at least one first-author paper is "in press" before the thesis is signed. Learning to respond to reviewer critiques is a critical part of graduate training. There is, however, no simple bureaucratic formula to determine what is sufficient, and often the body of work forming a thesis is reported in multiple first-author publications; there are way too many scenarios, and so we rely on the judgment of the thesis committees to make the evaluation of a substantial and original contribution to science.

1.10.2 Student Guidance and Support Evaluation

Students will provide feedback after each quarter through feedback forms to evaluate their experiences with their PhD Advisor. The feedback forms will provide students with the opportunity to voice their opinions and provide suggestions for any areas of improvement. This mechanism will help ensure that students are receiving appropriate support and guidance.

SECTION 2. PROGRAM

The difficulty in attracting talented and qualified potential students into our proposed dual degree PharmD/PhD program is generally acknowledged. This is attributed to the challenges of balancing and adapting to both pharmacy practice coursework and PhD coursework with the transition from PharmD into PhD, and an expected completion time of about 7 years. Based on that, we will take a highly aggressive recruitment strategy through direct and indirect recruitment:

Direct Recruitment:

A. We will use our internal listserv to advertise the program to the entire School of Pharmacy student body.

B. Print advertisement: We will design posters to advertise our proposed PharmD/PhD Dual Degree Program, which are now prominently displayed in the School of Pharmacy and School of Medicine bulletin boards close to student affairs as well as residents' lounges. In these posters, we will highlight the

main advantages of obtaining a PharmD/PhD degree and how integration of both clinical and research skills can make the graduates of this program more competitive in academia and/or industry.

Indirect Recruitment:
A. Web based recruitment: We will create a webpage for the UCSF PharmD/PSPG PhD Dual Degree Program, which will serve as a valuable resource for attracting candidates.
B. Active recruitment at scientific meetings at both a regional and national level: Regionally, the program will be promoted at events such as the UC Berkeley Graduate School Fair, UC Davis Graduate School Fair, UC Irvine Graduate School Fair, and Stanford Graduate Fair. Nationally, the PharmD/PSPG PhD Dual Degree Program will be promoted at annual organizational meetings such as the American Society for Clinical Pharmacology and Therapeutics (ASCPT), American College of Clinical Pharmacology (ACCP), American Association of Pharmaceutical Scientists (AAPS), and American College of Clinical Pharmacy (ACCP), Society for Advancement of Chicanos/Hispanics & Native Americans in Science (SACNAS), Annual Biomedical Research Conference for Minoritized Scientists (ABRCMS), Out in Science, Technology, Engineering, and Mathematics (STEM), and Women in Science, Technology, Engineering, and Mathematics (WiSTEM) meetings.

2.1 Applicant qualifications

Students must be admitted into both PharmD and PhD programs. Students who are already matriculated to the PharmD program and are interested in applying for the PhD program in Pharmaceutical Sciences and Pharmacogenomics may apply to the sequential PharmD/PhD program in their first or second year in the PharmD program because the PharmD/PhD Dual Degree Program is a standalone degree program. For the PharmD/PhD Dual Degree program eligibility:

-Students must satisfy all PharmD and PhD prerequisites with course work approved by the Office of Student Affairs (all prerequisites must be completed prior to July 1 of the year of entry into the program). It is the responsibility of the applicants to verify if their course work is approved to meet the UCSF PharmD prerequisites. Applicants are also expected to have adequate preparation in the biological and physical sciences. In most cases, adequate background preparation includes courses such as analytical geometry and calculus, physics, physical chemistry (physical pharmacy), organic chemistry, biochemistry, molecular biology, pharmacology, and biological sciences.

-Students who have completed a bachelor's degree or recognized equivalent degree from an accredited institution with a competitive GPA (minimum GPA of 3.0 on a 4.0 scale) will be considered for admission.

-If offered admission, students must be able to secure and maintain a valid intern pharmacist license with the California Board of Pharmacy.

-All students offered provisional admission will be required to complete a criminal background check prior to final admissions decisions.

-Applicants whose native language is not English will be eligible for admission under the same conditions but need to demonstrate proficiency in English by taking the Test of English as a Foreign Language (TOEFL, http://www.toefl.org), or the International English Language Testing System (IELTS,

https://www.ielts.org/en-us/) exam, or have demonstrated proficiency in English by completing one year of full-time study with a minimum GPA of 3.2 in an accredited University in the United States. Minimum acceptable scores for the TOEFL exam will be 550 (paper version) and 213 (computer version). Minimum acceptable scores for the IELTS exam will be 7.

-Graduate Record Examination (GRE) scores will not be accepted, reflecting evolving best practices around standardized testing. In seeking to increase the diversity of students, the program will employ a holistic review approach, evaluating a range of applicant's attributes, experiences, and academic metrics. Prospective students will be from diverse cultural, economic, and social backgrounds.

2.2 Diversity

UCSF celebrates diversity and is committed to building a broadly diverse and inclusive community. The PharmD/PhD Dual Degree Program in Pharmaceutical Sciences and Pharmacogenomics also places a high value on diversity and has a deep appreciation for the perspectives and rich experiences that a varied student body and faculty can bring to the educational process. Strategies to uphold these values throughout the recruitment and admissions process can be found in Section 1.7.

The UCSF Office of Diversity and Outreach leads the campus effort to foster a culture of equity and inclusion by serving as the central resource for internal and external community members. It fosters a collaborative culture by leading outreach efforts to increase the number of underrepresented students at all levels of the educational pipeline and to increase the diversity of the pool for faculty, staff and leadership positions. Additionally, it is the home of a wealth of resources such as the Multicultural Resource Center, Diversity Hub, LGBT Resource Center, free on-demand training and many other programs to support a welcoming climate.

In an effort to reach underrepresented applicants, the UCSF Office of Diversity and Inclusion will be featured prominently on the homepage of the Program's website. As the website will be an integral marketing tool, featuring this resource will highlight UCSF's and the Program's commitment to foster an environment inclusive to everyone. Promotion of the Program will also occur at university campuses, which possess diverse student bodies.

As part of our application essay questions, we will include the following question to elicit information from applicants regarding their commitment to serving underserved communities, "*Explain how your educational, employment, or other extracurricular experiences have provided you an opportunity to actively engage with diverse populations and/or address health disparities. How will these experiences help you to succeed in our PharmD/PhD Dual Degree Program and in the pharmacy profession? An increasingly diverse society in America has significant implications for the future practice of pharmacy. At UCSF, addressing health disparities and promoting diversity are values we hold close. Use examples from your own experiences in addressing these issues and how they will help you succeed in our program and in the profession*".

The following scholarship opportunities related to DEI will be also available:

-Justice, Equity, Diversity, and Inclusion (JEDI) Scholarship, which supports students who have demonstrated their commitment to diversity and addressing healthcare disparities.

-Champion of Diversity Scholarship, which recognizes students who have made a significant impact on addressing DEI initiatives.

2.3 Program of study

The Program will conform to the Requirements for the Doctor of Philosophy Degree as outlined by the UCSF Graduate Council Regulations and Procedures. This plan requires six quarters in residence and that the student must register for a minimum of three quarters after advancing to candidacy, as part of the six quarter residency requirement.

2.3.1 Unit Requirements

This intensive, full-time, 6.75 years PharmD/PhD Dual Degree Program in Pharmaceutical Sciences and Pharmacogenomics is a unique joint effort between the UCSF School of Pharmacy's PharmD program and the Pharmaceutical Sciences and Pharmacogenomics PhD program from the UCSF Graduate Division. Through careful structuring of the UCSF PharmD-PhD Dual Degree Program, it is possible for students to complete the requirements for both the PharmD and PhD degrees in a shorter time than would be expected in the sequential PharmD/PhD program (7 years) and that would be expected if the two degrees were obtained separately (8 years). Students are encouraged to complete two required research rotations during the second and third years of the program. Unlike the PharmD program, which has a set, three-year curriculum, the PhD is a research degree, and, as a result, the duration of the path is not fixed. Traditional PhD students typically require a minimum of 5 years to complete their degree, but efficiencies built into the PharmD-PhD Dual Degree Program are intended to shorten the time required to complete the PhD degree. It is estimated that UCSF PharmD-PhD students will be able to complete their PhD degree as early as four years after the PharmD degree. The PharmD-PhD degree will only be awarded after completion of the required coursework (full unit requirements) including the PharmD curriculum, clinical experience for the PharmD curriculum, and acceptance of the thesis research project. This very rigorous program requires a full-time commitment and is not suited for students with concurrent employment or work. This curriculum will provide the students with the skills required to translate basic pharmaceutical sciences and pharmacogenomics research to clinical applications.

2.3.2 Required Courses

The curriculum has been carefully designed to ensure mastery in pharmacy practice, patient care, pharmaceutical sciences, and pharmacogenomics, that will pave the way to perform basic and clinical research and to translate basic science research into clinical application. The course of study will prepare graduates for careers in academia, as faculty members in schools and colleges of pharmacy, government, leaders in drug discovery and development in the pharmaceutical industry, or other health settings where they will engage in academic instruction, clinical care, and research.

All courses in the curriculum are required. Special exceptions may be made for students demonstrating prior mastery in course subjects. Students should submit a petition to the Curriculum Committee and the relevant course instructor(s) to test out of said course. No more than two courses can be waived. Decisions will be made at the discretion of the Curriculum Committee in collaboration with course instructors. In lieu of these core courses, students will choose to enroll in electives.

The Steering Committee, charged with creating the PharmD/PhD dual degree courses, began its deliberations with the definition of the skills, attributes and knowledge of the program graduates. Table 2 outlines these specific skill-based goals for the program along with expected competencies and outcomes, learning methods, and means of assessment to gauge those outcomes. Each didactic course is designed to map to these competencies and skills. All courses are described in greater detail in Section 5.

Table 2.

Competencies and Outcomes	**Learning Methods**	**Assessment**
PharmD Curriculum: Baseline knowledge and fundamental concepts in pharmacy profession	Coursework of Foundations I: Area 1 (Therapeutic sciences), Area 2 (Inquiry), Area 3 (Social and Administrative Sciences) Coursework of Foundations II	Objective written exams, homework assignments, class participation
PharmD Curriculum: In-depth exploration of science and therapeutics, and inquiry, through the lens of eight organ systems and disease categories	Integrated Themes Year 1 themes: Cardiovascular Science & Therapeutics; Respiratory Science & Therapeutics; Renal Science & Therapeutics; Gastrointestinal Science & Therapeutics Year 2 themes: Endocrine Science & Therapeutics; Neuroscience & Therapeutics; Oncology Science & Therapeutics; Infectious Disease Science & Therapeutics	Objective written exams, homework assignments, patient cases, and class participation
PharmD Curriculum: Hands-on pharmacy practice and communications skills	Coursework: Applied Patient Care Skills (APCS) course	Objective written exams, homework assignments, class participation
PharmD Curriculum: Clinical experiences that reflect the situations and challenges student will face as a practicing pharmacist	Practice rotations: Introductory Pharmacy Practice Experiences (IPPEs) in community pharmacies, health systems, medical centers and hospitals, ambulatory care clinics, managed care, and industry; and Advanced Pharmacy Practice Experiences (APPEs) (including one	A competency-based pass/no pass system, with frequent feedback from preceptors; evaluations primarily focus on meeting specific goals and objectives outlined for each experience, including communication, professional

	required Pharmacogenomics APPE) at a medical center, hospital, or clinic setting that provides real-world pharmacy experience	behavior, and clinical decision-making abilities.
PhD Curriculum: Student PhD research project	PhD dissertation research project (PSPG 250 – Dissertation Research, PSPG 220 – Student Research Talks)	Presentations, posters, and published papers
PhD Curriculum: Critical review of published scientific papers, including comprehension, analysis, and evaluation of published scientific data	PSPG 297 – QBC Journal Club	Presentations
PhD Curriculum: Learning how to address key issues affecting the responsible conduct of scientific research, including scientific misconduct and ethics and biomedical research and human subjects	GRAD 214 – Responsible Conduct of Research (NIH requirement for training required for all graduate students)	Case studies
PhD Curriculum: Exploring the relationship between notions of race and science, including the impact of bias and lack of diversity in science and ways in which to address these deficiencies	GRAD 202 – Racism in Science	Class participation
PhD Curriculum: Providing an in-depth introduction of the use of systems approaches in pharmacology research, and core principles in systems biology and pharmacogenomics approaches	PSPG 245B.1 – Systems Pharmacology and PSPG 245B.2 – Systems Pharmacogenomics	Analyzing complex biological data sets, and hands on project-oriented workshops
PhD Curriculum: Providing a foundation in modern biostatistical methods and statistical reasoning for pharmaceutical sciences research	BIOSTAT 272 – Foundations in Biostats	Workshops and student-based project

PhD Curriculum:	PSPG Core Elective (one in the third year of the program): Biostat 272, Pharmacology 274, BMS 255: Principles of Genetics, BMS 225 B: Tissue & Organ Biology, BMI 206: Statistical Methods for Bioinformatics, BMI 203: Biocomputing Algorithms, PSPG 271: Advanced Pharmacokinetics/Pharmacodynamics, BPS 272 A: Advanced Drug Delivery-Controlled & Targeted Drug Delivery, BP 204 B: Macromolecular Structure and Interactions, BMS 225 A: Human Disease-Technologies & Biomedical Applications, CELLBIO 245: Cell Biology, CHEM 243: Chemical Biology, EPI 217: Molecular and Genetic Epidemiology I, EPI 219: Molecular and Genetic Epidemiology II	

YEAR 1

SUMMER (17 units)	FALL (15 units)	WINTER (15.5-18 units)	SPRING (17.5-20 units)
Coursework of Foundations I (PHARMIS 110): Area 1 (Therapeutic sciences), Area 2 (Inquiry), Area 3 (Social and Administrative Sciences) (14.5 units) APCS I (CL PHARM 170) (2.5 units)	Cardiovascular Science & Therapeutics Inquiry (PHARMIS 111) (11.5 units) APCS II (CL PHARM 171) (1 unit) IPPE – Community A (2.5 units)	Inquiry Immersion (PHARMIS 122) (2.5 units) Respiratory Science & Therapeutics Inquiry (PHARMIS 112) (9.5 units) APCS III (CL PHARM 172) (1 unit) IPPE – Community B (2.5-5 units) PSPG 225A – Pizza Talks	Renal Science & Therapeutics Inquiry (PHARMIS 113) (6 units) Gastrointestinal Science & Therapeutics Inquiry (PHARMIS 114) (8 units) APCS IV (CL PHARM 173) (1 unit) IPPE – Community B (2.5-5 units) PSPG 225A – Pizza Talks

YEAR 2

SUMMER (13.5 units)	FALL (17-19 units)	WINTER (16-18 units)	SPRING (3.5-11.5 units)
Coursework of Foundations II (PHARMIS 115): spans all levels of pharmacy practice including special populations, therapeutic sciences, health care policy, and evidence-based health care (3 units) Endocrine Science & Therapeutics Inquiry (PHARMIS 116) (9.5 units) APCS V (CL PHARM 174) (1 unit) Teaching Assistant Requirement	Neuroscience & Therapeutics Inquiry (PHARMIS 117) (14.5 units) APCS VI (CL PHARM 175) (1 unit) IPPE – Health Systems (1.5-3.5 units)	Oncology Science & Therapeutics Inquiry (PHARMIS 118) (5.5 units) Infectious Disease Science & Therapeutics Inquiry (PHARMIS 119) (8 units) APCS VII (CL PHARM 176) (1 unit) IPPE – Health Systems (1.5-3.5 units)	PSPG lab rotation 1 and 2 (PSPG 206, 2-8 units) IPPE – Health Systems (1.5-3.5 units)

YEAR 3

SUMMER (4-16 units)	FALL (11-17 units)	WINTER (10.5-18 units)	SPRING (5-11 units)
PSPG lab rotation 2 (continued) (PSPG 206, 2-8 units) PSPG 250 – Dissertation Research (2-8 units)** PSPG Primer – led by current students Clinical Practice (one day weekly)*	PSPG 250 – Dissertation Research (2-8 units)** PSPG 220 – Student Research Talks/Seminars (1 unit) PSPG 297 – QBC Journal Club (1 unit) PSPG 223 – PSPG Formal Seminar GRAD 202 – Racism in Science (3 units) BIOSTAT 272 – Foundations in Biostats (4 units)	PSPG 250 – Dissertation Research (2-8 units)** PSPG 220 – Student Research Talks/Seminars (1 unit) PSPG 297 – QBC Journal Club (1 unit) PSPG 223 – PSPG Formal Seminar PSPG 245B.1 – Systems Pharmacology (2 units) PSPG 245B.2 – Systems Pharmacology (2 units)	PSPG 250 – Dissertation Research (2-8 units)** PSPG 220 – Student Research Talks/Seminars (1 unit) PSPG 297 – QBC Journal Club (1 unit) PSPG 223 – PSPG Formal Seminar GRAD 214 – Responsible Conduct of Research (1 unit) Clinical Practice (one day weekly)*

	Clinical Practice (one day weekly)*	PSPG Core Elective (select one): BMI 203: Biocomputing Algorithms (4 units); CHEM 244: Reaction Mechanism (3 units); BMS 255: Principles of Genetics (4 units); PSPG 274 – Special Topics in Pharmacology (2.5 units) Clinical Practice (one day weekly)*	

YEAR 4

SUMMER (4-10 units)	FALL (5-11 units)	WINTER (4-10 units)	SPRING (4-10 units)
PSPG 250 – Dissertation Research (2-8 units)** PSPG 220 – Student Research Talks/Seminars (1 unit) PSPG 297 – QBC Journal Club (1 unit) PSPG 223 – PSPG Formal Seminar Clinical Practice (one day every other week or half day weekly)	PSPG 250 – Dissertation Research (2-8 units)** PSPG 220 – Student Research Talks/Seminars (1 unit) PSPG 297 – QBC Journal Club (1 unit) PSPG 223 – PSPG Formal Seminar BP 297 – Grant Writing Workshop (1 unit) Clinical Practice (one day every other week or half day weekly)	PSPG 250 – Dissertation Research (2-8 units)** PSPG 220 – Student Research Talks/Seminars (1 unit) PSPG 297 – QBC Journal Club (1 unit) PSPG 223 – PSPG Formal Seminar PSPG Qualifying Exam Clinical Practice (one day every other week or half day weekly)	PSPG 250 – Dissertation Research (2-8 units)** PSPG 220 – Student Research Talks/Seminars (1 unit) PSPG 297 – QBC Journal Club (1 unit) PSPG 223 – PSPG Formal Seminar Clinical Practice (one day every other week or half day weekly)

YEAR 5

SUMMER (3-9 units)	FALL (3-9 units)	WINTER (3-9 units)	SPRING (3-9 units)
PSPG 250 – Dissertation Research (2-8 units)**	PSPG 250 – Dissertation Research (2-8 units)**	PSPG 250 – Dissertation Research (2-8 units)**	PSPG 250 – Dissertation Research (2-8 units)**

PSPG 220 – Student Research Talks/Seminars (1 unit) PSPG 223 – PSPG Formal Seminar Clinical Practice (one day every other week or half day weekly)	PSPG 220 – Student Research Talks/Seminars (1 unit) PSPG 223 – PSPG Formal Seminar Clinical Practice (one day every other week or half day weekly)	PSPG 220 – Student Research Talks/Seminars (1 unit) PSPG 223 – PSPG Formal Seminar Clinical Practice (one day every other week or half day weekly)	PSPG 220 – Student Research Talks/Seminars (1 unit) PSPG 223 – PSPG Formal Seminar Clinical Practice (one day every other week or half day weekly)

YEAR 6 (if needed)

SUMMER (3-9 units)	FALL (3-9 units)	WINTER (3-9 units)	SPRING (3-9 units)
PSPG 250 – Dissertation Research (2-8 units)** PSPG 220 – Student Research Talks/Seminars (1 unit) PSPG 223 – PSPG Formal Seminar Clinical Practice (one day every other week or half day weekly)	PSPG 250 – Dissertation Research (2-8 units)** PSPG 220 – Student Research Talks/Seminars (1 unit) PSPG 223 – PSPG Formal Seminar Clinical Practice (one day every other week or half day weekly)	PSPG 250 – Dissertation Research (2-8 units)** PSPG 220 – Student Research Talks/Seminars (1 unit) PSPG 223 – PSPG Formal Seminar Clinical Practice (one day every other week or half day weekly)	PSPG 250 – Dissertation Research (2-8 units)** PSPG 220 – Student Research Talks/Seminars (1 unit) PSPG 223 – PSPG Formal Seminar Clinical Practice (one day every other week or half day weekly)

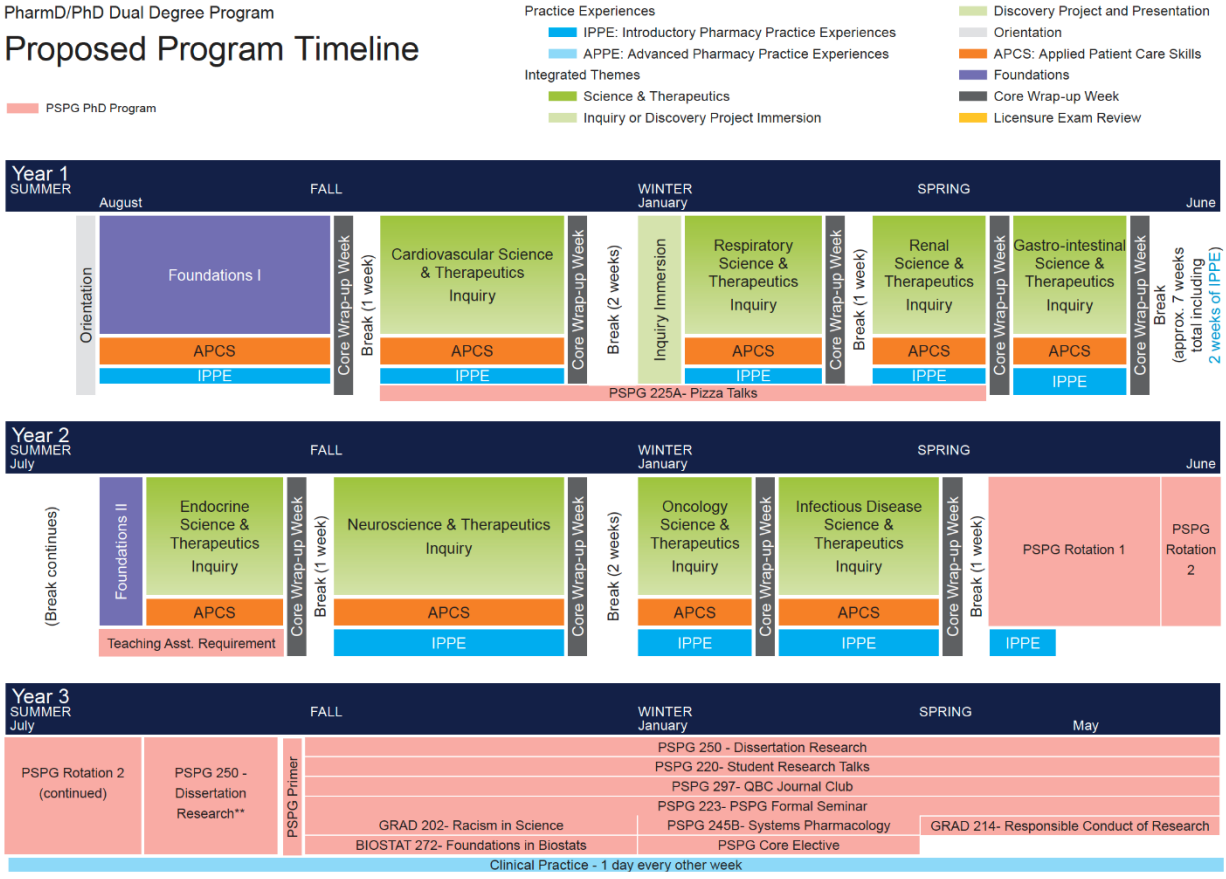
YEAR 7

SUMMER (7 units)	FALL (21 units)	Winter (7 units)
One Clinical APPE (7 units)	Three Clinical APPE (each is 7 units)	One Clinical APPE (7 units)

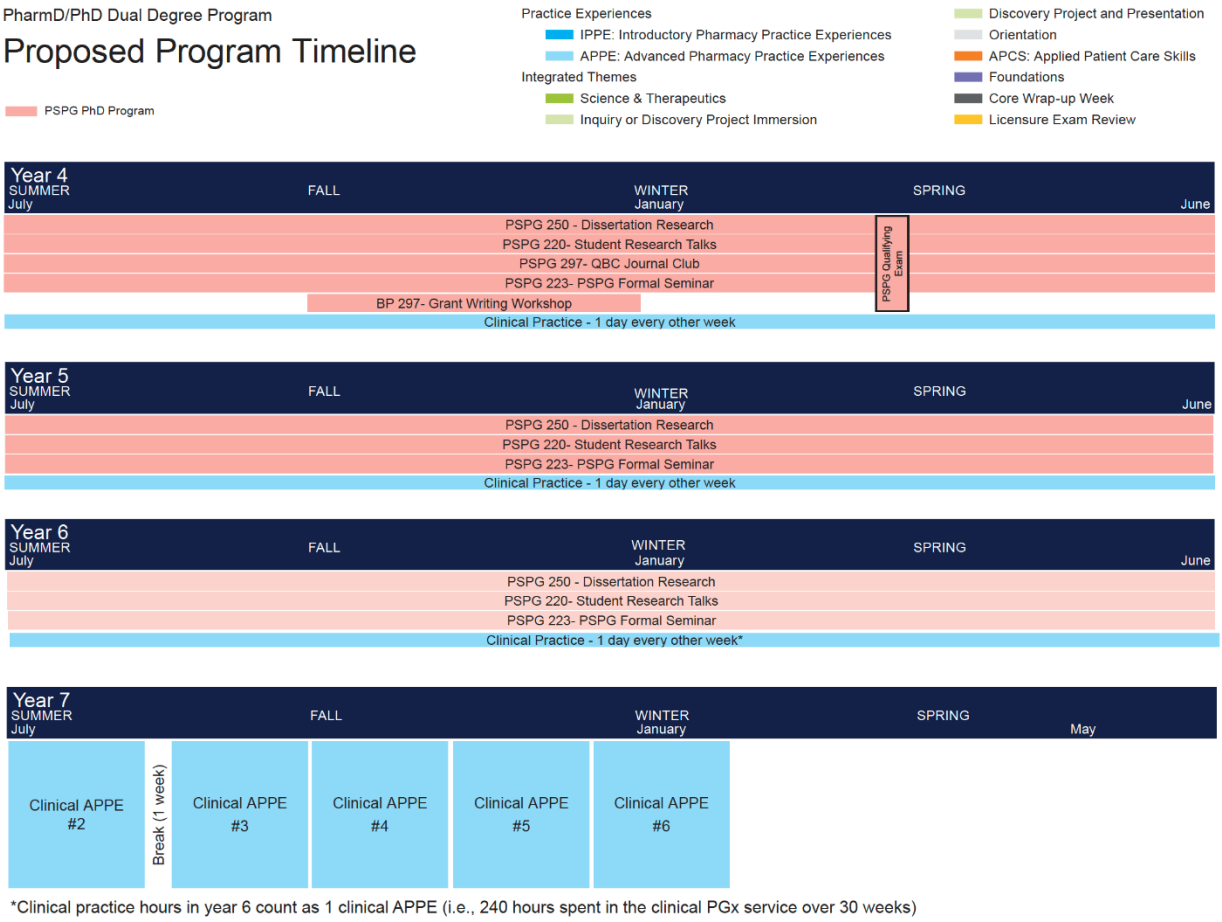
***The longitudinal clinical rotations (30 consecutive weeks) in year 3 will count for one clinical APPE (240 hours spent in the clinical pharmacogenomics service). The students must fulfill a total of 6 APPEs (1440 hours) (one APPE as sequential clinical practice in year 3 and the remaining six APPEs will be taken last year of the program). Of those 6, 4 must be core rotations (General Medicine, Community, Hospital, and Ambulatory) and 2 are electives (1 direct patient care and 1 non-direct patient care).**

****480 hours of dissertation research count as two non-clinical APPEs (the two Non-Direct Patient Care APPE Electives CL PHARM 190A and 190B).**

Figure 1. Timeline of the proposed PharmD/PhD dual degree program



*Clinical practice hours in year 6 count as 1 clinical APPE (i.e., 240 hours spent in the clinical PGx service over 30 weeks)



2.3.3 Student Assessment and Grading

The following courses will be graded P/NP (Pass/Not Pass) or S/U (Satisfactory/Unsatisfactory): PHARMIS 110 Foundations I, PHARMIS 115 Foundations II, PHARMIS 111 Cardiovascular Science & Therapeutics Inquiry, PHARMIS 112 Respiratory Science & Therapeutics Inquiry, PHARMIS 113 Renal Science and Therapeutics Inquiry, PHARMIS 114 Gastrointestinal Science and Therapeutics Inquiry, PHARMIS 116 Endocrine Science and Therapeutics Inquiry, PHARMIS 117 Neuroscience and Therapeutics Inquiry, PHARMIS 118 Oncology Science and Therapeutics Inquiry, PHARMIS 119 Infectious Disease Science and Therapeutics Inquiry, APCSs (CL PHARM 170-176), IPPEs, APPEs, PHARMIS 122 Inquiry Immersion, PSPG 250 – Dissertation Research, PSPG 220 – Student Research Talks, PSPG 297 – QBC Journal Club, PSPG 223 – PSPG Formal Seminar, GRAD 214 – Responsible Conduct of Research, BIOSTAT 272 – Foundations in Biostats, and PSPG 274 – Pharmacology (PSPG Core Elective). Students will be given a letter grade for the following courses: GRAD 202 – Racism in Science, PSPG 245B – Systems Pharmacology, and BP 297 – Grant Writing Workshop, as well as the PSPG Core Electives BMI 203: Biocomputing Algorithms, CHEM 244: Reaction Mechanism, and BMS 255: Principles of Genetics. Grades will be determined from assessment of competencies via methods outlined in Table 2.

Following UCSF Policy on Student Progress guidelines:
(https://graduate.ucsf.edu/policy-student-progress)

Unsatisfactory progress indicators for the program will include:

-Failing grades in any course
-Falling below a 3.0 GPA
-Failure to find a lab
-Unsatisfactory work in the lab (rotation or thesis, as reported by the PI)
-Unprofessional conduct in the lab/research environment (rotation or thesis, as reported by the PI)
-Failing the qualifying exam the first time
-Failure to submit dissertation chapters in a timely fashion
-Issues in academic misconduct and professionalism infractions

Note: Disciplinary problems and other infractions that fall within the scope of UCSF's Policy on Student Conduct and Discipline will be referred for consideration by UCSF's Director of Student Rights and Responsibilities.
Process by which failing students will be notified and remediated:
Students whose progress is unsatisfactory (according to one or more of the criteria listed above) will be notified and will meet with the advisor and the program director to develop an individualized remediation plan to address the deficiencies. The meeting results in a memorandum of understanding that clearly outlines specific steps and associated deadlines that the student must fulfill in order to receive a satisfactory report. The report is then signed by the following parties: the student, the primary advisor, and the program director. At this point, the report is filed in the student's academic file within the program, and a copy is sent to the assistant dean for diversity and learner success.

Should the student be unable to fulfill the expectations according to the timeline outlined in the letter, the student will be subject to dismissal from the program. Depending on the student's standing in the program, PhD candidates may be allowed to leave with a terminal master's degree.

The process for in-depth review of a student's eligibility for dismissal will follow the UCSF Divisional Procedure for Student Grievance in Academic Affairs, section 4.0, and will be conducted by the program's in-depth committee. The in-depth review committee shall consist of three faculty members on the curriculum committee. Students who meet the requirements for either PharmD or PhD degree, but don't meet the requirements for both, should still be able to receive the one degree.

Additionally, all students in the proposed PharmD/PhD dual degree program must acquire teaching experience as part of their graduate studies, regardless of previous training or the nature or source of their financial support. Students in their second year of the PharmD/PhD dual degree will have opportunities to serve as small group leaders (i.e., Teaching Assistants) for P1 students in the PharmD program in order to fulfill their teaching requirements. Teaching performance is monitored by the course directors and the graduate advisors. Teaching assistants will be appointed and evaluated in accordance with appropriate University policy. The teaching requirement is one quarter.

2.3.4 PhD Dissertation Research Project and Student Guidance

The Dissertation Research Project is required for graduation from the PharmD/PhD Dual Degree program. In the Spring of the second year and the Summer of the third year of the proposed dual degree program, students will be required to complete two laboratory rotations. The purpose of rotations is to

allow students to familiarize themselves with the people and research taking place in program laboratories. The ultimate goal is for students to find a permanent laboratory for thesis research by the Fall of their third year in the dual degree program. If a student wishes to rotate with a faculty member who is not a part of the graduate program the student will need to receive approval from their academic adviser. The student and academic adviser should notify the program manager that the rotation outside the program has been approved. Rotations should be confirmed by the start of each quarter, but no more than one quarter in advance.
Selecting a research advisor is the most critical decision to be made during a student's graduate career and must be made on a fully informed basis. Students are encouraged to discuss research interests with a variety of faculty members in the graduate program. This is considered a part of the learning process and an activity essential to graduate education. The research advisor:
-Serves as chair of the thesis (dissertation) committee.
-Signs forms regarding a student's academic status.
-Provides financial support for each student advisee.
The research advisor must be a member of the graduate program faculty.

The PSPG offers the following six areas of research emphasis: Pharmacogenomics and Functional Genomics, Quantitative and Systems Pharmacology, Computational Genomics, Molecular Pharmacology, Drug Development Sciences, and Therapeutic Bioengineering. Below, specific descriptions of each of the six research areas are provided.

Pharmacogenomics and Functional Genomics: Pharmacogenomic and human genomic research is undertaken in addiction, liver disease, asthma, cardiovascular disease, diabetes, psychiatry, HIV, cancer and autism. Research involves state of the art genomic technologies, including genome-wide genotyping, exome and whole genome sequencing, RNA-seq, ChIP-seq and additional 'seq' technologies in large and ethnically diverse patient populations collected at UCSF and world-wide. Students working on pharmacogenomic projects are often involved in multi-investigator research and have opportunities for interactions with a broad range of scientists spanning the clinical to basic spectrum. Most investigators have a significant emphasis on functional genomic studies to understand the molecular basis of genetic associations with drug response and toxicity. Functional genomic studies involve cell-based systems, model organisms, induced pluripotent stem cells and analysis of human tissues. Interest in understanding genetic variation in noncoding regions relies heavily on ChIP-seq, RNA-seq, and CRISPR technologies.

Quantitative and Systems Pharmacology: The explosion of data, driven by technological advances in genomics, proteomics, metabolomics, epigenomics and related fields, coupled with advances in data integration from the molecular to whole organism level has fueled research in quantitative and systems pharmacology. Research in this area underlies advances in precision medicine and is an area of growth within the PSPG program. Some faculty are involved in high throughput screens of chemical libraries with collection of phenotypes at the molecular, cellular and whole organism level. Others are focused on the development of integrated models to explain drug response and disease progression in humans. The repurposing of drugs for new therapeutic indications is another new area of research in this field. Students working in quantitative, and systems pharmacology often have both computational and experimental components to their dissertation research.

Computational Genomics: A number of PSPG faculty are focused on the development and application of computational methods to mine large omics datasets for investigating variability in drug response and disease risk and for understanding basic mechanisms underlying disease. Many of these investigators utilize large publically available datasets like 1000 Genomes and ENCODE in developing robust and efficient computational methods that correlate and display genome-wide data. A number are inaugural members of the new UCSF Institute for Computational Health Sciences, established as the cornerstone for precision medicine at the institution. Students working in this area develop strong computational skills that can be applied to critical questions related to optimal drug design, development, and use.

Molecular Pharmacology: There has been a resurgence in molecular pharmacology at UCSF as the discoveries in pharmacogenomics and systems pharmacology are translated into a mechanistic understanding of drug action. Molecular Pharmacology research utilizes model organisms and cellular systems to explore drug-induced cell signaling and mechanisms of drug-induced toxicity. A deep understanding of the cellular signaling pathways underlying normal cell and organ function and alterations during disease serves as the basis for testing new and established therapeutic agents. Chemical libraries are often tested to identify new therapeutic targets. Pharmacology expertise is found broadly across medical disciplines, including cancer, CNS diseases, HIV, cardiovascular, renal and pulmonary. Students working in molecular pharmacology labs develop strong molecular and cellular biology skills and often interact with chemists and computational biologists.

Drug Development Sciences: The PSPG graduate program, and before that the Pharmaceutics pathway of the Pharmaceutical Chemistry graduate program, is internationally recognized for training in the drug development sciences. Recently, we have added a new area of research, regulatory sciences, to drug development sciences through procurement of a large center grant in regulatory sciences and innovation, CERSI, funded by the FDA. This center provides funding for pilot proposals in innovative research in drug development and regulatory sciences and offers numerous educational seminars and workshops available to the campus community. Faculty members in this research group have broad expertise in pharmacokinetics, pharmacodynamics, drug metabolism and transport, and clinical pharmacology. Active areas of research include drug transporter function, regulation and variability, interplay between transporters and metabolizing enzymes in drug absorption and elimination, the clinical pharmacology of drugs used for the treatment of addiction, diabetes, infectious disease, organ transplantation and cancer, the use of biophysical methods to predict absorption, distribution, metabolism and excretion of new chemical entities, and the development of biomarkers of drug response and toxicity. Research involves whole organism studies in preclinical animal models and humans as well as molecular and cellular studies of drug action. Pharmacometric research on integrated pharmacokinetic-pharmacodynamic models describing drug response and disease progression has important applications in precision medicine and clinical trial design. Students completing dissertation research in drug development sciences develop experimental and computational skills and knowledge that are critical for preclinical and clinical drug development.

Therapeutic Bioengineering: A small but dynamic group of faculty are part of the therapeutic bioengineering research group. Research in this area has expanded from a traditional focus on liposomal drug delivery to include areas related to drug devices, imaging, and microfluidics. Research includes the use of droplet-based microfluidics for directed evolution and single cell gene expression profiling. In addition to applications in basic science research, microfluidics have enormous promise for medical

diagnostics. Research into vaccine, drug and nucleic acid delivery systems, the design and fabrication of micro and nano systems for drug targeting and delivery, the use of BioMEMs devices for tissue repair, artificial organs, diagnostics and delivery, and applications of imaging for studying disease pathogenesis and progression, as diagnostic tools and for monitoring drug response are undertaken by these investigators. Pharmacokinetic and pharmacodynamic principles are incorporated into many of these studies. Most laboratories have a fertile training environment for students with either a biology or engineering background. Students mentored by faculty members in therapeutic bioengineering typically undertake experimental work that integrates cellular and molecular approaches with bioengineering tools.

A complete list of program faculty members working in each of the six research areas can be found in the following webpage https://pspg.ucsf.edu/degree-program/research-areas

Once the research advisor (thesis/dissertation committee chair) is selected, the student should start thinking about the selection of the other committee members. It is important that the selected committee members will be able to understand the student's research topic and offer constructive and insightful criticism. The main responsibility of the thesis committee is to facilitate and ensure that all PSPG students receive rigorous training and that they complete a body of novel research in an appropriate amount of time. It is also their responsibility to ensure that the student is considering career options and preparing for life after graduate school. The committee is expected to be composed of two or more PSPG Program faculty members in addition to the thesis advisor. Non-PSPG faculty members can serve on the committee subject to approval by PSPG program director (no need to receive approval for non-PSPG committee members that have already received this approval in the past). While the thesis committee includes the thesis advisor, it is expected to serve as an independent advisory committee. An effective thesis committee provides scientific expertise that complements the expertise of the PI, evaluates progress independent of the PI, provides career development advice, can serve to mediate conflicts between the student and the PI, and is readily available for consultation. Committee members must be Academic Senate members. The student can petition the Graduate Division to include members outside of the Academic Senate, add additional members to their committee, reconstitute their committee, and/or change the student's original thesis title. At least one thesis committee meeting is required every 6-9 months, with the first meeting taking place within six months of the oral qualifying examination.

In consultation with his or her research advisor, the student should also select the members of the qualifying examination committee, which consists of a chair and three other Academic Senate faculty members.
-A student may petition to include one non-Academic Senate faculty member as a member of the committee, but they must be a member of a graduate training faculty and have an understanding of the requirements for the examination.
-At least two members of the committee, including the chair, must be members of the PSPG faculty.
-Neither the research advisor nor other faculty members who have significantly contributed to the supervision or direction of the proposed research may be members of the oral qualifying examination committee.

Students are expected to prepare a dissertation proposal, which is presented at an oral qualifying examination. In preparation of the oral examination, the student is expected to write a proposal stating the purpose and goals for their research project, the preliminary data they have, and what is the student plan

in the future. It is recommended that the proposal be thorough but concise. The written proposal should be distributed to the student's the research advisor, the committee chair, and each committee member for feedback. The format of the written proposal follows that required for an National Institutes of Health (NIH) R21 application and is limited to six pages, not including references. The format is: Specific aims, background and significance, innovation, and research design and methods.

To be eligible to take the qualifying examination, students must pass all of their core PSPG curriculum with a grade of B or higher. All required coursework and the biostatistics proficiency requirement must be completed before the exam can be taken. The qualifying exam must be taken by the end of Winter quarter of year four of the dual degree program. Once all program requirements are fulfilled and the student is ready to take the oral examination, the student finalizes selection of the qualifying examination committee and sets a date for the examination. By the end of Fall quarter of year 4 of the dual degree program, the program manager should be notified of the committee composition and fields for examination. At that time, the Application for Qualifying Exam form should be submitted to the graduate program manager. The qualifying exam committee, which is formed by the student in consultation with the research advisor, consists of a Chair and three additional faculty members. Neither the research advisor nor any other faculty member who has significantly contributed to the supervision of the proposed research may sit on the committee. In the oral examination, the purpose is to determine whether the candidate is properly prepared to conduct independent research leading to the completion of a doctoral dissertation. It is not to be regarded as a test of the student's knowledge of a particular field of interest, though such knowledge must be demonstrated. The student must also demonstrate that they:
-Understand how to pose a scientific question.
-Are able to develop a systematic approach to its solution that incorporates rigorous study design and statistical analysis.
-Can interpret the results of that approach concisely and rigorously.
-Are able to frame that interpretation both within the context of the system in question and of other related biological systems.
-Can apply their knowledge of pharmaceutical sciences, pharmacogenomics, and statistics to address significant problems in the field.

After the oral examination, the orals committee discusses the student's performance and take one of the following actions:
-Pass the student without further questioning
-Fail the student without further questioning
-Ask the student to return for further questioning
The third option is the most common. During this second phase of the examination, the committee members ask questions pertaining to subjects relevant to the student's area of interest or questions related to material covered in the PSPG core courses. The committee then votes on the outcome. It is the responsibility of the chair of the committee to file the appropriate form indicating the outcome with the Graduate Division:
-Full pass: A student who passes the examination is eligible for advancement to candidacy and thesis progression.
-Conditional pass: A student who passes the examination but demonstrates weaknesses in specific fields may be asked to prepare further oral or written materials or take an additional course. The committee chair will send a letter stating the requirements to be met and a deadline date, with copies to the program

director and the student's research advisor. Upon timely completion of these tasks, the student will be eligible to advance to candidacy. Failure to meet the set deadline results in an automatic fail.
-Fail: A student who fails the examination has the opportunity to retake it within six months. The committee chair will send notification in writing of subjects for re-examination and a suggested date for the second examination. A copy of the letter to the student is sent to the program director, program manager, and the student's research advisor. The committee chair and the research advisor will assist in planning for the second examination. The student's committee members must remain the same for the second examination. A student is provided two opportunities to pass the qualifying examination. Failure to pass the second examination will result in expulsion from the program.

Within three months of passing the oral examination, a student must form his or her thesis committee and file an application for Advancement to Candidacy. If there are any incomplete grades, a student may not advance to candidacy. Following Graduate Division approval, a student is officially advanced to candidacy. Students must be registered for a minimum of three quarters after advancement to candidacy before the PhD degree may be awarded.

Obtaining a PhD from UCSF signifies that a student has demonstrated the ability to perform and complete high-quality research that makes an original contribution to their field. In practice, the expectation is that at least one first-author paper is "in press" before the thesis is signed. Learning to respond to reviewer critiques is a critical part of graduate training. There is, however, no simple bureaucratic formula to determine what is sufficient, and often the body of work forming a thesis is reported in multiple first-author publications; there are way too many scenarios, and so we rely on the judgment of the thesis committees to make the evaluation of a substantial and original contribution to science.

The thesis committee has broad authority to determine when a student has completed a sufficient body of scientific work to graduate, by 'signing off' on the thesis. In rare cases, the Executive Committee and the program director may become involved in the process, e.g., if the student and his/her advisor do not agree on when it is appropriate for the student to graduate. In no case is it acceptable for a student to ask their committee to sign their thesis solely because they have accepted a job or wish to 'move on' for one reason or another. The degree will not be granted until the thesis committee is satisfied that the requirements for graduation have been met, e.g., by completing the publication process for a critical portion of the thesis, regardless of whether the student remains 'in residence' at UCSF.

The written thesis must be provided to faculty several weeks before they are asked to 'sign off', to give them time to review it and provide feedback. Generally, faculty will focus on portions of the thesis that have not yet been subjected to peer review, or any aspects on which the student requests feedback. After committee approval, the thesis is submitted to the Graduate Division. The Thesis Seminar is a PSPG requirement.

Students are expected to complete their PhD portion of the proposed dual PharmD/PhD dual degree program within four years, not counting approved leaves of absence. The program recognizes however that some challenging projects may take longer. With this in mind, time-to-degree guidelines are as follows:
-Exceptions beyond 5 years can only be granted by the Executive Committee.

-If a student and his or her thesis committee do not feel the student will be able to meet the five-year deadline, a maximum six-month extension must be requested by January of year five. Generally, the Executive Committee has been inclined to grant approvals for 3-6 month extensions in cases where the student, the advisor, and the other members of the thesis committee all agree that the additional time is warranted, most frequently in cases where the student is completing an ambitious project.
-The Executive Committee has broad authority to set expectations and requirements for the extension, which may include holding thesis committee meetings (or meeting with the Executive Committee itself) prior to or after approval.
-Requests for a second extension, beyond an initially granted 3-6 month extension, are subjected to a higher level of scrutiny. In no case will extensions be granted that would cause the total time to-degree, excluding leaves of absence, to exceed 6 years.

Throughout the duration of the program, students will have support from all PharmD and PSPG faculty and staff, as well as access to UCSF's vast resources. These include but are not limited to basic (housing, transportation, etc.), academic, career, community, financial, health & wellness, safety, and legal support. The Student Academic Affairs (SAA) hosts a wide range of vital services for students with 18 functional units, supporting the development of the optimal learning environment. A broad overview of offerings can be found through the UCSF Student Success Center. Students have perpetual access to the Student Health and Counseling Services for any mental or physical health needs.

2.3.5 Licensure Exam

As outlined in section 2.3.2, the students in the proposed dual degree program will finish their PharmD curriculum (including Foundations I and II, Integrated Themes, Patient Care Skills/APCSs, IPPE Practice Rotations) in the first two years of the program. They will also be also engaged into clinical practice throughout their PhD years (year 3 – 5 or 6 (if required) of the program) (30 consecutive weeks of clinical rotations will count as one clinical APPE, including 240 spent in a pharmacogenomics clinical service). In the last year of the proposed dual degree program (year 6 or year 7), the students will return back to continue their PharmD Practice Rotations, which will be composed of five APPEs. The total of six APPEs will add up to 1440 hours of APPEs, which satisfies the Accreditation Standards. At the end of the Winter quarter of the last year, the students will be able to apply for the pharmacy board examination that they can take after graduation to become licensed pharmacists. To support the students' preparation for this exam, the Synthesis Weeks provide time to further integrate concepts learned in each Integrated Theme. To take the North American Pharmacist Licensure Examination (NAPLEX), the examinee must be a graduate of a pharmacy school accredited by the Accreditation Council for Pharmacy Education (ACPE), and he/she must also meet the eligibility requirements of the state or jurisdiction where he/she wants to practice as a pharmacist. To be licensed as a Pharmacist in California, the person must pass the NAPLEX and the California Practice Standards and Jurisprudence Examination for Pharmacists (CPJE). To be made eligible to sit for the NAPLEX and/or CPJE, the California State Board of Pharmacy (Board) must determine that the examinee have met all the requirements for examination.

2.3.6 Workshops

Workshops will include tutorials that will reinforce and solidify the concepts and skills learned as well as case studies where students are given a scenario to which they apply their learned knowledge and tools to solve a given case. Workshops are already an integral part of some core courses such as PSPG 245B and BIOSTAT 272.

2.3.7 Seminars and Events

In the PhD portion (year 3 – 5 or 6 of the proposed dual degree program), the students are required to give oral presentations through PSPG 220 Student Research Talks. These weekly seminars (every Tuesday 9-10 am) will provide graduate students with a forum in which to develop seminar presentation skills, critically organize and critically review scientific data, and analyze and question oral scientific presentations. In the PhD portion (year 3 – 5 or 6 of the proposed dual degree program), the students will be enrolled in PSPG 223 Seminar Series, which is a series of bi-weekly seminars (every other Wednesday, 12-1 pm) in pharmaceutical sciences and pharmacogenomics and bioengineering by visiting lecturers, faculty members, and advanced graduate students. Students are required to attend all seminars in-person. Absences are excused with doctor's note or scientific conference attendance. Approval to watch remotely will be given due to illness.

In the PhD portion (years 3 and 4 of the proposed dual degree program), the students will also participate in a weekly journal club through PSPG 297 - QBC Journal Club. This is a joint journal club, where first- and second-year students in the Biological and Medical Informatics Graduate Program, the Biophysics Graduate Program, Chemistry and Chemical Biology Graduate Program, and Pharmaceutical Sciences and Pharmacogenomics Graduate Program participate. Each student presents one journal article outside of his or her immediate study. These seminars are open to faculty members and other interested colleagues. This activity serves two purposes, both broadening the interests of students and giving them the opportunity for oral presentations.

In the PhD portion (only year 3 of the proposed dual degree program), the students will participate in PSPG 225A – Pizza Talks, where PSPG faculty present their research interests on a weekly basis (Tuesdays, 5-7:30 pm).

Additionally, the Biological and Medical Informatics Graduate Program, Biophysics Graduate Program, Chemistry and Chemical Biology Graduate Program, and Pharmaceutical Sciences and Pharmacogenomics Graduate Program hold an annual joint retreat in Monterey, California. This QBC Graduate Program Retreat spans two days and focuses on faculty research talks and a poster session. The retreat is typically held in late autumn and provides excellent opportunity for scientific discussion and exchange.

SECTION 3. PROJECTED NEED

3.1 Enrollment

An estimate of 2-3 students are to be matriculated at implementation of the program in Summer 2027 and each year thereafter.

Soaring advances in pharmaceutical sciences have led to a dramatic change in the way science is conducted across industry and academia. This has resulted in an enormous demand for scientists with interdisciplinary skill sets in clinical practice, pharmaceutical sciences, pharmacogenomics, and drug discovery and development. UCSF is one of the world’s preeminent institutions in these fields. Our stature and location attract the top innovators and talent in science, education, and care.

In addition to the UCSD's PharmD/PhD Dual Degree Program (outlined in section 1.6), there are some PharmD/PhD Dual/Joint Degree Programs currently offered by U.S universities including University of Tennessee, University of Arizona, University of Michigan, Mercer University, Wayn State University, USC University of Southern California, University of Illinois Chicago, Washington State University, Rutgers University, and Virginia Commonwealth University. Overall, these programs enables highly qualified students to obtain both degrees in a shortened period of time. Similar to our proposed program, the main aim of these programs to train highly qualified pharmaceutical scientists for academic, industrial, and governmental positions to operate at the interface between basic research and clinical settings in order to facilitate faster translational innovations into the patient. Total duration for expected program completion and obtaining both PharmD and PhD degrees ranges from seven to nine years (with duration of expected PharmD completion of 4 years). With our unique three-year (year-round curriculum without extended Summer breaks) UCSF PharmD program, our proposed dual degree program is expected to be completed in about 6.75 years.

Most of the existing PharmD/PhD programs offer the students a number of different coursework/research tracks that they can choose from for their PhD portion, including Health and Pharmaceutical Outcomes and Policy Research, Medicinal Chemistry, Pharmaceutics, Bioanalysis, Pharmacometrics, Pharmacology and Toxicology, Clinical Pharmacy Translational Sciences, Drug Development, Forensics, and Pharmacognosy. However, only a few programs (including programs offered by University of Arizona, Washington State University, and University of Michigan) have faculty members whose research focus on pharmacogenomics. In contrast, our proposed dual degree program has several pharmacogenomics- and bioinformatics-focused research areas including pharmacogenomics and functional genomics, quantitative and systems pharmacology, and computational genomics, along with 240 hours of APPEs spent in a clinical pharmacogenomics service.

Most of the U.S.-based PharmD/PhD dual degree programs require the completion of PharmD curriculum and clinical rotations before beginning of their PhD portion, with a few exceptions such as Rutgers University, University of Michigan, and University of Illinois Chicago. For example, in the PharmD/PhD dual degree program offered by the University of Michigan, the timing of the PharmD IPPEs and APPEs can be flexible and negotiated with the student, the research advisor, and the Experiential Education Director. Conversely, our proposed dual degree program has the advantage of including clinical practice (as either one clinic day every other week or a half clinic day every week including 240 hours to be spent in the clinical pharmacogenomics service) during the PhD years (year 3-6 of the dual degree program) counted as three APPEs. Additionally, our proposed program includes three clinical APPEs in the last year of the program after completion of the PhD portion. This will allow the students to attain professional experience and further develop their clinical skills while working on their PhD research dissertation project, which allows for student's growth both professionally and academically at the same time.

Additionally, some of the existing PharmD/PhD programs, such as the programs offered by University of Tennessee and Rutgers University, require submission of GRE scores as part of the application process. In contrast, in our proposed dual degree program, we do not require GRE, reflecting the evolving best practices around standardized testing and seeking to increase the diversity of students, evaluating a range of applicant's attributes, experiences, and academic metrics.

Regarding financial support, all the existing PharmD/PhD dual degree programs provide funding for the PhD portion on a competitive basis (including full tuition waiver, stipend, and health benefits for students and their dependents), whereas they provide no or little scholarships/assistantships for the PharmD portion. For example, the University of Michigan provides up to $45,000 forgivable grant for the PharmD portion of the dual program. However, in our proposed PharmD/PhD program, students would receive graduate student assistantship during the PhD years (years 2-6). For the PharmD portion of the program, the Dean's office in School of Pharmacy has committed to funding $5K/student per year for the first 2.5 years of the program (Summer Year 1 through Spring Year 2), in addition to Summer/Fall of Year 7, where the students are expected to complete their PharmD APPEs. In addition to that, once we have established a track record, the plan is to apply for slots through the MSTP program to fully cover the training.

Moreover, due to the reasons explained in section 1.2 regarding the rapid advancements in pharmaceutical sciences and the justifications provided in sections 3.2 through 3.4, there is an overall increased market demand for more leaders in drug discovery and development in academia, pharmaceutical industry, and other healthcare settings. This justifies the need for creation of more PharmD/PhD dual degree programs with more graduates who are competitive as leaders and researchers in biotechnology and pharmaceutical companies.

3.2 Volume and quality of student demand for the program

Student demand for programs in innovative approaches in drug discovery and development (e.g. model-informed drug development approaches) and functional and computational genomics continues to grow reflecting the community awareness of the rapid advances in these fields. Also, the pressing need of translating basic research results into clinical practice (bridging the gap between bench and bedside) underscores the need for clinician-scientists. As described in section 3.1, our proposed PharmD/PhD Dual Degree Program has several advantages over the existing U.S.-based PharmD/PhD programs. According to the Bureau of Labor Statistics (BLS), employment of medical scientists, including clinical pharmacologists, is projected to grow 11% over the next 10 years.

Genomics programs:

The growing demand for gene therapy, targeted therapy, precision medicine, and the application of innovative approaches in drug discovery and development resulted in an increased growth rate in genomics market size by 16.5% from 2024 to 2030 (https://www.grandviewresearch.com/industry-analysis/genomics-market#). Concurrently, the number of genomics PhD degrees conferred in the US has significantly increased in recent years, reflecting the rapid growth of genomics field and the demand of researchers with expertise in this area. However, the integration and application of genomics to advance health outcomes is still deficient, partially due to the inadequate genomics education and training among healthcare professionals and public health practitioners. In a 2021 study, Niemchick et al. published the results of a descriptive study, focusing on the level of genomics content in accredited Master of Public Health (MPH) programs in the U.S. They demonstrated that only 30.4% schools and programs offered some type of genomics education, with 17% having a course in genetic biostatistics or bioinformatics (PMID: 34694924). Another study published in 2020 by Gammal et al. showed that only a small number of U.S. pharmacy schools offer an APPE with a primary focus in pharmacogenomics (PMID: 34283786). In a survey conducted by the UCSF School of Pharmacy on May 2024 on potential dual degree programs, the PharmD students expressed their interest in pharmacogenomics-based programs. With didactic

pharmacogenomics courses, research areas focused on functional and computational genomics, and 240 hours spent in clinical pharmacogenomics clinical service as part of the APPEs, our proposed program addresses the high unmet demand for pharmacogenomics education and clinical practice.

PharmD/PhD dual degree programs:
Of the existing PharmD/PhD programs in the U.S., only few have coursework and research areas focused on bioinformatics, computational genomics, drug repurposing, pharmacometrics, and real-world evidence. The PhD portion of our program has several different research areas, including areas related to the innovative approaches currently rapidly growing in drug discovery and development. These include quantitative and systems pharmacology, computational genomics, precision medicine, regulatory sciences, development of biomarkers of drug response and toxicity, RWE, and model-informed drug development approaches.

As an interdisciplinary program and UCSF leading the fields of health in intellectual energy and reputation, we anticipate significant interest from students with a variety of backgrounds. Overall, the acceptance rate for a PharmD/PhD program often falls within the range of only 10-20%, demonstrating competitive demand.

3.3 Opportunities for placement of graduates
The course of study will prepare graduates for careers in academia, as faculty members in schools and colleges of pharmacy, government, leaders in drug discovery and development in the pharmaceutical industry, or other health settings where they will engage in academic instruction, clinical care and research.

Job posting sites including Indeed and LinkedIn list over 1700 postings for PharmD/PhD graduates/holders. These postings include roles in academia, industry, and non-profit organizations. Employment opportunities in academia are becoming increasingly available due to the current significant shortage of faculty at schools of pharmacy. The academic jobs involve teaching and clinical research roles.
Biotechnology companies continue to increase hiring demand, fueled by sizable rounds of venture capital financing, new contracts with Big Pharma partners, and initial public stock offerings. Almost 50% of all pharmaceutical companies are currently hiring for at least one position, and at a faster rate than all other industries. The LinkedIn industry jobs span around various roles, including Translational Medicine Leads, Clinical Outcome Scientists, Principal Clinical Scientists, Clinical Pharmacologists, Clinical Development Scientists, Pharmacometrician, Medical Writers, Pharmacovigilance Scientists, and Medical Affairs/Medical Evidence Generation Leads. The non-profit organizations positions include Bioinformaticians, Genetic Epidemiologists, Toxicology Scientists Leads, Senior Scientists, Principal Investigators, and Research Scientists.

The proposed PharmD/PhD program not only provides participants with the foundational knowledge necessary to secure employment, but also prepares them to become the next leaders in drug discovery and development.

The abundant number of professional opportunities for graduates of PharmD/PhD are also evidenced by numerous conferences dedicated to clinical pharmacology, clinical pharmacy, pharmacogenomics, healthcare informatics, healthcare machine learning and AI, drug discovery, and more:

- American College of Clinical Pharmacology (ACCP)
  https://www.accp1.org/
- American College of Clinical Pharmacy (ACCP)
  https://www.accp.com/meetings/am25/index.aspx
- American Society for Clinical Pharmacology & Therapeutics (ASCPT)
  https://www.ascpt.org/meetings/annual-meeting
- Pharmacogenomics Global Research Network (PGRN)
  https://www.pgrn.org/event-5921668
- American Society of Human Genetics (ASHG)
  https://www.ashg.org/
- Other conferences based on the subject matter of the student's PhD dissertation research project

3.4 Importance to the discipline

With a plethora of new technologies and their applications, the drug discovery and development environment is rapidly changing. The adoption of artificial intelligence, genomics, and high-throughput screening technologies is accelerating drug discovery and development. In a workshop held at the 18th Annual Conference of the Pharmaceutical Contract Management Group in September 2022, there was a consensus that clinical trial designs are expected to become more complex in the future with an increasing role of new technologies. Since it is expected that more complex clinical trials would require the collection of much higher volumes of data from variety of sources, there will be a greater need for data scientists and clinician-scientists (PMID: 37313038). There are also currently unmet medical needs, since a growing number of diseases (especially rare diseases) have limited treatment options, which pushes the need for new drug candidates. Understanding the new technologies applied in drug discovery and development and staying on the cutting edge of innovation, especially among professionals with patient care skills, is essential to raising the next generation of pharmaceutical leaders and scientists.

UCSF is the leading university exclusively focused on health and its graduate programs should reflect this. Its standing as a world-renowned, leading research institution and the School of Pharmacy's excellence makes it the ideal environment for implementing this program. As explained in sections 3.1 and 3.2, our proposed PharmD/PhD Dual Degree Program focused on pharmacogenomics and computational genomics has several advantages over the currently existing U.S.-based PharmD/PhD programs. Graduates will be prepared for careers in academia, as faculty members in schools and colleges of pharmacy, government, leaders in drug discovery and development in the pharmaceutical industry, or will be able to translate basic science research into clinical application, which is a current pressing need. Specifically, graduates will be able to address challenges related to interindividual variability in drug response, precision medicine and targeted therapy, drug repurposing, omics big data analysis, deep understanding of the cellular signaling pathways as the basis for establishing new therapeutic agents, development and validation of predictive biomarkers of drug response, model-informed drug development approaches, and use of RWD for evidence generation.

3.5 Ways in which the program will meet the needs of society

The National Institutes of Health (NIH) spends $45B on medical research annually, pouring over 84% of its budget into extramural research through grants to universities, medical schools, and other research institutions including UCSF. In the past 20 years, spending on research and development in the pharmaceutical industry has increased by 118% to about $83B, with the average cost of developing a single therapy ranging anywhere from a few hundred million to $4B. Much of this cost accumulates due to time-intensive processes during initial drug discovery and research; utilizing computational, bioinformatics, pharmacogenomics, and artificial intelligence/machine learning technologies can and will greatly reduce the resources needed in these processes, allowing new medications to reach the market at record speeds and lower costs. This increases accessibility to medicine for all, especially people with rare disease diagnoses, disabilities, racial and ethnic minority groups, rural areas, and lower-income socio-economic groups with historically lower access and higher barriers to medicine.

The interdisciplinary nature of our proposed PharmD/PhD program will also contribute to developing much-needed scientific investigators, equipped with clinical and research/computational skills, with deep connections to application areas of research, healthcare, biotechnology, and pharmaceuticals. Graduates will become thought leaders in their fields with hybrid skill sets to think both analytically and innovatively, driving pivotal advances for drug discovery and development as well as translating basic research science into clinical practice.

Beyond the United States, there remains deep disparities in medicine from structural and historical roots, made even more apparent by the COVID-19 pandemic. The PharmD/PhD program will emphasize the values of diversity, equity, inclusion, belonging, and justice to develop the next generation of clinician-scientists with both the training and experiences to create lasting, transformative change. Graduates of the PharmD/PhD program can use clinical pharmacology methodologies to develop new knowledge that delivers critical scientific discoveries with broad influence locally and globally. These discoveries drive advancements in health for patients, families, and communities around the world.

3.6 Relationship of the program to research and professional interests of the faculty

A list of supporting faculty conducting research in six main research areas is provided in Section 4.1. These research areas are 1) Pharmacogenomics and functional genomics, 2) Quantitative and systems pharmacology, 3) Computational genomics, 4) Molecular pharmacology, 5) Drug development sciences, and 6) Therapeutic bioengineering.

In Appendix 1 and 2 are Letters of Support from Faculty and the Dean expressing their support for the program.

3.7 Program differentiation

There is an increased demand for qualified professionals with patient care skills combined with research skills and experience, allowing for having the clinical focus that can inform important research questions. Through our proposed PharmD/PhD program, students will be able to advance their clinical and research skills, specifically in rapid growing areas such as pharmacogenomics, systems pharmacology, pharmacometrics, bioinformatics, and RWE. Additionally, there is currently a recognized significant shortage of pharmacy faculty and pharmacists and a significant overall decrease in student demand for PharmD programs in the United States. The American Association of Colleges of Pharmacy (AACP) reported that the healthcare industry in 2022 saw the largest drop in the number of graduating pharmacists

since 1983. This shrinkage in pharmacists' talent pool contrasts with the surging demand for pharmacists. According to the AACP's Pharmacy Demand Report, there was a remarkable 17.9% increase in job postings for pharmacists in 2022-2023. Many reasons can contribute to this decreased demand for pharmacy education, including the unawareness of the diverse career opportunities that are available to pharmacy graduates. This underscores the need for pharmacy graduates who also have research skills (clinician-scientists) so that they can expand their career opportunities in academic settings, pharmaceutical industry, and government (FDA and NIH). This was reflected by the reported significant interest among our current students and pharmacy school applicants for a path to careers in industry and clinical translational science through the survey conducted by the UCSF School of Pharmacy on May 2024. We also believe that our proposed PharmD/PhD dual degree program will result in increased visibility of PharmD program in the light of declining applicant numbers, attracting students interested in combining clinical and research degrees. This program will allow the students to earn both degrees in 6.75 years instead of 7 years for the PharmD/PhD sequential degree and 8 years for studying the two degrees separately.

As emphasized in section 3.1, our proposed PharmD/PhD program has several advantages over the currently existing U.S.-based PharmD/PhD programs. Also, as explained in sections 1.5 and 1.6, the most similar programs within UCSF (MSTP, and the PharmD/PhD sequential degree program) and the UC system (UCSD's PharmD/PhD dual degree program) do not offer the same coursework/research focus that the proposed PharmD/PhD dual degree program offers. These similar programs have also longer time to completion compared to our proposed program. Another benefit of the proposed PharmD/PhD program is that it will allow the UCSF School of Pharmacy to get more funding in the future, and allow more collaboration with the existing MSTP program and cohort (e.g sharing resources).

On a broader scale, UCSF has excellent and unique resources to support the PharmD/PhD program, staff, faculty, and students in general. UCSF is a world-renowned institution where students will be trained and mentored by the nation's leading experts in their field. Additionally, the SF/Bay Area is centered among various technology, biotechnology and biopharmaceutical companies, all of which have a huge demand for clinician-scientists. With the increasing application of innovative computational technologies and clinical pharmacology methodologies to all aspects of drug discovery and development, the range, options, and opportunities for employment for graduates of the PharmD/PhD Program are immense.

SECTION 4. FACULTY

The students in the PharmD/PhD dual degree program will be supported by existing UCSF faculty from the departments of Bioengineering and Therapeutic Sciences (BTS), Pharmaceutical Chemistry, Clinical Pharmacy and Epidemiology and Biostatistics, among others.

4.1 Participating faculty

The faculty comprising the proposed PharmD/PhD Dual Degree Program are listed below. Letters of participation from the members are included in Appendix 2.

Faculty Member	*Affiliation*
Adam Abate, PhD	Department of Bioengineering and Therapeutic Sciences
Nadav Ahituv, PhD**	Department of Bioengineering and Therapeutic Sciences

Steven Altschuler, PhD	Department of Pharmaceutical Chemistry
Shea Andrews, PhD	Department of Psychiatry
Michelle Arkin, PhD^	Department of Pharmaceutical Chemistry
Francesca Aweeka, PharmD*	Department of Clinical Pharmacy
Leslie Benet, PhD	Department of Bioengineering and Therapeutic Sciences
Trever Bivona, MD, PhD	Department of Cellular and Molecular Pharmacology
Laura Bull, PhD	Department of Medicine
Atul Butte, MD, PhD	Department of Pediatrics
Diego Calderon, PhD	Department of Bioengineering and Therapeutic Sciences
Tony Capra, PhD	Department of Epidemiology & Biostatistics, School of Medicine
Jonathan Chou, MD, PhD	Department of Medicine
Joanne Chun, PharmD, PhD*	Department of Bioengineering and Therapeutic Sciences
Carlo Condello, PhD	Department of Neurology
Bruce Conklin, MD	Department of Medicine
Ryan Corces, PhD	Department of Neurology
Willow Coyote-Maestas, PhD, MS	Department of Bioengineering and Therapeutic Sciences
Charles Craik, PhD	Department of Pharmaceutical Chemistry
Kyle Cromer, PhD	Department of Surgery
Amelia Deitchman, PharmD, PhD	Department of Clinical Pharmacy
Jennifer Doudna, PhD	Department of Cellular and Molecular Pharmacology
Michael Evans, PhD	Department of Radiology and Biomedical Imaging
James Fraser, PhD^	Department of Bioengineering and Therapeutic Sciences
Jason Gestwicki, PhD	Department of Pharmaceutical Chemistry
Kathy Giacomini, PhD, BSPharm^	Department of Bioengineering and Therapeutic Sciences
Andrei Goga, MD, PhD	Department of Cell & Tissue Biology
Hani Goodarzi, PhD	Department of Biophysics & Biochemistry
Su Guo, PhD**	Department of Bioengineering and Therapeutic Sciences
Ryan Hernandez, PhD	Department of Bioengineering and Therapeutic Sciences
Chris Hsiung, MD, PhD	Department of Surgery
Franklin Huang, MD, PhD	Department of Medicine
Isha Jain, PhD	Department of Biophysics & Biochemistry
Babak Javid, MB, PhD	Division of Experimental Medicine
Natalia Jura, PhD	Department of Cellular and Molecular Pharmacology
Aimee Kao, MD, PhD	Department of Neurology
Aparna Lakkaraju, PhD	Department of Ophthalmology
Hao Li, PhD	Department of Biochemistry and Biophysics
Wilson Liao, MD	Department of Dermatology
Wendell Lim, PhD	Department of Cellular and Molecular Pharmacology
Rongze "Olivia" Lu, PhD	Department of Neurological Surgery
Aashish Manglik, MD, PhD	Department of Pharmaceutical Chemistry
Michael McManus, PhD	Department of Microbiology and Immunology

Marisa Medina, PhD	Department of Pediatrics
Hideho Okada, MD, PhD	Department of Neurological Surgery
Akinyemi Oni Orisan, PharmD, PhD	Department of Clinical Pharmacy
Melanie Ott, MD, PhD	Department of Medicine
Patrick Phillips, PhD, MS, MA	Department of Medicine and Department of Epidemiology & Biostatistics
Xianhua Piao, MD, PhD	Department of Pediatrics
Katie Pollard, PhD	Department of Epidemiology & Biostatistics
Nadia Roan, PhD	Department of Urology
Dorit Ron, PhD	Department of Neurology
Jennifer Rosenbluth, MD, PhD	Department of Medicine
Shuvo Roy, PhD	Department of Bioengineering and Therapeutic Sciences
Andrej Sali, PhD	Department of Bioengineering and Therapeutic Sciences
Rada Savic, PhD	Department of Bioengineering and Therapeutic Sciences
Jason Sello, PhD	Department of Pharmaceutical Chemistry
Neil Shah, MD, PhD	Department of Medicine
Yin Shen, PhD	Department of Neurology
Dean Sheppard, MD	Division of Pulmonary & Critical Care
Brian Shoichet, PhD	Department of Pharmaceutical Chemistry
Marina Sirota, PhD	Department of Pediatrics
Alejandro Sweet-Cordero, MD	Department of Pediatrics
Bani Tamraz, PharmD, PhD	Department of Clinical Pharmacy
Catherine Tcheandjieu Gueliatcha, DVM, PhD	Department of Epidemiology & Biostatistics
Dara Torgerson, PhD	Department of Epidemiology & Biostatistics
Christian Vaisse, MD, PhD	Department of Medicine
Laura Van 't Veer, PhD	Department of Laboratory Medicine
Lauren Weiss, PhD	Department of Psychiatry
William Weiss, MD, PhD	Departments of Neurology, Pediatrics, and Neurological Surgery
James Wells, PhD	Department of Pharmaceutical Chemistry
Arun Wiita, MD, PhD	Department of Laboratory Medicine
Beth Apsel Winger, MD, PhD	Department of Clinical Pharmacy
Alan Wu, PhD	Department of Laboratory Medicine
Lani Wu, PhD	Department of Pharmaceutical Chemistry
Iwei Yeh, MD, PhD	Departments of Dermatology and Pathology
Jennifer Yokoyama, PhD	Department of Neurology
Liang Zhao, PhD, MAS, MBA	Department of Bioengineering and Therapeutic Sciences
Elad Ziv, MD	Department of Medicine
Brian Alldredge, PharmD	Office of the Executive Vice Chancellor & Provost
Dorie Apollonio, PhD, MPP	Department of Clinical Pharmacy
Kirsten Balano, PharmD	Department of Clinical Pharmacy

Sourav Bandyopadhyay, PhD	Department of Bioengineering and Therapeutic Sciences
Al Burlingame, PhD	Department of Pharmaceutical Chemistry
Leslie Carstensen Floren, PharmD, PhD, MA*	Department of Clinical Pharmacy
Tram Cat, PharmD*	Department of Clinical Pharmacy
Noelle Chapman, PharmD, MBA	Pharmacy Management Group
Valerie Clinard, PharmD*	Department of Clinical Pharmacy
Jennifer Cocohoba, PharmD, MAS	Department of Clinical Pharmacy
Robin Corelli, PharmD	Department of Clinical Pharmacy
Charles S. Craik, PhD	Department of Pharmaceutical Chemistry
Donna Dare, PharmD	Department of Clinical Pharmacy
William DeGrado, PhD	Department of Pharmaceutical Chemistry
Cathi Dennehy, PharmD*	Department of Clinical Pharmacy
Tejal Desai, PhD	Department of Bioengineering and Therapeutic Sciences
Sophie Dumont, PhD	Department of Bioengineering and Therapeutic Sciences
Ignacia Echeverria Riesco, PhD	Department of Bioengineering and Therapeutic Sciences
Pamela England, PhD	Department of Pharmaceutical Chemistry
Danica Galonić Fujimori, PhD	Department of Cellular and Molecular Pharmacology
Zev Gartner, PhD	Department of Pharmaceutical Chemistry
Yessica Gomez, PhD	Department of Pharmaceutical Chemistry
Michael Grabe, PhD	Cardiovascular Research Institute
John Gross, PhD	Department of Pharmaceutical Chemistry
Katherine Gruenberg, PharmD, MA*	Department of Clinical Pharmacy
Chad Hatfield, PharmD, MHA	UC Davis Health
Stuart Heard, PharmD	Department of Clinical Pharmacy
Yvette Hellier, PharmD	Department of Clinical Pharmacy
Bo Huang, PhD	Department of Pharmaceutical Chemistry
C. Anthony Hunt, PhD	Department of Bioengineering and Therapeutic Sciences
Jeroen Jansen, PhD	Department of Clinical Pharmacy
Shannan Takhar, PharmD	Department of Clinical Pharmacy
Robyn Kaake, PhD	Department of Bioengineering and Therapeutic Sciences
Tanja Kortemme, PhD	Department of Bioengineering and Therapeutic Sciences
Desi Kotis, PharmD	Office of COO
Nevan Krogan, PhD	Department of Bioengineering and Therapeutic Sciences
Lisa Kroon, PharmD*	Department of Clinical Pharmacy
Janel Long-Boyle, PharmD, PhD	Department of Clinical Pharmacy
Shalini Lynch, PharmD	Department of Clinical Pharmacy
Conan MacDougall, PharmD, MAS*	Department of Clinical Pharmacy
James R. McNulty, PharmD	Department of Clinical Pharmacy
Igor Mitrovic, MD*	Department of Physiology
Emily Mrig, PhD	Department of Clinical Pharmacy
Jeffrey Neitz, PhD	Department of Pharmaceutical Chemistry

Kathryn Phillips, PhD	Department of Clinical Pharmacy
Tiffany Pon, PharmD	Department of Clinical Pharmacy
Adam Renslo, PhD	Department of Pharmaceutical Chemistry
Rosa Rodriguez-Monguio, PhD, MS	Department of Clinical Pharmacy
Nancy Sambol, PharmD	Department of Bioengineering and Therapeutic Sciences
Daniel Santi, MD, PhD	Department of Pharmaceutical Chemistry
Rita Shane, PharmD	Department of Clinical Pharmacy
Jaekyu Shin, PharmD, MS*	Department of Clinical Pharmacy
Seth Shipman, PhD	Department of Bioengineering and Therapeutic Sciences
Xiaokun Shu, PhD	Department of Pharmaceutical Chemistry
David Smith, PharmD	Department of Clinical Pharmacy
Danielle Swaney, PhD	Department of Bioengineering and Therapeutic Sciences
Francis Szoka, PhD**	Department of Bioengineering and Therapeutic Sciences
Trang Trinh, PharmD, MPH	Department of Clinical Pharmacy
Candy Tsourounis, PharmD*	Department of Clinical Pharmacy
Rupa Tuan, PhD*	Department of Cellular and Molecular Pharmacology
Samantha Valle-Oseguera, PharmD	Department of Clinical Pharmacy
Lei Wang, PhD	Department of Pharmaceutical Chemistry
Michelle Wang, PharmD, PhD	Department of Bioengineering and Therapeutic Sciences
Jonathan Watanabe, PharmD, PhD^	Department of Clinical Pharmacy
Jim Wells, PhD	Department of Pharmaceutical Chemistry
Catera Wilder, PhD	Department of Bioengineering and Therapeutic Sciences
Leslie Wilson, PhD	Department of Clinical Pharmacy
Katherine Yang, PharmD, MPH*	Department of Clinical Pharmacy
Sharon L. Youmans, PharmD, MPH	Department of Clinical Pharmacy
Balyn Zaro, PhD	Department of Pharmaceutical Chemistry
Crystal Zhou, PharmD*	Department of Clinical Pharmacy

*Individual faculty members identified by an asterisk are core teaching faculty in the PharmD program (including Integrated Theme Directors as well as Experiential Education Directors) and those identified by a double asterisk are core teaching faculty in the PSPG PhD program. Faculty noted with a “carat” denote heads of departments in the SOP (i.e., Bioengineering and Therapeutic Sciences, Clinical Pharmacy and Pharmaceutical Chemistry) and our Dean.

SECTION 5. COURSES

The PharmD/PhD Dual Degree Program curriculum will consist of core and elective courses. Core and elective courses for the Program will be drawn from PharmD and PhD existing courses.

The main proposed curricular changes to PharmD curriculum are:
-Waiving of the PharmD discovery project. In the proposed PharmD/PhD Dual Degree Program, the PhD dissertation research project will count towards the PharmD discovery project. The PhD dissertation research (480 hours) will be also counted as two non-clinical APPEs (the two Non-Direct Patient Care APPE Electives CL PHARM 190A and 190B).

-The proposed dual degree program will also include clinical practice experience throughout the PhD years (year 3-6). Of these sequential clinical rotations, one year (one day weekly for 30 consecutive weeks) will count towards one clinical APPE.
-The one APPE (sequential clinical rotations over a year) that will be taken during the PhD years will include a clinical pharmacogenomics service (240 hours).
-The last seventh year will include five clinical APPEs.

The main proposed curricular changes to PhD (PSPG) curriculum are:
-Decreased the required PhD lab/research rotations from three to two (will be completed in the Spring of the second year and Summer of the third year).
-The PSPG 245A will be waived and replaced by a self-study module.
-The PSPG 245C will be waived and replaced by getting involved in the clinical pharmacogenomics service (240 hours).
-Two of three required PSPG mini-courses will be waived.
A detailed description of all the coursework throughout the PharmD/PhD Dual Degree Program by year is presented in section 2.3.2.

5.1 Existing courses
The following list contains existing courses available to PharmD/PhD Program students from the PharmD program:

Required core courses for PharmD:
PHARMIS 110 Foundations I (Summer, 14.5 units)
Summer of YEAR 1 PharmD/PhD
Instructor(s): Joanne Chun, Katherine Yang
Foundations I is an integrated course that provides foundational concepts which will serve as the basis for content that will be taught in all subsequent preclinical courses. The content of this course spans all levels of pharmacy practice including the therapeutic sciences, health care policy and management, and evidence-based health care. A key emphasis of this course is to lay the foundation for the development of compassionate critical thinkers and transformative leaders in healthcare.

CL PHARM 170 Applied Patient Care Skills I (Summer, 2.5 Units)
Summer of YEAR 1 PharmD/PhD
Instructor(s): Leslie Floren
The APCS course trains students to care for patients by advancing skills in three areas: hands-on (e.g., immunizations), communication, and critical thinking skills. Activities incorporate self-reflection and are designed to uphold principles of DEI. This course introduces students to history taking, patient interviewing, chart documentation, immunizations, and aseptic technique. Students are evaluated through direct observation in skills sessions and an OSCE.

PHARMIS 111 Cardiovascular Science & Therapeutics (Fall, 11.5 Units)
Fall of YEAR 1 PharmD/PhD
Instructor(s): Jaekyu Shin

This Cardiovascular Integrated Theme course focuses on the medical treatment of 4 cardiovascular diseases (ischemic heart disease, dyslipidemia, heart failure, and arrhythmias) by integrating related basic and clinical sciences as well as behavioral/social/administrative sciences. It also explores knowledge gap in inquiry classes. The course concludes with a Synthesis week for reflection, exploration of career-options, and integration with the Foundations I course content.

CL PHARM 171 Applied Patient Care Skills II (Fall, 1 Units)
Fall of YEAR 1 PharmD/PhD

Instructor(s): Crystal Zhou

The APCS course complements the core, inquiry, and experiential education elements of the curriculum. The purpose of the APCS course is to help students further build upon their knowledge to care for patients as a whole and enhance communication skills with patients and other healthcare providers both orally and in writing. The APCS course is fully case-based and will focus on advancing 3 domains: hands-on skills, communication skills, and critical thinking skills.

CL PHARM 181 Introductory Pharmacy Practice Experience- Community A (Fall, 2.5 Units)
Fall of YEAR 1 PharmD/PhD

Instructor(s): Valerie Clinard

Through IPPEs, student pharmacists are expected to master foundational competencies in multiple domains including patient care, population health, interprofessional practice, practice management, professional development and medical information. Each student will complete a longitudinal experience in a community pharmacy setting. The student pharmacists will become a member of the healthcare team.

PHARMIS 112 Respiratory Science & Therapeutics (Winter , 9.5 Units)
Winter of YEAR 1 PharmD/PhD

Instructor(s): Yessica Gomez

This is an integrated course focused on pharmacologic/non-pharmacologic approaches to tobacco cessation, medical treatment of 5 common diseases, and conditions involving the respiratory system. This is done by integrating related basic, clinical, and behavioral/social/administrative sciences. It also explores knowledge gaps in inquiry classes. The course concludes with a Synthesis week for reflection, exploration of career-options, and integration with previous course content.

PHARMIS 122 Inquiry Immersion 1 (Winter, 2.5 Units)
Winter of YEAR 1 PharmD/PhD

Instructor(s): Joanne Chun

This Inquiry Immersion course within the Bridges Curriculum is a two-week block that includes foundational didactics, a selective mini-course, and scholarship skill-building.

CL PHARM 172 Applied Patient Care Skills III (Winter, 1 Units)
Winter of YEAR 1 PharmD/PhD

Instructor(s): Jennifer Cocohoba

The APCS course trains students to care for patients by advancing skills in three areas: hands-on (e.g., immunizations), communication, and critical thinking skills. Activities incorporate self-reflection and are designed to uphold principles of DEI. This course trains students to conduct a respiratory physical exam,

demonstrate pulmonary device use, and provide counseling on respiratory conditions. Students are evaluated through direct observation in skills sessions and an OSCE.

PHARMIS 113 Renal Science and Therapeutics (Spring , 6 Units)
Spring of YEAR 1 PharmD/PhD

Instructor(s): Igor Mitrovic, Tristan Storm

This integrated theme course focuses on the pharmaceutical interventions available in the medical treatment of hypertension and chronic kidney disease by integrating related basic and clinical sciences as well as behavioral/social/administrative sciences. It also explores knowledge gaps through inquiry sessions. The course predominantly focuses on the practice of drug dosing adjustments needed in renal dysfunction and renal replacement therapy.

PHARMIS 114 Gastrointestinal Science and Therapeutics (Spring, 8 Units)
Spring of YEAR 1 PharmD/PhD

Instructor(s): Cathi Dennehy

This integrated theme course focuses on the pharmaceutical interventions available in the medical treatments of inflammatory bowel disease, irritable bowel syndrome, liver disease, and gastrointestinal reflux and peptic ulcer disease. Pharmaceutical self-care as well as the basics of nutrition are also introduced in this course. It also explores knowledge gaps through inquiry sessions.

CL PHARM 173 Applied Patient Care Skills IV (Spring, 1 Units)
Spring of YEAR 1 PharmD/PhD

Instructor(s): Crystal Zhou

The APCS course trains students to care for patients by advancing skills in three areas: hands-on (e.g., immunizations), communication, and critical thinking skills. Activities incorporate self-reflection and are designed to uphold principles of DEI. CP173 trains students to assess blood pressure, conduct motivational interviewing, and participate in case-based exercises on renal and gastrointestinal conditions. Students are evaluated through direct observation in skills sessions and an OSCE.

CL PHARM 182 Introductory Pharmacy Practice Experience - Community B (Winter, Spring, 2.5-5 Units)
Winter and Spring of YEAR 1 PharmD/PhD

Instructor(s): Valerie Clinard

Through IPPEs, student pharmacists are expected to master foundational competencies in multiple domains including patient care, population health, interprofessional practice, practice management, professional development and medical information. Each student will complete a longitudinal experience in a community pharmacy setting. The student pharmacists will become a member of the healthcare team.

PHARMIS 115 Foundations II (Summer, 3 Units)
Summer of YEAR 2 PharmD/PhD

Instructor(s): Sharon Youmans

Foundations II is an integrated course that provides foundational concepts which will serve as the basis for content that will be taught in all subsequent preclinical courses for the second year of the PharmD

curriculum. The content of this course spans all levels of pharmacy practice including the therapeutic sciences, health care policy and management, and evidence-based health care.

PHARMIS 116 Endocrine Science and Therapeutics (Summer, 9.5 Units)
Summer of YEAR 2 PharmD/PhD

Instructor(s): Candy Tsourounis

This integrated theme course focuses on the pharmaceutical interventions available in the medical treatments of diabetes, thyroid and adrenal disorders. Pharmaceutical self-care are also introduced in this course. It also explores knowledge gaps through inquiry sessions.

CL PHARM 174 Applied Patient Care Skills V (Summer, 1 Units)
Summer of YEAR 2 PharmD/PhD

Instructor(s): Bani Tamraz

The APCS course trains students to care for patients by advancing skills in three areas: hands-on (e.g., immunizations), communication, and critical thinking skills. Activities incorporate self-reflection and are designed to uphold principles of DEI. This course trains students on their ability to demonstrate blood glucose monitoring and insulin injection and counsel on endocrine-related conditions. Students are evaluated through direct observation in skills sessions and an OSCE.

PHARMIS 117 Neuroscience and Therapeutics (Fall, 14.5 Units)
Fall of YEAR 2 PharmD/PhD

Instructor(s): Stephanie Hsia, Rupa Tuan

This integrated theme course focuses on the pharmaceutical interventions available in the medical treatments of stroke, epilepsy, pain insomnia, anxiety disorders, major depressive disorder, schizophrenia, Alzheimer's disease, Parkinsons disease, and alcohol/opioid/substance use disorders. It also explores knowledge gaps through inquiry sessions.

CL PHARM 175 Applied Patient Care Skills VI (Fall, 1 Units)
Fall of YEAR 2 PharmD/PhD

Instructor(s): Trang Trinh

The APCS course trains students to care for patients by advancing skills in three areas: hands-on (e.g., immunizations), communication, and critical thinking skills. Activities incorporate self-reflection and are designed to uphold principles of DEI. This course trains students to counsel patients on neurological and psychiatric conditions, conduct telehealth visits, and present patients to a preceptor. Students are evaluated through direct observation in skills sessions and an OSCE.

PHARMIS 118 Oncology Science and Therapeutics (Winter, 5.5 Units)
Winter of YEAR 2 PharmD/PhD

Instructor(s): Janel Long-Boyle

This integrated theme course focuses on the role of the clinical pharmacist in the treatment of a patient requiring chemotherapy or immunotherapy as treatment (malignant and non-malignant disease). It also explores knowledge gaps through inquiry sessions.

PHARMIS 119 Infectious Disease Science and Therapeutics (Winter, 8 Units)

Winter of YEAR 2 PharmD/PhD

Instructor(s): Conan MacDougall

This integrated theme course focuses on antimicrobial regimen selection, antimicrobial stewardship, and the pharmaceutical interventions available in the treatment of respiratory tract infections, urinary tract Infections, skin and soft tissue infections, fungal infections, CNS infections, GI infections, sepsis and septic shock, HIV infection, viral hepatitis, viral infections, and tuberculosis. It also explores knowledge gaps through inquiry sessions.

CL PHARM 176 Applied Patient Care Skills VII (Winter, 1 Units)
Winter of YEAR 2 PharmD/PhD

Instructor(s): Katherine Gruenberg

The APCS course trains students to care for patients by advancing skills in three areas: hands-on (e.g., immunizations), communication, and critical thinking skills. Activities incorporate self-reflection and are designed to uphold principles of DEI. This course trains students to conduct calculations, counsel patients, communicate with providers, and critically evaluate infectious diseases and oncology conditions. Students are evaluated through direct observation in skills sessions and an OSCE.

CL PHARM 183 Introductory Pharmacy Practice Experience - Health Systems (Fall, Winter, Spring, Summer, 1.5-3.5 Units)
Fall, Winter, and Spring of YEAR 2 PharmD/PhD

Instructor(s): Valerie Clinard

Through IPPEs, student pharmacists are expected to master foundational competencies in multiple domains including patient care, population health, interprofessional practice, practice management, professional development and medical information. Each student will complete a concentrated and a longitudinal experience in a health system pharmacy setting. The student pharmacists will become a member of the healthcare team.

CL PHARM 191A Direct Patient Care APPE Elective (Fall, Winter, Spring, Summer; 7 Units)

Instructor(s): Staff

A core required rotation, this course is a supervised pharmacy experience where students develop & explore their roles on an interprofessional healthcare team, sharing responsibilities with patients, caregivers, & other health professionals for drug therapy outcomes in a patient care setting. Students are expected to master competencies in multiple domains including patient care, population health, interprofessional practice, practice management, professional development & medical information.

CL PHARM 191B Direct Patient Care APPE Elective (Fall, Winter, Spring, Summer; 7 Units)

Instructor(s): Staff

A core required rotation, this course is a supervised pharmacy experience where students develop & explore their roles on an interprofessional healthcare team, sharing responsibilities with patients, caregivers, & other health professionals for drug therapy outcomes in a patient care setting. Students are expected to master competencies in multiple domains including patient care, population health, interprofessional practice, practice management, professional development & medical information.

CL PHARM 192 Hospital Pharmacy Systems & Practice APPE (Fall, Winter, Spring, Summer; 7 Units)

Instructor(s): Staff

A core required rotation, this course is a supervised pharmacy experience where students develop & explore their roles on an interprofessional healthcare team, sharing responsibilities with patients, caregivers, & other health professionals for drug therapy outcomes in a health system setting. Students are expected to master competencies in multiple domains including patient care, population health, interprofessional practice, practice management, professional development & medical information.

CL PHARM 193 Community Pharmacy Systems & Practice APPE (Fall, Winter, Spring, Summer; 7 Units)

Instructor(s): Staff

A core required rotation, this course is a supervised pharmacy experience where students develop & explore their roles on an interprofessional (IP) healthcare team, sharing responsibilities with patients, caregivers, & other health professionals for drug therapy outcomes in a community pharmacy setting. Students are expected to master competencies in multiple domains including patient care, population health, IP practice, practice management, professional development & medical information.

CL PHARM 194 Acute Patient Care APPE (Fall, Winter, Spring, Summer; 7 Units)

Instructor(s): Staff

A core required rotation, this course is a supervised pharmacy experience where students develop & explore their roles on an interprofessional (IP) healthcare team, sharing responsibilities with patients, caregivers, & other health professionals for drug therapy outcomes in an acute patient care setting. Students are expected to master competencies in multiple domains including patient care, population health, IP practice, practice management, professional development & medical information.

CL PHARM 195 Ambulatory Patient Care APPE (Fall, Winter, Spring, Summer; 7 Units)

Instructor(s): Staff

A core required rotation, this course is a supervised pharmacy experience where students develop & explore their roles on an interprofessional (IP) healthcare team, sharing responsibilities with patients, caregivers, & other health professionals for drug therapy outcomes in an ambulatory care setting. Students are expected to master competencies in multiple domains including patient care, population health, IP practice, practice management, professional development & medical information.

The following list contains existing courses available to PharmD/PhD Program students from the PhD (PSPG) program:

Required core courses for PhD:
PHARMGENOM 206 Laboratory Rotation (Fall, Winter, Spring, 2-8 Units)

Spring of YEAR 2 and Summer of YEAR 3 PharmD/PhD

Instructor(s): Staff

A laboratory rotation course to familiarize new students in the Graduate Program in Pharmaceutical Sciences and Pharmacogenomics with various approaches to research in the pharmaceutical sciences and to gain exposure to potential dissertation research projects.

GRAD 202 Racism in Science (Fall, 3 Units)
Fall of YEAR 3 PharmD/PhD

Instructor(s): Aimee Medeiros, D'anne Duncan

This introductory course provides the historical background of systemic racism in scientific research. It explores the relationship between notions of race and science and how scientific research has been informed by and perpetuates anti-Black racism. This course also examines the impact of bias and a lack of diversity in science and ways in which to address these deficiencies. Students will learn the principles of social justice-oriented scientific research and its potential.

BIOSTAT 272 Foundations in Biostatistical Principles and Methods (Fall, 4 Units)
Fall of YEAR 3 PharmD/PhD

Instructor(s): Patrick Phillips, Suzanne Dufault

This course provides a foundation in modern biostatistical methods and statistical reasoning for pharmaceutical sciences research. The course will explore common data types and distributions, experimental design, exploratory data analysis, methods for hypothesis testing (both parametric and non-parametric), and model-building and comparison. During this hands-on course, students will reinforce their understanding by implementing what they have learned in R.

PHARMGENOM 245B.1 Systems Pharmacology (Winter, 2 Units)
Winter of YEAR 3 PharmD/PhD

Instructor(s): Joanne Chun

An in-depth introduction to the use of systems approaches in pharmacology research. The course covers experimental and computational methods to understanding target identification and validation, drug biomarker discovery, drug repurposing drug development and identifying mechanisms of adverse drug reactions and multidrug resistance. Emphasis is placed on computational modeling and quantitative data analysis. Students will work in teams to analyze complex biological data sets.

PHARMGENOM 245B.2 Systems Pharmacology (Winter, 2 Units)
Winter of YEAR 3 PharmD/PhD

Instructor(s): Joanne Chun

A series of lectures and hands-on workshops designed to teach students core principles in systems biology and pharmacogenomics approaches. Example topics include precision medicine, drug development, drug repurposing, big data analysis and biomarker discovery. The purpose is to acquaint students with emerging topics in the field and provide a firm basis in computational analysis and programming through hand on, project-oriented workshops.

GRAD 214 Responsible Conduct of Research and Rigor & Reproducibility (Fall, Winter, Spring, 1.5 Units)

Spring of YEAR 3 PharmD/PhD

Instructor(s): D'anne Duncan

This course, which will be delivered over three quarters to first year PhD students in the basic sciences, will cover topics related to the responsible conduct of research and rigor and reproducibility. 50% in-person attendance at scheduled lectures and discussions sessions will be expected. Students will review and participate in case study discussions.

PHARMGENOM 297 Pharmaceutical Sciences and Pharmacogenomics Journal Club (Fall, Winter, Spring, 1 Units)

Summer, Fall, Winter, and Spring YEAR 3 – 4 PharmD/PhD

Critical review of published scientific papers from scholarly journals including comprehension, analysis and evaluation of published scientific data.

BIOPHYSICS 297 Scientific writing: applying for the NSF predoctoral fellows (Fall, 1 Units)

Fall of YEAR 4 PharmD/PhD

Instructor(s): Brian Shoichet

Communicating your best ideas is critical to obtaining the resources necessary to work on them. This course prepares you to conceive, organize, and communicate scientific ideas in written form. Built around the NSF GRF application, this course covers important funding agencies and fellowship opportunities, formulating a research plan in the form of hypotheses and specific aims, organizing research proposals, and peer editing. Course culminates in submission of materials to NSF and other agencies.

PHARMGENOM 250 Research (Fall, Winter, Spring, Summer, 8 Units)

Summer, Fall, Winter, and Spring YEAR 3 – 6 PharmD/PhD

Instructor(s): Staff

In this course, students will work together with a primary research advisor to select a research question and design a project workplan that will be carried out by the student. Through this activity, the student will gain experience in research strategy, learn techniques associated with modern biomedical research and practice how to interpret results. At the conclusion of the course, the student will present on their progress.

PHARMGENOM 220 Student Research Seminar (Fall, Winter, Spring, 1 Units)

Summer, Fall, Winter, and Spring YEAR 3 – 6 PharmD/PhD

Instructor(s): Su Guo

This seminar will provide graduate students with a forum in which to develop seminar and poster presentation skills; critically organize and critically review scientific data; and analyze and question oral scientific presentations.

PHARMGENOM 223 Formal Seminar (Fall, Winter, Spring, 1 Units)

Summer, Fall, Winter, and Spring YEAR 3 – 6 PharmD/PhD

Instructor(s): Su Guo

This course is designed to expose students to advancements in PSPG & prepare students for their own oral presentations- at retreats, in other classes, lab presentations, etc. The students will see first hand and close up how professionals in their field organize & present their research. While they won't have oral

presentations for this class, they will have oral presentations throughout the year that don't go on record because they are not related to a class (such as our retreat).

Elective courses (students will select one of the following electives in Winter of YEAR 3 PharmD/PhD):
-BMI 203 Biocomputing Algorithms, Tony Capra (Winter, 4 units)
-CHEMISTRY 244 Reaction Mechanisms, Adam Renslo (Winter, 3 Units)
-BIOMED SCI 255 Basic Genetics & Genomics, Robert Nussbaum, Anita Sil (Winter, 4 Units)
-PSPG 274 Special Topics in Pharmacology, Staff (Winter, 2.5 units)

5.2 Proposed courses
All courses of the proposed PharmD/PhD program are existing PharmD and PhD (Pharmaceutical Sciences and Pharmacogenomics) courses. No new courses will be proposed for this program.

5.3 Staffing of courses
Existing courses that will be part of the PharmD/PhD curriculum are already staffed by their respective Departments.

5.4 Admission Process
Prospective students will apply to both PharmD and PhD (PSPG) programs by completing both PharmD and PSPG applications. Current UCSF PharmD students can apply to the PhD program directly by completing the PSPG application. To be eligible to apply, students must have completed a bachelor's degree or recognized equivalent degree from an accredited institution with a minimum GPA of 3.0 on a 4.0 scale. Students must satisfy all PharmD and PhD prerequisites with course work approved by the Office of Student Affairs (all prerequisites must be completed prior to July 1 of the year of entry into the program). Overall, qualified applicants will have diverse backgrounds with an undergraduate degree in the biological sciences, genetics, chemistry, bioinformatics, pharmacology, engineering and pharmacy. Applicants whose native language is not English need to demonstrate proficiency in English by taking TOEFL or IELTS, or have demonstrated proficiency in English by completing one year of full-time study with a minimum GPA of 3.2 in an accredited University in the United States. A detailed description of the applicant qualifications is provided in section 2.1.

Applications for the PharmD portion will be submitted through Pharmacy College Application Service (PharmCAS) and will include official transcripts and three to four letters of recommendations. Shortlisted candidates will undergo an interview process with two members of the community (such as a faculty member and a current student) to assess their commitment, communication skills, critical thinking, empathy, and future plans. On the day of the interview, the candidates will have an essay exercise, which can help the admission committee assess their writing skills, problem solving, and critical thinking abilities. interpersonal skills, and alignment with program goals.

Applications for the PhD portion will be submitted through a program (PSPG)-specific portal and will include official transcripts, current CV, three letters of recommendations, Research Statement, and Statement of Purpose. The PSPG admissions committee will evaluate and rank candidates during the application review process based on academic preparation, scholarly potential, life skills, and program fit/match.

For a prospective student applying for both programs, they have to state his/her intention to apply to the PharmD/PhD Dual Degree Program in the PharmD application. In the PSPG application, they also have to indicate that they submitted the recommendation letters, course history, and information related to honors, awards, and fellowships in their PharmD application.

SECTION 6. RESOURCE REQUIREMENTS

6.1 Faculty and Staff Support

The faculty of the PharmD/PhD program will be the same faculty of both PharmD and PhD (PSPG) programs. To implement the program, there will be a Program Director (1.0 FTE) and a Program Administrator/TBD (To Be Determined) Faculty (1.0 FTE).

6.1.1 Program Directors

The Program Director (Dr. Leslie Carstensen Floren) is a full-time UCSF employee with 1.0 FTE. The director is a Professor of Clinical Pharmacy and the Associate Dean for Fellowships in the School of Pharmacy. She served as the co-Director of the CPT Program from 2007- 2024 and now, as the Director of Fellowship Education, and oversees the trainees' training and education in clinical pharmacology and regulatory sciences. The director's teaching responsibilities have primarily included teaching foundational clinical skills and respiratory therapeutics to first year pharmacy students; pharmacokinetics/ pharmacodynamics, clinical pharmacology and principles of drug development and regulatory sciences to a wide variety of students, including professional students in the Pharm.D. program, clinical pharmacology trainees, junior faculty members, and working professionals from backgrounds in industry; and providing clinical preceptorship in Transitions of Care. She has received the School of Pharmacy Dean's Recognition for Excellence in Teaching every year since 2005 and received the highest honor in the School of Pharmacy for teaching in 2010, the Long Award for Excellence in Teaching and in 2020 she was named "Teacher of the Year" by the PharmD students.

The Program Co-Director (Dr. Brian Shoichet) is a full-time UCSF employee with 1.0 FTE. The co-director is a Professor in the Department of Pharmaceutical Chemistry and the Co-Vice Dean of Graduate Pharmacy Education Programs. The co-director's teaching responsibilities have primarily included teaching computational biophysics, drug discovery, physical chemistry, and grant writing to a wide variety of students, including professional students in the PharmD program and graduate students in the PhD programs in PSPG, Biological and Medical Informatics, Biophysics, and Chemistry and Chemical Biology. He co-leads the School of Pharmacy's plans for developing graduate education programs in the computational and experimental sciences. These programs are geared toward giving the School's PharmD students greater career opportunities throughout biomedicine.

The Director and the Co-Director will provide leadership to the PharmD/PhD Program while also providing oversight of the program budget, funding, and resources to ensure fiscal stability, managing marketing and recruitment activities, and helping to facilitate Faculty development. The Director will serve as Chair of the Curriculum Committee and oversee curriculum and competencies development and evaluations as outlined in Section 2.3.2. The Director and the Co-Director will be continually involved in strategic growth and vision of the Program and serve as the primary liaison within UCSF and other programs, institutions, industry partners, and professional societies. The Program Director and Co-

Director also have direct contact with the students by serving as an instructor for classes to PharmD Program students. They also supervise the Assistant Program Director or Program Administrator.

Duties and responsibilities:
- Program Growth and Vision
- Program Liaison
- Budget development and management
- Marketing
- Recruitment
- Faculty hiring
- Faculty development
- Competencies (Curriculum)
- Teaching

6.1.2 Program Administrator

A Program Administrator/TBD Faculty (1.0 FTE) will be hired and be responsible for supporting all the dual degree programs within College of Pharmacy. This Program Administrator will have background and expertise in clinical pharmacology and/or pharmacogenomics fields with a PhD, PharmD, or equivalent degree.

The Program Administrator is responsible for supporting the Program Director and Co-Director and assists with developing procedures to ensure effective operation of the Program.

Duties and responsibilities:
- Management of admissions process
- Management and coordination of course and class scheduling
- Oversee student advising and support
- Oversee faculty support
- Coordination of committees
- Correspondence and communications
- Monitoring student progress
- Student financial support
- Student materials
- Tracking course and instructor evaluations
- Website development and maintenance

6.1.3 Program Finance Assistant

A Program Finance Assistant will be hired to support all the graduate programs within College of Pharmacy, including the dual degree programs. This individual will devote 0.25 FTE to support the Program Director and Co-Director and plays an important role in ensuring the financial health and sustainability of the PharmD/PhD Program. Key responsibilities include:
- Budget management: Assist in development and management of the program's budget
- Identify funding sources and allocate resources
- Maintain financial records (track expenses, generate invoices, and prepare financial statements)
- Financial analysis and strategy recommendations

- Assist students navigating the financial aspects of the program (student charges, financial aid, and scholarships)

6.1.4 Program Faculty

The faculty of the PharmD/PhD Dual Degree Program are existing faculty members of both the PharmD and the PhD in PSPG Programs. As outlined in Section 4.1, the faculty of the PharmD/PhD are faculty member from several UCSF various departments, including the Departments of Clinical Pharmacy, Bioengineering and Therapeutic Sciences, Pharmaceutical Chemistry, Medicine, Epidemiology and Biostatistics, Neurology and Pediatrics, Cellular and Molecular Pharmacology, Surgery, Neurological Surgery, Radiology and Biomedical Imaging, Cell & Tissue Biology, Biophysics & Biochemistry, Experimental Medicine, Ophthamology, Dermatology, Pathology, Microbiology & Immunology, Urology, Pulmonary & Critical Care, and Psychiatry. A wide range of faculty members at UCSF have indicated their enthusiasm for the program and their willingness to serve on PharmD/PhD committees as well as serve as faculty or research advisors and mentors.

Core Program Faculty

The Core Program Faculty of the PharmD/PhD Program will teach and coordinate the PharmD and PhD (PSPG) courses listed in Section 2.3.2. The Core Program Faculty will play a critical role in maintaining the quality and relevance of the program and will serve as:

1. Course Directors: Course directors will be responsible for planning and designing courses and delivering instruction to students.
2. Mentoring and advising students: As described in Sections1.10.1 and 2.3.4, each student is expected to choose his/her PhD Advisor/Mentor by the end of the Summer of the third year of the PharmD/PhD Program and will meet on a regular basis throughout the PhD years.

As outlined in the table of Section 4.1, the core teaching PharmD faculty and the core teaching PSPG PhD faculty are identified.

6.1.5 PhD Dissertation Project Advisors

The PhD Dissertation Project Advisors of the PharmD/PhD Dual Degree Program are UCSF faculty who are actively engaged in teaching and research in the PSPG PhD program's various fields (Pharmacogenomics and Functional Genomics, Quantitative and Systems Pharmacology, Computational Genomics, Molecular Pharmacology, Drug Development Sciences, and Therapeutic Bioengineering) and who are qualified to advise and mentor students in these different research areas. The PhD Dissertation Project Advisors will provide student guidance throughout the dissertation research project. The responsibilities will include serving as the chair of the dissertation committee, signing forms regarding the student's academic status, providing financial support for each student advisee, providing career advice/mentorship, reviewing the PhD dissertation project requirements, and assisting in developing a timeline for completion of the project. Students will meet bi-weekly with their advisors to ensure timely progression of their research projects. Advisors will provide feedback on projects and also help prepare students for their future careers.

6.2 Library acquisitions

UCSF provides internet access to a large and comprehensive set of scientific journals so that faculty and students have easy access to the published literature. UCSF has two libraries, one on the

Parnassus Heights Campus and another at Mission Bay. The Library conducts classes and consultation for research projects and literature review. The Library also runs a Data Science Initiative which provides training in finding, sharing, and managing data; bioinformatics and statistics; programming; and data visualization. The Parnassus Heights Library also holds a collection of books, primary research documents, and archival journals.

All researchers and students have internet-based access to digital holdings from anywhere on campus and remotely via VPN, as well as access to the extensive holdings of the nine other campuses in the UC system. The Parnassus Library has a Teaching and Learning Center (TLC) with state-of-the-art computer and conferencing equipment that enhances the educational experience across curricula and training programs. The TLC supports curricular activities that use simulation, technology-enhanced small group learning, and computing labs or that require presentation practice.

There are no anticipated additional costs for library acquisitions as the books and journals necessary for the PharmD/PhD program are currently used by other graduate programs.

6.3 Computing requirements

All faculty labs and offices are equipped with computers available for image processing, word processing, and data analysis. The UCSF Information Technology Services (ITS) provides a campus-wide high-speed network infrastructure, which allows investigators to access a wide variety of computing technologies. Because the UCSF campus is geographically diverse, ITS uses a high-speed SONNET Ring backbone infrastructure to allow virtually instantaneous access to campus computing resources from any campus location, including a number of clinical facilities affiliated with UCSF. The computing capabilities of the campus are constantly growing and expanding. Computing resources are conveniently located throughout the campus. Students are provided with UCSF e-mail accounts and cloud-based server storage. Computer (IT) support is provided by the Departments of faculty mentors. Free access to standard and high-end computer workstations is provided to the program and its fellows by the UCSF Library.

In addition, computational resources are available through the Institute for Human Genetics (IHG). The available computational resources are among the world's best. Hardware platforms include high-performance workstations from Digital Equipment, Hewlett Packard, IBM, Silicon Graphics, Dell, Apple, and Sun Microsystems. The computers and workstations on campus are connected to a campus-wide local area network, which in turn is connected via a high-speed microwave link to the Internet. Access to remote computer facilities, such as the NSF-sponsored supercomputer centers, is also available via this Internet link. Access to extensive literature databases is available through systems such as MEDLINE and the University's MELVYL system. An online journal system, RED SAGE, provides desktop access to full text and graphic images for a growing number of journals. A central aspect of the computer resources is a computational cluster housed in the IHG. The IHG cluster for computationally demanding projects is a Linux Cluster. This is an HPC cluster consisting of 10 compute nodes housed in a Dell 1855 chassis. Each node provides 2 EM64T Xeon processors running at 3.6 MHz, 800 MHz front-side bus along with an L2 1 MB cache. Memory is provided by 2-2GB DDR 3200 sticks of RAM. The Master node is a Dell PE2850 with 4 EM64T Xeon processors running at 3.2 MHz, 800 MHz front-side bus along with an L2 1 MB cache. Memory is provided by 2-2GB DDR 3200 sticks of RAM. Main storage for the cluster is provided via 110GB RAID1 disk array with a 250GB RAID5 disk array for short-term data staging. Larger and long-term data storage is provided by a multi-terabyte EMC Storage Area Network adjacent to

the cluster. Platform Rocks version 3.3.0 is used for cluster head and compute node management and provisioning. Sun Gridengine 5.3 provides distributed resource management and is integrated with Platform LAVA for batch job queuing, processing, and management. Software maintained on the cluster includes current licenses for SAS and SAS/Genetics (version 9.1.2), STATA (version 7.0), Maple (version 7), Matlab (version 6.1), and S-PLUS (version 6). Maintained public domain software includes the R statistical programming language (version 2.1.1), TeX/LaTeX, Perl, Python, and recent versions of the Free Software Foundation (GNU) programming utilities. The current complement of genetics software includes but is not limited to Aspex, FBAT, Fisher, GeneHunter, Mendel, PHASE, S.A.G.E., SOLAR, and STRUCTURE.

No additional computing costs, outside of personal computers for staff, are needed. On-campus internet is already available to matriculated students. Students will provide their own desktop or laptop computers for class activities and homework. Matriculated students will receive the standard computing support available from the UCSF Library's Learning Tech Support Center. The UCSF Library has a full suite of technology for problem-based learning (e.g., the Collaborative Learning Environment). All UCSF faculty can use UCSF Library educational technology without cost. Video conference and teleconference technology will be available in the dedicated program space in the Mission Bay campus.

6.4 Equipment

No equipment needs are anticipated.

6.5 Space and other capital facilities

Program faculty have offices and laboratories, which include desk space for trainees, provided by UCSF at various campus locations. The majority of program faculty are located at the Mission Bay Campus, where there is desk space for trainees and classrooms for didactic training.

Program faculty and staff will have a dedicated workspace provided by the School of Pharmacy. Classrooms and conference rooms on the Mission Bay campus will be available to the Program and are booked through a standard process through UCSF's Educational Technology Services.

6.6 Other operating costs

6.6.1 Software License fees

No new software licenses needs are anticipated.

6.6.2 Guest lecturers

Guest lecturers from industry will enrich the teaching program and program faculty will be encouraged to invite guest lecturers to their courses. Additionally, the program anticipates hosting professional development workshops. Expenses such as honorarium, economy travel, meal and other expenses will be covered by the program.

6.6.3 Incidental expenses

Brochures and advertising, teaching materials, software and other educational support costs will be covered by program charges.

SECTION 7. PROGRAM BUDGET AND CHARGES

The informational data sheets below are the result of a multitude of meetings and collaborations with respective parties from SOP, SOM-MS, Grad Division/PhD, Student Services, and BRM who provided input and vetting. The data provided are only estimates at the time provided. The **assumptions** of these programs are to start in FY27-28 with each of their respective cohorts accepting 2 students per cohort per fiscal year.

The expense assumptions per program are minimal; from providing stipends to program leads, to marketing, and other administrative shared costs.
This data will be reviewed again during the overall PharmD program proposal in Fall 2025

Information Provided:

- Estimated Enrollment Cohort Map by Fiscal Year per Quarter; showing when a student is enrolled in which program (assume 2 students per cohort per program per fiscal year)
- Estimated Enrollment Map showing PDST tuition per student
- Estimated Expenses of each of these programs on the Pharm D side
- Estimates of Program By FY/QTR Revenue, Expenses, and Net
- Estimated PDST tables for future fiscal years

Pharm D-PhD Enrollment Cohort Map

These estimates are based on 2 students entering the cohort per quarter per academic year.

			FY27-28	FY28-29	FY29-30	FY30-31	FY31-32	FY32-33	FY33-34	FY34-35
YEAR	QUARTER	Pharm D/PhD Cohorts	PharmD/PhD Cohort1	PharmD/PhD Cohort2	PharmD/PhD Cohort3	PharmD/PhD Cohort4	PharmD/PhD Cohort5	PharmD/PhD Cohort6	PharmD/PhD Cohort7	PharmD/PhD Cohort8
FY27-28	Q1 Summer	2	2							
FY27-28	Q2 Fall	2	2							
FY27-28	Q3 Winter	2	2							
FY27-28	Q4 Spring	2	2							
FY28-29	Q1 Summer	4	2	2						
FY28-29	Q2 Fall	4	2	2						
FY28-29	Q3 Winter	4	2	2						
FY28-29	Q4 Spring	2	to PhD	2						
FY29-30	Q1 Summer	4	to PhD	2	2					
FY29-30	Q2 Fall	4	to PhD	2	2					
FY29-30	Q3 Winter	4	to PhD	2	2					
FY29-30	Q4 Spring	2	to PhD	to PhD	2					
FY30-31	Q1 Summer	4	to PhD	to PhD	2	2				
FY30-31	Q2 Fall	4	to PhD	to PhD	2	2				
FY30-31	Q3 Winter	4	to PhD	to PhD	2	2				

FY30-31	Q4 Spring	2	to PhD	to PhD	to PhD	2				
FY31-32	Q1 Summer	4	to PhD	to PhD	to PhD	2	2			
FY31-32	Q2 Fall	4	to PhD	to PhD	to PhD	2	2			
FY31-32	Q3 Winter	4	to PhD	to PhD	to PhD	2	2			
FY31-32	Q4 Spring	2	to PhD	to PhD	to PhD	to PhD	2			
FY32-33	Q1 Summer	4	to PhD	to PhD	to PhD	to PhD	2	2		
FY32-33	Q2 Fall	4	to PhD	to PhD	to PhD	to PhD	2	2		
FY32-33	Q3 Winter	4	to PhD	to PhD	to PhD	to PhD	2	2		
FY32-33	Q4 Spring	2	to PhD	to PhD	to PhD	to PhD	to PhD	2		
FY33-34	Q1 Summer	6	2	to PhD	to PhD	to PhD	to PhD	2	2	
FY33-34	Q2 Fall	6	2	to PhD	to PhD	to PhD	to PhD	2	2	
FY33-34	Q3 Winter	6	2	to PhD	to PhD	to PhD	to PhD	2	2	
FY33-34	Q4 Spring	2		to PhD	to PhD	to PhD	to PhD	to PhD	2	
FY34-35	Q1 Summer	6		2	to PhD	to PhD	to PhD	to PhD	2	2
FY34-35	Q2 Fall	6		2	to PhD	to PhD	to PhD	to PhD	2	2
FY34-35	Q3 Winter	6		2	to PhD	to PhD	to PhD	to PhD	2	2
FY34-35	Q4 Spring	2			to PhD	to PhD	to PhD	to PhD	to PhD	2

PharmD-PhD enrollment map with estimated PDST/Tuition per Student

The map shows when a student is enrolled in which program. This map is used for student services as well as the running of the curriculum.

PharmD/PhD Estimated PDST per Student						PDST Only	In State	Outstate	In State	Outstate
	Fiscal Year	Q1 Summer	Q2 Fall	Q3 Winter	Q4 Spring	(PharmD)	Tuition - Pharm D	Tuition - Pharm D	PhD Costs*	PhD Costs*
Year 1 (Summer of 2027)	FY27-28	Pharm D	Pharm D	Pharm D	Pharm D	$36,240	$66,219	$78,464		
Year 2	FY28-29	Pharm D	Pharm D	Pharm D	PhD	$37,328	$50,895	$59,059	$21,692	$25,947
Year 3	FY29-30	PhD	PhD	PhD	PhD				$90,317	$107,846
Year 4	FY30-31	PhD	PhD	PhD	PhD				$94,014	$112,069
Year 5	FY31-32	PhD	PhD	PhD	PhD				$97,865	$116,462
Year 6	FY32-33	PhD	PhD	PhD	PhD				$101,878	$121,033
Year 7	FY33-34	Pharm D	Pharm D	Pharm D		$32,454	$58,721	$66,885		
					TOTALS	$106,022	$175,835	$204,408	$21,692	$25,947

The PhD program costs are the estimated costs in support of the student

PharmD-PhD estimated expenses on PharmD side

The expense assumptions per program are minimal, including providing stipends to program leads, marketing, and other administrative shared costs.

PharmD - PhD	Program Effort	FY28	FY29	FY30	FY31	FY32	FY33	FY34	FY35
Program Leads	Stipends	$6,500	$6,500	$6,500	$6,500	$6,500	$6,500	$6,500	$6,500
(Guest, Marketing, etc)	100.0%	$10,927	$11,255	$11,593	$11,941	$12,299	$12,668	$13,048	$13,439
Shared Cost of Assistant/Admin	25.0%	$6,789	$13,984	$14,404	$14,836	$15,281	$15,740	$16,212	$16,698
Estimated Service Costs (Kanbar, Occupancy, Skills)	Estimates	$3,460	$3,564	$3,671	$3,781	$3,895	$4,011	$4,132	$4,256
	Estimated Expenses PharmD-PhD	$27,676	$35,304	$36,168	$37,058	$37,975	$38,919	$39,891	$40,893

PharmD-PhD By FY/QTR Revenue, Expenses, and Net Estimates

YEAR	QUARTER	Pharm D/PhD Cohorts	PDST Tuition	PDST Gross (Enrollment*Tuition)	SFA (33%)	Net To School (66%)	Estimated Expenses	PharmD/PhD (Net)
FY27-28	Q1 Summer	2	$ 9,060	$18,120	$6,040	$12,080	$6,919	$5,161

FY27-28	Q2 Fall	2	$ 9,060	$18,120	$6,040	$12,080	$6,919	$5,161
FY27-28	Q3 Winter	2	$ 9,060	$18,120	$6,040	$12,080	$6,919	$5,161
FY27-28	Q4 Spring	2	$ 9,060	$18,120	$6,040	$12,080	$6,919	$5,161
FY28-29	Q1 Summer	4	$ 9,332	$37,328	$12,443	$24,885	$8,826	$16,059
FY28-29	Q2 Fall	4	$ 9,332	$37,328	$12,443	$24,885	$8,826	$16,059
FY28-29	Q3 Winter	4	$ 9,332	$37,328	$12,443	$24,885	$8,826	$16,059
FY28-29	Q4 Spring	2	$ 9,332	$18,664	$6,221	$12,443	$8,826	$3,617
FY29-30	Q1 Summer	4	$ 9,612	$38,448	$12,816	$25,632	$9,042	$16,590
FY29-30	Q2 Fall	4	$ 9,612	$38,448	$12,816	$25,632	$9,042	$16,590
FY29-30	Q3 Winter	4	$ 9,612	$38,448	$12,816	$25,632	$9,042	$16,590
FY29-30	Q4 Spring	2	$ 9,612	$19,224	$6,408	$12,816	$9,042	$3,774
FY30-31	Q1 Summer	4	$ 9,900	$39,600	$13,200	$26,400	$9,264	$17,136
FY30-31	Q2 Fall	4	$ 9,900	$39,600	$13,200	$26,400	$9,264	$17,136
FY30-31	Q3 Winter	4	$ 9,900	$39,600	$13,200	$26,400	$9,264	$17,136
FY30-31	Q4 Spring	2	$ 9,900	$19,800	$6,600	$13,200	$9,264	$3,936
FY31-32	Q1 Summer	4	$ 10,197	$40,788	$13,596	$27,192	$9,494	$17,698
FY31-32	Q2 Fall	4	$ 10,197	$40,788	$13,596	$27,192	$9,494	$17,698
FY31-32	Q3 Winter	4	$ 10,197	$40,788	$13,596	$27,192	$9,494	$17,698
FY31-32	Q4 Spring	2	$ 10,197	$20,394	$6,798	$13,596	$9,494	$4,102
FY32-33	Q1 Summer	4	$ 10,503	$42,012	$14,004	$28,008	$9,730	$18,278
FY32-33	Q2 Fall	4	$ 10,503	$42,012	$14,004	$28,008	$9,730	$18,278
FY32-33	Q3 Winter	4	$ 10,503	$42,012	$14,004	$28,008	$9,730	$18,278
FY32-33	Q4 Spring	2	$ 10,503	$21,006	$7,002	$14,004	$9,730	$4,274
FY33-34	Q1 Summer	6	$ 10,818	$64,908	$21,636	$43,272	$9,973	$33,299
FY33-34	Q2 Fall	6	$ 10,818	$64,908	$21,636	$43,272	$9,973	$33,299
FY33-34	Q3 Winter	6	$ 10,818	$64,908	$21,636	$43,272	$9,973	$33,299
FY33-34	Q4 Spring	2	$ 10,818	$21,636	$7,212	$14,424	$9,973	$4,451
FY34-35	Q1 Summer	6	$ 11,143	$66,858	$22,286	$44,572	$10,223	$34,349
FY34-35	Q2 Fall	6	$ 11,143	$66,858	$22,286	$44,572	$10,223	$34,349
FY34-35	Q3 Winter	6	$ 11,143	$66,858	$22,286	$44,572	$10,223	$34,349
FY34-35	Q4 Spring	2	$ 11,143	$22,286	$7,429	$14,857	$10,223	$4,634

7.1.1 Student Support

Students enrolled in the PharmD/PhD dual degree program in Pharmaceutical Sciences and Pharmacogenomics will be eligible for federal student loans and all other loans and scholarships administered through UCSF. Other funding will be provided by external partnerships (e.g. Genentech). The PharmD/PhD Program is dedicated to supporting students from underrepresented groups and will pursue support from various sources including industry and foundations to assist with student funding.

The PharmD/PhD dual degree program in Pharmaceutical Sciences and Pharmacogenomics is an intensive 6.5-7 years program requiring full-time commitment. Students will not have the opportunity to take on other work responsibilities.

7.1.2 Health and Other Benefits

All graduate students will be provided with a comprehensive health plan and other benefits in accordance with UCSF Graduate Division policies.

SECTION 8. GOVERNANCE

8.1 Program leadership

The PharmD/PhD Program Steering Committee will govern the proposed program.

8.2 Faculty and staff

As described in Sections 4.1 and 6.1.3, Program Faculty are current faculty members from both PharmD program and PhD program in Pharmaceutical Sciences and Pharmacogenomics (PSPG). The PSPG Faculty focus on six main research areas, including pharmacogenomics and functional genomics, quantitative and systems pharmacology, computational genomics, molecular pharmacology, drug development sciences, and therapeutic bioengineering.

Key positions within the program's staff include the Program Director described in Section 6.1.1, the Program Administrator described in Section 6.1.2, and the Program Finance Assistant described in Section 6.1.3.

SECTION 9. CHANGES IN SENATE REGULATIONS

This program does not require any changes in Senate Regulations.

APPENDIX 1. Letter of support from UCSF School of Pharmacy Dean

Kathy Giacomini, PhD, BSPharm
Dean, School of Pharmacy

UCSF

University of California
San Francisco

Kathleen M. Giacomini, PhD, BSPharm
Dean
Troy C. Daniels Distinguished Professor of Pharmaceutical Sciences
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February 20, 2025

Leslie Floren, PharmD, PhD, MAEd
Brian Shoichet, PhD
Program Leads, PharmD/PhD Dual Degree Program

Re: Institutional Letter of Support for the PharmD/PhD in Pharmaceutical Sciences and Pharmacogenomics Dual Degree Program

Dear Drs. Floren and Shoichet,

I am writing to express my enthusiastic support for the PharmD/PhD in Pharmaceutical Sciences and Pharmacogenomics Dual Degree Program.

I believe that this proposed new dual degree program will train the next generation of scientists on building core knowledge in science and therapeutics as well as in essential patient care skills, experiencing pharmacy practice in various clinical settings, exploring new ideas and innovations in science and practice, and training them on how to develop effective drug therapies for patients that have a minimum of adverse effects with the application of genetics and genomics. The establishment of this program will lead to transformational changes occurring in the field of precision medicine and individualized patient care.

The UCSF School of Pharmacy is a leader in educating the future pharmacy workforce. With three departments focused on bioengineering and drug development sciences, pharmaceutical chemistry, and clinical pharmacy, along with a world-class faculty, our school is uniquely poised to educate the next generation of scientists focused on basic and clinical research and translating the research results into clinical practice. As Dean of the School, one of my goals is to prepare our PharmD students for advanced training through programs such as these. To this end, I am committing financial resources to support students for the first 2.5 years of the PharmD/PhD dual degree program.

The UCSF School of Pharmacy and I are fully committed to the success of the PharmD/PhD in Pharmaceutical Sciences and Pharmacogenomics Dual Degree Program. We are committed to developing and promoting a culture in which the highest standards of scientific rigor, reproducibility, and responsible conduct are advanced by leveraging existing resources and providing appropriate multidisciplinary research training opportunities and courses that will allow trainees to acquire state-of-the-art scientific knowledge to ensure the success of this program. We are committed to providing appropriate multidisciplinary research training opportunities, courses, and mentorship.

The dual PharmD-PhD degree program represents a unique educational pathway, which combines rigorous scientific research training of the PhD with training of the PharmD, while fully adhering to all PharmD accreditation standards. Students who will be in the PharmD/PhD in Pharmaceutical Sciences and Pharmacogenomics Dual Degree Program will be the next generation of clinical translational scientists by integrating rigorous pharmacy education with advanced training in pharmaceutical sciences and pharmacogenomics. One of the greatest strengths of this dual degree is utilizing two mature world-class educational programs with faculty who are leaders in academia and have a track record of successful graduates.

In summary, we believe that UCSF's PharmD and PhD in Pharmaceutical Sciences and Pharmacogenomics dual degree offers a superb opportunity for training a diverse group of individuals to conduct research and prepare for research careers to address our nation's pharmacology needs, thanks to our extensive state-of-the-art facilities; our well-funded, productive, and highly engaged faculty, our comprehensive array of student support services; our central resources dedicated to the responsible conduct of research, the promotion of diversity and inclusion, and the evaluation of outcomes for training programs; and our commitment to the success of this and other training programs.

I wish you the best of luck with this proposal.

Sincerely,

Kathleen M. Giacomini, PhD, BSPharm
Dean of the School of Pharmacy
Co-PI, UCSF-Stanford Center of Excellence in Regulatory Science and Innovation
Troy C. Daniels Distinguished Professor of Pharmaceutical Sciences
Associate Vice Chancellor, Pharmacy Affairs School of Pharmacy

APPENDIX 2. Letter(s) of support from UCSF faculty members

Su Guo, PhD
Department of Bioengineering and Therapeutic Sciences

Aparna Lakkaraju, PhD
Department of Ophthalmology

Igor Mitrovic, MD
Department of Clinical Pharmacy

Conan MacDougall, PharmD, MAS
Department of Clinical Pharmacy

Joanne Chun, PharmD, PhD
Department of Bioengineering and Therapeutic Sciences

UCSF

University of California
San Francisco

Su Guo, Ph.D., Professor
Department of Bioengineering and Therapeutic Sciences
Director, Center for Collaborative Innovation (CCI)
Co-Director, Graduate Program of Pharmaceutical Sciences and Pharmacogenomics (PSPG)
Programs in Human Genetics and Biological Sciences
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Institute for Regenerative Medicine
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Schools of Pharmacy and Medicine
Bioengineering and Therapeutic Sciences

February 11, 2025

Leslie Floren, PharmD, PhD, MAEd
Brian Shoichet, PhD
Program Leads, PharmD/PhD Dual Degree Program

Dear Drs. Floren & Shoichet,

We write to express our enthusiastic support for the PharmD/PhD in Pharmaceutical Sciences and Pharmacogenomics (PSPG) Dual Degree Program.

We are aware of the urgent need to have clinicians and clinically oriented scientists actively participate in and lead clinical pharmacology-focused research involving drug use in both adult and pediatric populations.

This newly proposed PharmD/PhD dual degree is dedicated to developing the next generation of clinical translational scientists by integrating rigorous pharmacy education with advanced training in pharmaceutical sciences and pharmacogenomics. We firmly believe that this dual degree program is uniquely positioned to meet the growing and evolving needs for expertise in clinical pharmacology in academic medicine, industry, and regulatory agencies. This clinically focused, research-intensive, dual degree program will provide the next generation of clinical pharmacologists with outstanding training and preparation to meet these needs.

As the co-directors of the UCSF PSPG doctoral program, we offer our strongest support for the dual degree proposal and sincerely hope that the application is successful.

Please do not hesitate to contact us if we can be of any additional assistance.

Sincerely,

Su Guo, PhD
Professor, Bioengineering and Therapeutic Sciences
Co-Director, PSPG Graduate Program
University of California, San Francisco

Aparna Lakkaraju, PhD
Professor, Bioengineering and Therapeutic Sciences
Co-Director, PSPG Graduate Program
University of California, San Francisco

University of California
San Francisco

Igor Mitrovic, MD

Vice Dean
PharmD Education
School of Pharmacy

Professor
Department of Physiology
School of Medicine

Professor
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February 18, 2025

Leslie Floren, PharmD, PhD, MAEd
Brian Shoichet, PhD
Program Leads, PharmD/PhD Dual Degree Program

Dear Drs., Floren and Shoichet,

We are writing to express our enthusiastic support for the PharmD/PhD in Pharmaceutical Sciences and Pharmacogenomics Dual Degree Program. This dual degree is an essential pathway for students who want to combine clinical and research skills to help obtain the foundational skills to pursue future research careers in the Pharmaceutical Industry, Academia, and Government.

We know the demand for professionals holding dual PharmD/PhD degrees is notably strong, particularly in research-intensive sectors. Individuals with this combined expertise are highly qualified and competitive for roles in the pharmaceutical industry, including positions such as senior scientists. The unique combination of clinical and research training inherent in a dual PharmD/PhD program makes graduates valuable assets in industry and academia, with a sustained demand for their specialized expertise. UCSF's PharmD/PhD in Pharmaceutical Sciences and Pharmacogenomics Dual Degree Program will train the next generation of practitioners in science and therapeutics and essential patient care skills to meet this increased demand. We also know that there is a significant interest among our current students and pharmacy school applicants for a path to careers in industry and clinical translational science.

In addition to the advantages listed above, this program would provide us with a competitive advantage in recruitment to our PharmD program. This is particularly important when the interest in and applications to the pharmacy schools are near historical lows. Moreover, some of our closest competitors (such as the University of Michigan College of Pharmacy, The Ohio State College of Pharmacy, and the University of Southern California Mann School of Pharmacy) offer PharmD/PhD dual degrees.

In summary, combining the two key strengths (education and discovery) of our school that have made our school a worldwide leader in pharmacy education and biopharmaceutical research will provide exceptional opportunities and achievements for our trainees, our school, and society! Thus, the PharmD Program Leadership is fully committed to the success of the PharmD/PhD in Pharmaceutical Sciences and Pharmacogenomics

Dual Degree Program at UCSF. We will leverage existing resources to ensure the success of this dual degree program and wish you the best of luck in submitting your proposal.

Sincerely,

Igor Mitrovic, M.D.
Vice Dean Pharmacy Education
Professor of Physiology
and Clinical Pharmacy
Departments of Physiology
and Clinical Pharmacy
University of California San Francisco

Conan MacDougall, PharmD, MAS, BCPS, BCIDP
Associate Dean of Integrated Core Curriculum
Professor of Clinical Pharmacy
Department of Clinical Pharmacy
University of California San Francisco School of Pharmacy

February 19, 2025

Leslie Floren, PharmD, PhD, MAEd
Brian Shoichet, PhD
Program Leads, PharmD/PhD Dual Degree Program

Dear Drs. Floren & Shoichet,

I am writing to write to express my support for the PharmD/PhD in Pharmaceutical Sciences and Pharmacogenomics (PSPG) Dual Degree Program.

As the director of the Master of Science (MS) Degree Program in Computational Drug Discovery and Drug Development at UCSF, I believe that this collaboration between two departments in the School of Pharmacy, Clinical Pharmacy and Bioengineering and Therapeutic Sciences offers a remarkable opportunity for learners interested in both clinical care and pharmacology-focused research. This dual degree will prepare graduates to pursue careers in academia, clinical research, regulatory science, or the pharmaceutical industry.

The field of pharmacy continues to evolve and expand each year, and the field of Pharmaceutical Sciences and Pharmacogenomics is also rapidly evolving. These rapid advancements in pharmaceutical sciences, including pharmacokinetics, pharmacodynamics, pharmacogenomics, and molecular pharmacology, highlight the need for experts who could bridge clinical practice and research. Students admitted to this dual program will be uniquely qualified to translate basic pharmaceutical sciences and pharmacogenomics research to clinical applications.

We also know that incoming pharmacy students are extremely interested in dual degree programs such as this one and I am confident that this program will attract highly motivated students who seek to expand their professional skill sets and contribute to pharmacological and clinical research.

I strongly endorse this program and believe it will be invaluable for future clinicians.
Please do not hesitate to contact me if I can be of any additional assistance.

Sincerely,

Joanne Chun, PharmD, PhD
Director, MS in AICD3
Director, Postgraduate Education Programs
Assistant Professor
Department of Bioengineering and Therapeutic Sciences
University of California, San Francisco