A STUDENT GUIDE TO THE M.D./PH.D. PROGRAM

SAINT LOUIS UNIVERSITY SCHOOL OF MEDICINE

2024 – 2025 ACADEMIC YEAR

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TRAINING OBJECTIVES AND PROGRAM SUMMARY

Saint Louis University (SLU) offers M.D./Ph.D. training to promote academic excellence in clinical medicine and disease-based scientific research. Faculty mentors train M.D./Ph.D. students to become physician-scientists with the credentials to succeed in academic medicine and related careers. As coordinated by the M.D./Ph.D. Program Steering Committee, applicants are selected based on their past transcripts and demonstrated ability in scholarly research. In turn, graduates of this program reflect the best features of our innovative M.D. curricula and our exceptional Ph.D. training environments. Throughout their tenure at SLU, the M.D./Ph.D. trainees are continuously evaluated to assure that they develop into self-motivated intellectual leaders and compassionate problem-solving diagnosticians, as well as being creative scientists capable of sustained research productivity.

The program is available to all interested applicants to the School of Medicine. Candidates for interviews are selected from a national applicant pool based on their undergraduate credentials (including science/math GPA and MCAT), and a demonstrated ability to participate in publishable research. Candidates meet with current students and potential mentors, medical school, and the M.D./Ph.D. Admissions Committee. During interviews each applicant will give a brief research seminar to the MD PhD Admissions Committee. Successful applicants receive full tuition support and competitive stipends throughout their M.D. and Ph.D. training, contingent on continued academic excellence and acceptable progress toward their research objectives. Most trainees are chosen in the early spring to begin research rotations by early June before commencing their Year 1 M.D. studies. Other qualified individuals may apply after beginning their M.D. training.

In addition to completing the specific courses and research requirements for both degrees, trainees participate in M.D./Ph.D. colloquia to enhance critical thinking, scientific writing, career selection, research presentations and public speaking skills. By early fall of M.D. Year 2, trainees select a Ph.D. mentor in whose department they will complete their Ph.D. research. The Steering Committee has specific grant writing and research presentation requirements for trainees during their Ph.D. years. Completion of all Ph.D. candidacy requirements and oral defense of the doctoral dissertation are followed by a transitional clerkship that facilitates reentry into the M.D. training program. As this clinical training is being pursued, each student receives individualized career guidance from faculty at SLU. Trainees in this program normally should complete all requirements for both degrees within 7-9 years, including national licensure exams through USMLE Step 2.

APPLICATION PROCESS AND SELECTION CRITERIA

All completed AMCAS applications received by November 30th are evaluated by the Medical School Admissions Committee and the M.D./Ph.D. Program Admissions Committee for the quality and breadth of students' undergraduate training, including their science/math GPA and MCAT scores. Although the Graduate Record Examination (GRE) and advanced coursework are not required, GREs are recommended for the Ph.D. in Health Care Ethics, and many applications are strengthened by such information when available. All applicants must have completed at least one year of research, during which they should have demonstrated their intellectual involvement by writing honors theses, abstracts for scientific meetings, and/or peer-reviewed publications. Three letters of recommendation are solicited from individuals identified by the applicants. These individuals are asked to provide a candid assessment of an applicant's research aptitude, integrity, interpersonal skills, and commitment to completing dual-degree training.

The MD PhD Admissions Committee invites selected applicants for interviews in January. Applicants are required to make a brief presentation of their previous research experience(s) to the members of the Program Admissions Committee. These informal presentations may last up to 25 min, including time allowed for questions by the faculty. Applicants also meet privately with current trainees & with at least three potential Ph. D. mentors of their choice.

Interviewees are evaluated by the Admissions Committee for their perceived competence and likelihood of individual success in the University's training environment. Successful applicants are admitted with offers of full tuition remission plus annual stipends for the duration of their M.D./Ph.D. training, the continuation of which are contingent upon academic performance and progress toward Ph.D. research objectives. The Admissions Committee may also invite applicants to join the M.D./Ph.D. Program as non-funded trainees. Such non-funded trainees receive the same support provided to funded trainees in the M.D./Ph.D. Program. The University holds M.D. tuition costs for non-funded M.D./Ph.D. students to the level paid by their entering medical school class, to reduce the impact of inflation on completing M.D. training after finishing their Ph.D. degree. Members of the Year 1 and Year 2 M.D. classes who are in good academic standing and who meet the other requirements identified above may apply to the M.D./Ph.D. Program. Such applicants are rapidly screened and may be considered for acceptance at any time during the year.

RESEARCH ROTATIONS

Rotations introduce M.D./Ph.D. students to the research areas of individual faculty. Students complete at least two rotations (³ 7 wk, 40 h/wk) before completing the first two years of medical school. New students normally begin their first rotation in early June before starting M.D. training in August, having selected a mentor prior to arriving in St. Louis. By spring of Year 1 M.D. studies, students select a second mentor in whose lab they will perform a second research elective, during the summer between Years 1 and 2 of M.D. training. Students normally must choose their Ph.D. mentor and graduate department by September 1 of their Year 2 M.D. training. Trainees who choose to complete their Ph.D. in Health Care Ethics or in Health & Clinical Outcomes Research often use these summer lab rotation periods to complete additional courses and directed readings that are required by those programs.

CHOOSING A PH.D. MENTOR AND A GRADUATE PROGRAM

Research mentors must be members of the Graduate Faculty and should be selected based on scientific expertise and personal compatibility with trainees and their career goals. The Program Director provides guidance and maintains a Mentor Roster of faculty whose published research and grant support demonstrate a suitable training environment. Three basic science departments in the Medical School grant Ph.D. degrees with curricula approved for M.D./Ph.D. trainees: Biochemistry & Molecular Biology; Molecular Microbiology & Immunology; and Pharmacological & Physiological Science. Descriptions of their curricula and degree requirements are enclosed. Each basic science department transfers 30 credits equated to Year 1 and Year 2 M.D. courses (p. 7) toward the 36 didactic credits required by SLU for a Ph.D. Then M.D./Ph.D. trainees complete 6 didactic credits plus 12 credits of dissertation research required by the Office of Graduate Education for completion of the Ph.D. Owing to unique features of the Ph.D. programs in Health Care Ethics (HCE) and Health & Clinical Outcomes Research (HCOR), those departments transfer fewer credits from M.D. years 1 and 2, and their trainees use the summer rotations to complete other required courses and practica (pp. 20-28). Throughout training, students are continuously monitored by the Steering Committee. All trainees are expected to submit at least one extramural grant application for pre-doctoral support within their first 2 years of graduate training, written with guidance from their Ph.D. mentors.

CURRICULUM TIMETABLE AND IMPORTANT MILESTONES

M.D. YEAR ONE

April (Before starting M.D. program): Choose first mentor and lab rotation.
Early June: Arrive in St. Louis to register, complete finance and health care forms, obtain ID and parking pass, locate housing, and begin first rotation (~ 7 weeks).
Early August: Begin M.D. curriculum Year 1.
December: Choose second mentor and lab rotation.
May: Complete all M.D. year 1 exams and begin second lab rotation (~ 7 weeks).

M.D. YEAR TWO (first semester)

Early August: Return to M.D. classes.
September: Select Ph.D. mentor and department. Complete all M.D. year 2 exams and study for USMLE Step 1
October: Request leave of absence from medical school effective January 1.
December: Take Step 1.
January: Start Ph.D. Program as full time Ph.D. student.

PH.D. YEARS

1. Complete all Graduate Education Requirements.
2. Submit at least one individual extramural pre-doctoral fellowship application.
3. Present research results at regional or national meetings.
4. Prepare and submit research manuscripts to peer-reviewed journals.
5. Seek assignment of clinical mentor(s) to provide career guidance and register for appropriate transitional clerkship (see below).
6. Notify Offices of Student Financial Aid and Curricular Affairs of intent to rejoin M.D. curriculum; select desired sequence of Year 3 M.D. clerkships.

M.D. YEARS TWO (second semester),THREE, AND FOUR

1. Complete all core clerkships including any required subject exams, written reports and USMLE Step 2 CK licensure exam.
2. After #1, complete all elective requirements (including away rotations), acting internship, emergency medicine clerkship, ambulatory medicine clerkship, and capstone for the MD program prior to graduation
3. Schedule and attend regular meetings with appropriate clinical mentor(s) for guidance in career and residency selection processes.
4. Continue to meet with Ph.D. dissertation advisor to ensure timely publication of all relevant research results in peer-reviewed journals.

TRANSITIONAL CLERKSHIPS

The M.D./Ph.D. Program Steering Committee at SLU concurs with the national recommendation that trainees complete non-graded transitional clerkships after completing their Ph.D. degrees and before commencing their required core clerkships. This policy has evolved because at least three years have elapsed since such trainees completed preclinical M.D. training and USMLE Step 1 and learned the skills necessary to perform a basic history and physical exam on patients. Thus, transitional clerkships provide a 2 – 3-week period of adjustment to the schedule, expectations, content, and demands of clinical medicine. By the time the dissertation defense is scheduled, trainees should have chosen their desired sequence of core clerkships. Once assigned, the trainee is expected to participate fully in all rotations, call schedules, and other clerkship activities despite the non-graded nature of the transitional experience.

PREPARING FOR RE-ENTRY TO MEDICAL SCHOOL

While you are in the final year of your PhD:

During the final Ph.D. year, students should meet with both the Associate Dean of Clinical Curriculum and the Associate Dean of Student Affairs, at the beginning of the year (either July or January) to prepare for re-entry to the MD program.

1. In the meeting with the Associate Dean of Clinical Curriculum, students should discuss the following:
2. Clerkship Lottery
3. Clerkship Scheduling
4. Preparation for Clerkships
    a. Participation in Clinical Diagnosis Preceptorship
    b. Arrangement for access to Sketchy, Pathoma, Amboss
    c. Arrangement of a two-week onboarding clerkship in internal medicine or pediatrics prior to re-starting clerkships.
    d. Clerkship onboarding
5. Graduation requirements and M4 scheduling
6. Timeline and dates for re-entry to MD curriculum
    a. Ensure participation in clerkship orientation.

In the meeting with the Associate Dean of Student Affairs, students should discuss the following:

1. Updates to Student Affairs
2. Resources for students
3. Study plans and strategies for MD re-entry (may require referral to learning specialist)
4. Clerkship onboarding – may include verification of drug screening, vaccination, PPD records.

5. Career advising (may require referral to asst dean of student affairs who oversees career advising)
6. Timeline and dates for re-entry to MD curriculum
    a. Referrals to financial aid and University Health Plan, as needed.
    b. Updating status for registrar based on re-entry.

Students should touch base with both the Associate Dean of Clinical Curriculum and Associate Dean of Student Affairs 6 months prior and 3 months prior to ensure that all arrangements have been made. The 6- and 3-month meetings may be via email, but the initial meeting a year prior must be in-person. Students are encouraged to reach out to the Offices of Curricular Affairs or Student Affairs as needed to ensure a smooth transition from PhD back to MD.

At the same time, students should contact their PhD mentors and departmental business managers to begin onboarding paperwork, including a Graduate Assistantship Contract and transition of student status with the Registrar and Workday.

ACADEMIC STANDARDS AND PERFORMANCE REQUIREMENTS

All M.D./Ph.D. trainees are evaluated throughout the academic year to ensure their adequate performance in all required coursework and research activities. At least yearly, trainees meet privately with the Program Director to review their updated *curriculum vitae* (CV) and their individual development plans (IDPs) for the current academic year. Funded trainees must pass all courses, electives, and research rotations. Students who do not maintain these performance standards must meet with the Program Director to develop a revised IDP or remediation plan and are placed on academic probation for at least the next semester. Performance is deemed improved, and probationary status may be removed, if the student passes all major courses in the next semester. Students who do not improve to these standards in the next semester are interviewed by the Program Steering Committee. The Committee may decide to maintain a trainee's probationary status for another semester or to permanently revoke a trainee's tuition waiver and stipend support. Trainees who enter the program with non-funded M.D./Ph.D. status are subject to these same academic standards. Further, it is strongly recommended that non-funded trainees strive to rank highly among their medical school peers to be considered competitive applicants for any funded positions that are identified by the Program Steering Committee.

Regardless of funding status, all M.D./Ph.D. trainees must complete USMLE Step 1 by December 31 of their Year 2 of M.D. training before a leave of absence is granted from the M.D. program to pursue Ph.D. training. Once trainees have formally entered their chosen Ph.D. program, they are subject to all rules and regulations normally imposed upon other graduate students in that department. These regulations may include, but are not limited to, trainee participation in coursework, research seminars, journal clubs, student-led discussions and laboratories, teaching assignments, and research symposia. In addition to those departmental regulations, the M.D./Ph.D. program requires that all trainees attempt to obtain extramural funds that support the cost of their Ph.D. training. This requirement is usually satisfied when a trainee submits pre-doctoral fellowship applications to appropriate, non-institutional funding agencies within the first 2 years of joining a graduate department. Beyond these regulations, all M.D./Ph.D. trainees are expected to follow specific departmental guidelines regarding preliminary exams, advancement to doctoral candidacy, and defense of the Ph.D. dissertation. It is the firm policy of the M.D./Ph.D. program that trainees cannot commence clerkship rotations until all degree requirements of the Ph.D. department and Office of Graduate Education have been completed, notably final submission of the signed dissertation.

TUITION WAIVERS AND STIPENDS FOR M.D./PH.D. STUDENTS

In compliance with institutional policy at Saint Louis University, the tuition costs of funded M.D./Ph.D. trainees enrolled in M.D. Years 1 and 2 are paid in the form of loans, whose repayment is waived upon completion of the Ph.D. degree. When trainees who have completed their Ph.D. degrees return to the M.D. program, their tuition costs for the final two years are also paid in the form of a loan, whose repayment is waived upon completion of the M.D. degree. All paperwork required establishing these loans and their relief by waiver is originated and maintained by the Office of Student Financial Services or Student Financial Services Office in the Medical School. Funded trainees who withdraw from the M.D./Ph.D. Program before completing both degrees have the same responsibilities to repay these tuition loans as other M.D. students, as stipulated by the Office of Student Financial Services or Student Financial Services Office. Such trainees also have the same eligibility as other M.D. students to seek additional loans or financial aid to complete their M.D. degree at Saint Louis University. The obligation to repay tuition loans assumed by M.D./Ph.D. trainees who withdraw from the Program may be waived only by the Dean of the Medical School, acting upon recommendations from the Program Steering Committee. Such a recommendation to waive repayment requires a two-thirds majority vote by the Steering Committee, followed by written notification to the Dean by the Program Director.

Funded M.D./Ph.D. trainees also receive competitive stipends throughout their M.D. and Ph.D. training, contingent upon the aforementioned academic standards while in medical school and acceptable research progress toward the Ph.D. degree. These stipends normally begin on July 1 of the summer before trainees join the M.D. program and originate from the Office of Student Financial Services or Student Financial Services Office or from the various Ph.D. departments, depending on trainee status. All such stipends are considered direct grants to the trainee and are not subject to repayment if a student is removed for academic causes, or voluntarily withdraws, from the M.D./Ph.D. Program. Fees for health insurance that are normally incurred by trainees are also provided by the M.D./Ph.D. loan waiver or by the Ph.D. department, depending on trainee status. All trainees may choose to purchase supplemental health insurance for dependents at reduced rates.

The Steering Committee and University administration also make a good-faith effort to reduce the personal financial debt incurred by non-funded M.D./Ph.D. trainees enrolled in this Program. As mentioned above, such trainees receive preferential consideration for any available funded positions if they are academically qualified. Further, their medical tuition is held at the same level as these trainees would have paid had they not taken a leave of absence to complete their Ph.D. degree. These non-funded M.D./Ph.D. trainees are also given preference for any stipend monies that may be made available by the Dean of the Medical School for medical students pursuing summer research activities. Finally, non-funded students in good academic standing often are specifically nominated by the Steering Committee for various cash awards, travel fellowships, and other incentives that are available only to M.D./Ph.D. trainees.

THE M.D./PH.D. CURRICULUM IN BIOCHEMISTRY AND MOLECULAR BIOLOGY

Students accepted for the M.D./Ph.D. program are subject to the regulations and residency requirements of the Office of Graduate Education and the Medical School. Students are also required to meet the course requirements in the Department of Biochemistry & Molecular Biology. However, courses taken in the School of Medicine are accepted toward fulfillment of course requirements for the Ph.D. degree. These include 30 credits for coursework in M.D. Phases 1 and 2 (see p. 7). After successfully completing the M.D. Phases 1 and 2 curricula and USMLE Step 1, the M.D./Ph.D. trainee begins studies toward the Ph.D. in Biochemistry and Molecular Biology, commencing on or about May 1 of their second full year at SLU.

REQUIRED EXAMINATIONS

Each M.D./Ph.D. trainee in the Department of Biochemistry & Molecular Biology must pass written and oral examinations based on a research proposal written by the student in the form of an NIH Predoctoral Fellowship application (NRSA F31, without a budget). This proposal is written on the research topic to be undertaken for the Ph.D. degree, and is reviewed by the **Preliminary Exam Committee**, consisting of the student mentor (non-voting member), two course directors, BMB PhD Program Director, and two committee members. At least one Committee member should be a member of the M.D./Ph.D. Program Steering Committee. This preliminary exam committee prepares a detailed written evaluation of the written proposal, and if modifications are recommended the student must submit a revised version. Once the written proposal has been approved by the committee, the trainee then presents an oral defense of the proposed project to the committee. During this defense, the preliminary exam committee may question the trainee both on the project's specific details and on its broader scientific context. Students must successfully defend their proposal before advancement to candidacy.

Upon successful defense of the research proposal, the student and mentor assemble the **Dissertation Committee** that is chaired by the mentor and includes at least two other medical school faculty, one of whom must be a member of the M.D./Ph.D. Program Steering Committee. The dissertation committee oversees the preparation of and signs the trainee's Ph.D. candidacy papers that must be submitted to the Office of Graduate Education within six months of completing the preliminary exams. This committee also meets annually to evaluate, advise, and approve the student's progress. When the committee determines that the student is ready to defend the dissertation, the student prepares the dissertation document and defends the dissertation both in a public presentation and in a private defense before their dissertation committee.

THE PHILIP AND LILLIAN KATZMAN SCHOLARSHIP FUND

A second point of entry to the M.D./Ph.D. program follows the second year of the traditional medical school curriculum. Medical students who have strong scholastic records plus interest and experience in research may be accepted directly as Ph.D. trainees by the Department of Biochemistry and Molecular Biology. Such students entering the Ph.D. program after their second year of medical school are eligible to apply for a Katzman Fellowship award from the Philip and Lillian Katzman Scholarship Fund. This fund was established by the family of Dr. Philip Katzman, a former faculty member in the department, to encourage research training of medical students. The fellowship provides tuition remission for medical students during both their graduate Ph.D. training and Years 3 and 4 of medical school.

SUMMARY OF COURSEWORK REQUIRED

Prerequisites: Successful completion of Phases 1 and 2 of the M.D. Curriculum and USMLE Step 1. M.D./Ph.D. trainees receive up to 30 graduate credits that are transferred from Phases 1 and 2 courses.

Required Courses during Ph.D. Training Years:
Coursework required during Ph.D. training is determined by the advisory committees of the students involved, depending upon their backgrounds and individual needs. The only course required of all graduate students in the department is BCH-G6250, *Preparation and Evaluation of Scientific Research Proposals*, as described below.

Course Descriptions:
BCH-G6230 *Macromolecules: Structure, Function, and Interactions* (4 credits). Students participate in laboratory and computer database demonstrations, and then complete self-directed problem-solving exercises. These exercises provide familiarity with concepts and methodology in the analysis of enzyme catalysis, protein-nucleic acid interactions, and protein function and regulation. Students learn to independently investigate available information and resources, design experimental approaches, evaluate data, manage time in independent study, and discuss and defend the rationale for their research plans and expected results.

BCH-G6240 *Advanced Topics: Molecular Basis of Human Disease* (3 credits). The objective of this lecture-based course is to study human diseases that illustrate important biochemical principles, concepts, and mechanisms. Recent topics include defects in cell signaling, protein folding and turnover, and metabolic regulation.

BCH-G6250 *Preparation and Evaluation of Scientific Research Proposals* (4 credits). The ability to write a fundable grant proposal is one of the most important skills of biomedical research scientists. A systematic strategy to mastering this skill is taught, practiced, and evaluated. Lectures include the basic organization of an NIH proposal, the purpose and importance of each component, and an overview of the grant review process. These are followed by presentations of published papers selected by students in areas outside their dissertation research. Students develop and prepare research proposals on their topic

through weekly meetings, which faculty and students critique in an NIH-style grant study section. The students then revise their proposals in light of the written critiques and resubmit them for final evaluation and grading.

BCH-G6280 *Introduction to Bioinformatics and Genomics* (2 credits). Students are introduced to current computational techniques to find information in biological sequence, genome, and molecular structure databases. The course also covers identification of informational patterns in DNA and approaches to linking genome data to information on gene function. Lectures are integrated with practical hands-on exercises designed to reinforce concepts and develop the necessary computer skills to effectively use publicly available databases and tools.

BCH-G6910 *Biochemistry and Molecular Biology Colloquium* (1 credit). Students attend weekly seminars on topics in the literature of biochemistry and molecular biology. Each student presents once during the semester. Students work with mentors toward the dual goals of mastering the techniques of public presentation of scientific research and developing the ability to critically evaluate scientific publications. (One semester required)

BCH-G6950 *Special Study for Examinations* (0 credit).

BCH-G6970 *Research Topics* (1-3 credits). Prior permission of mentor and graduate program director required. May be repeated. Titles of topics must be registered.

BCH-G6980 *Graduate Reading Course* (1-3 credits).

BCH-G6990 *Dissertation Research* (0-6 credits).

THE M.D./PH.D. CURRICULUM IN MOLECULAR MICROBIOLOGY AND IMMUNOLOGY

The Department of Molecular Microbiology and Immunology (MMI) offers a program in molecular microbiology and immunology leading to the Ph.D. degree. The goal of the MMI graduate program is to graduate exceptionally well-trained researchers who are prepared for a career in academic science or biotechnology. Research in the Program is diversified. Areas of research emphasis include cell and molecular biology, virology, immunology, cancer therapy and antiviral drug development. Graduate training in the Program includes advanced coursework, training in scientific writing and oral presentation skills, and performance of original biomedical research leading to the Ph.D. Dissertation.

Students in the M.D./Ph.D. program select a dissertation mentor in the MMI Graduate Program following laboratory rotations as part of the M.D./Ph.D. program. Although each Ph.D. candidate has a primary Ph.D. research mentor plus a dissertation committee of at least two additional MMI faculty members, the responsibility for educating each student ultimately lies with the Department as a whole.

M.D./Ph.D. trainees pursuing their Ph.D. studies in MMI must complete all requirements of the Office of Graduate Education. A total of 36 coursework credits and 12 credits of dissertation research are required. Of these 36 credits, M.D./Ph.D. trainees receive 34 graduate credits for Phase 1 and 2 courses passed as medical students. Two additional credits, one each in advanced immunology and advanced virology, are required as described below. Other coursework may be recommended or required by the mentor and/or the preliminary exam committee, to strengthen trainees' background knowledge in their chosen fields of research.

REQUIRED EXAMINATIONS

Two examinations plus a dissertation defense are required. The first exam, the Preliminary Degree Examination, must be taken before the end of the summer session of the first year of graduate studies in the MMI program. This is an oral examination whose goal is to determine whether the student has an adequate foundation of knowledge in the biomedical sciences to support Ph.D. studies. The Examination allows weaknesses and deficiencies in the student's training to be identified, which then can be corrected. The Examination covers all material expected as a prerequisite to enter the MMI program, taught as part of the medical school curriculum or covered in the second year MMI coursework. A committee of 5 faculty members appointed by the MMI Graduate Program Directors administers the Examination. A pass in this examination requires a majority vote of the committee. Should the student fail, a second Examination may be taken prior to the end of fall semester of his/her third year of graduate studies. Successful completion of the Preliminary Degree Examination is required to continue as a student in good standing in the MMI graduate program.

The second or Candidacy Examination is composed of both Written and Oral components. The Candidacy Examination will be administered by a committee (the

Candidacy Examination Committee) of the Graduate Faculty which includes the student's mentor as Chairperson plus four other faculty members appointed by the Graduate Program Directors, two of whom may have primary appointments outside of MMI if their scientific expertise is felt to be beneficial to the student. The Candidacy Examination will be taken for the first time before the end of summer session of the second year of studies in the MMI program.

The goals of the Candidacy Examination are to determine whether the student can formulate, test, and evaluate hypotheses at a level suitable for a Ph.D. scientist, and to evaluate the suitability of the student's proposed dissertation project. A pass in the Candidacy Examination requires a favorable vote from the majority of the Candidacy Examination Committee on both the Oral and Written Components. If the student fails either component, the Candidacy Examination Committee plus the Associate Provost for Graduate Education must approve a second attempt on the failed component. The Candidacy Examination must be successfully completed by the end of the summer session of the third year in the MMI program.

The Candidacy Examination-Written Component must be written in a grant-style format [e.g., AHA, NIH F30 (M.D./Ph.D.), NIH F31 (Ph.D.), or NIH F31-Diversity (Ph.D.) predoctoral grants] and focus on the student's anticipated Ph.D. research project. It should contain preliminary data developed by the student if his/her research project has advanced to a point where this is possible. The Candidacy Examination-Written Component usually forms the basis of the required application for support from an external granting agency. The Candidacy Examination-Written Component must be submitted to the Candidacy Examination Committee at least 1 week prior to administration of the Oral Component.

Candidacy Examination-Oral Component. The student is examined by the Candidacy Examination Committee on the both Candidacy Examination-Written Component and their area of research. To pass, the student must 1) Display adequate knowledge of their project, appreciation of the scientific method, and intellectual flexibility; and 2) Be able to apply this understanding to their research project.

Once the M.D./Ph.D. trainee completes these exams, a **Doctoral Dissertation Committee** is organized with the research mentor as chair, who is joined by at least two other members of the Graduate Faculty. Additional Graduate Faculty may serve on a Dissertation Committee if their scientific expertise is felt to be beneficial to the student. Non-SLU faculty may serve on a Dissertation Committee if they have been granted Graduate Status. The Dissertation Committee's role is to guide the student and his/her mentor during the student's dissertation research, to assist as needed during writing of the student's dissertation, and to approve the final dissertation. The Dissertation Committee will meet at least two times annually to review and critique the research progress; more frequent meetings are strongly encouraged. Submitting a brief written report to the Dissertation Committee prior to each meeting is required. Students are highly encouraged to frequently interact with their Dissertation Committee members on an informal basis throughout their dissertation studies.

Ultimately, a trainee submits a written dissertation to, and makes an oral presentation before the dissertation committee, whose members then vote privately to approve the

dissertation or to require additional studies. Upon gaining the committee's approval, the student schedules a public seminar. The MMI faculty consider that a Ph.D. is earned when students achieve an appropriate depth of knowledge and demonstrate the ability to independently define a question and to execute experiments whose unambiguous results answer the posed question. It is expected that the dissertation research will consist of at least two or three publications in peer-reviewed journals, with the trainee being first author on at least one of these. Although students are considered individually, they are expected to write these manuscripts themselves under supervision by the Ph.D. mentor.

SUMMARY OF COURSEWORK REQUIRED

Prerequisites: Successful completion of Phases 1 and 2 of the M.D. Curriculum and USMLE Step 1. M.D./Ph.D. trainees receive up to 34 graduate credits that are transferred from Phases 1 and 2 courses.

Required Courses during Ph.D. Training Years:
MB.6240: Advanced Topics in Immunology
MB.6820: Advanced Topics in Virology and Cell Biology
MB-G6990 Dissertation Research

Required Course Descriptions:

MB.6240: Advanced Topics in Immunology (1credit)
This course entails a discussion of research publications focused on topics of current importance in molecular and cellular immunology. These may include recombination in the Ig and TCR loci; signal transduction coupled to antigen and cytokine receptors; molecular aspects of intracellular pathways in antigen processing; ligand-receptor interactions in cell-cell communications; chemokine and cytokine networks and infection; role of T cell subsets in host defense mechanisms; and immune mechanisms in pathogenesis of infectious disease.

MB.6820: Advanced Topics in Virology and Cell Biology (1 credit)
This course is taught by one or more of the faculty in the program. Students meet with the instructor one to three times per week to discuss and analyze a research topic in virology or the relationship between viruses and their host cells. Material is taken from research papers published in leading research journals, with supporting information from graduate-level textbooks. Topics for the course are selected by the faculty of the molecular microbiology and immunology program.

MB-G6990: Dissertation Research (12 credits required prior to graduation).

Electives Any class offered for graduate credit may be taken as an elective if the student's mentor feels that it would advance the student's education.

THE M.D./PH.D. CURRICULUM IN PHARMACOLOGY AND PHYSIOLOGY

The Department of Pharmacology and Physiology provides a Ph.D. program that trains students to be independent investigators in the interrelated disciplines of physiology and pharmacology. The department also contains the Institute for Translational Neuroscience. The overall goals of the Ph.D. program are to instill enthusiasm for discovery and the scientific process; foster critical thinking, research competence, and oral and written communication skills; and promote a commitment to lifelong scholarship. Diverse research interests of the department faculty ensure that trainees can select projects that span physiology and pharmacology from the subcellular through integrative levels. M.D./Ph.D. trainees join this graduate program with 30 credits transferred from the Phase 1 and 2 M.D. curricula toward the total of 34 credits and 12 dissertation credits required for the Ph.D. degree by the Office of Graduate Education. The remaining six coursework credits are satisfied through completion of two 1-credit required courses described below, and by regular participation in the Department's scheduled journal clubs and seminar series that are also detailed below. Journal clubs cover a broad range of subjects, as do the weekly departmental seminars that feature outstanding speakers from the U.S. and abroad.

REQUIRED EXAMINATIONS

Preliminary Examination

Every M.D./Ph.D. trainee in the Department must pass written and oral exams that are based on a research proposal written by the student as a grant application. Following a satisfactory performance in PPY-5110 and PPY-5140, the trainee develops an original proposal that complies with NIH R21 page limits (Specific Aims + six pages + bibliography). The requirements are identical to that for standard Pharm/Phys Ph.D. students except that the preliminary examination committee must include a Pharm/Phys faculty member who is also a member of the M.D./Ph.D. steering committee.

The Preliminary Examination Committee is assembled in two stages. First, two members of the departmental Standing Preliminary Committee and the dissertation mentor form a three-person ad hoc committee that reviews a one-page "Specific Aims" summary of the research proposal supplied by the student. One of the two members of the Standing Committee serves as chairperson. After the ad hoc committee accepts the written short proposal, the student's final preliminary examination committee is formed by the addition of two departmental faculty members. The preliminary examination committee must include a Pharm/Phys faculty member who is also a member of the M.D./Ph.D. steering committee.

The final written R21 type proposal is reviewed privately by the preliminary exam committee, to decide if the document is acceptable and to plan the oral portion of the exam. If the document is not acceptable, the student must revise it by consulting with committee members to clearly identify and remediate its deficiencies. Revision can be repeated twice before the student may be dismissed from the program. Once the written proposal is approved, the committee chairperson schedules an oral defense within two weeks. Following a 15-20 min PowerPoint presentation of the proposal by the trainee, committee members question the trainee both on the proposal's details and its broader scientific context. The oral exam is not a comprehensive test of all postgraduate coursework but probes the trainee's knowledge in scientific areas considered essential for a full understanding of the research topic. Committee members vote privately on the acceptability of the oral defense. Students that fail this process may be granted an additional opportunity to pass.

Dissertation Examination

Completion of the preliminary exam permits the M.D./Ph.D. trainee and mentor to assemble a Dissertation Committee and to file formal Ph.D. candidacy papers with the Graduate School. Again, the requirements for this process are identical to those described for standard departmental Ph.D. students except that one member of the dissertation committee must serve on the M.D./Ph.D. steering committee (not the mentor).

The dissertation committee meets at least twice a year to evaluate, advise, and approve of progress being made. It is expected that students will submit completed segments of their dissertation research to peer-reviewed journals during their training.

When sufficient research progress has been determined, the Dissertation Committee will approve the writing up of the dissertation. Upon completion and submission of this document, the candidate will meet with the committee to conduct a private defense of their dissertation. The students will present their results, and answer any remaining questions asked by the committee. The candidate will then be excused from the meeting, after which the committee will discuss their evaluations of the candidate and complete the official results form. If the committee requires major revisions of the dissertation following the defense, the ballot form will not be completed until every committee member is satisfied. A unanimous positive evaluation of the dissertation committee is necessary for final approval of the dissertation.

Following the private defense, successful candidates are required to present a public oral presentation of their dissertation work as a formal seminar. The presentation should conclude after 45 minutes and is followed by a discussion/examination period

at which time all members of the audience may examine the Ph.D. candidate. Spontaneous questions that arise during the presentation are also encouraged.

SUMMARY OF COURSEWORK REQUIRED

Prerequisites: Successful completion of Phases 1 and 2 of the M.D. Curriculum and USMLE Step 1. M.D./Ph.D. trainees receive up to 30 graduate credits that are transferred from Phases 1 and 2 courses.

Required Didactic and Participatory Department of Pharmacology and Physiology Courses during Ph.D. Training Years:

· PPY-5110 Introduction to Pharmacology and Drug Discovery

· PPY-5140 Fundamentals of Effective Grant Construction

· PPY-6800 Pharmacology and Physiology Departmental Seminar

· PPY-6900 Pharmacology and Physiology Colloquium Journal Club

PPY-5110 Introduction to Pharmacology and Drug Discovery (1 credit). Taught in the fall semester, this course covers the topics of: binding theory; concepts of ligand efficacy and potency; partial agonists and antagonists; allosteric modulators; quantitative pharmacology (technology & statistical tools); biotransformation; drug pharmacokinetics; basic principles of medicinal chemistry; and structure/function relationships in drug

design. In class time includes two sessions of problem-based practice and review; two in-class exams comprise the final course grade.

PPY-5140 Fundamentals of Effective Grant Construction (1 credit). Beginning at the end of the spring semester and extending through mid-summer, this course includes didactic lectures, one-on- one mentoring sessions, and dedicated proposal writing time, culminating in a 20 – 30 min oral presentation followed by questions and faculty critiques. The final proposal must include all main narrative sections of an NIH-formatted R01 grant application (12 pages + bibliography). Students may use a shortened revision of their PPY-5140 proposals for their Preliminary Exam for advancement to doctoral candidacy (see above).

PPY-6800 Pharmacology and Physiology Departmental Seminar (0-1 credit per semester). Selected topics in pharmacology and physiology are presented by local, national, and international guest speakers. Seminars are held at least twice monthly

and usually more often. Attendance and participation are required for all Ph.D. students for this yearlong course.

PPY-6900 Physiology and Pharmacology Colloquium Journal Club (0-1 credit per semester). Selected topics in pharmacology and physiology are discussed from the current literature in these fields. Colloquial journal clubs are held at least twice monthly and usually more often. Attendance and participation are required for all Ph.D. students.

PPY-6990 Dissertation Research (0 – 6 credits per semester; 12 credit hours required for graduation).

Responsible Conduct of Research. This is non-credit based but training in the responsible conduct of research is required of all Ph.D. students at Saint Louis University and by the National Institutes of Health.

THE M.D./PH.D. CURRICULUM IN HEALTH CARE ETHICS

The Department of Health Care Ethics offers a Ph.D. program in Health Care Ethics for the M.D./Ph.D. trainee. A minimum of 48 credits is required for the Ph.D. This ordinarily includes 33 didactic credits, three credits of practica, and 12 credits of dissertation research. The Department accepts 7 credits from Phase 1 and Phase 2 of the M.D. curriculum; the required courses HCE-6110 Introduction to Medicine for Ethicists (1 credit), one Topics and Scholars elective (3 credits), and HCE 6150 Practicum (3 credits) are waived based on medical school coursework in Patient, Physician, and Society I and II, and in Fundamentals of Biomedical Science. The 0-credit Research Tools requirement to ensure knowledge of medical terminology and biostatistics is also waived for M.D./Ph.D. students based on trainee knowledge and experience. The 0-credit library database searches Research Tool requirement, the remaining 27 credits of Ph.D. coursework, comprehensive exams, the dissertation, and the public defense of the dissertation must be completed during the three years of Ph.D. study.

REQUIREMENTS FOR COMPREHENSIVE EXAMINATIONS

After all courses and practica are complete, each student must pass the comprehensive examinations with an Examination Board (hereafter “Board”) comprised of faculty. The Center Director recommends the Board to the Associate Provost for Graduate Education in care of the Doctoral Candidacy Advisor. These examinations will be written and oral and they will be scheduled as required by the Center Director or delegate. Ordinarily, comprehensive exams (written and oral) should be completed within one academic semester (excluding summer) of completing course work. Failure to pass the written and oral comprehensive exams within one year of completing coursework ordinarily will result in administrative withdrawal from the Ph.D. program.

The purpose of the written exam is to assess the student’s ability to write a doctoral dissertation in Health Care Ethics. The following process will be followed for the written exam. The written exam will consist of a 25-page un-mentored normative research paper on a bioethics topic. The essay must display above all the ability to develop a critical ethics argument and to integrate the relevant interdisciplinary literature. Students may not receive mentoring of any kind from faculty or peers in writing the assigned essay. (Students who receive mentoring on the essay, plagiarize, or otherwise breach clear standards of scholarly integrity will automatically fail the exam and will ordinarily be denied the opportunity to re-sit the exam.) Essays will be assessed on four criteria: 1) development of the argument; 2) integration of the literature; 3) problem and significance; 4) writing style and form. Essays will be graded in the following manner:

• Pass. Essays that meet the evaluation criteria in their present form will receive a passing grade. Such essays may have only minor flaws. In general such essays should be of publishable quality.

• Revise and resubmit. Essays that show promise, but have some significant flaws will be returned to the student with feedback from the faculty. Feedback will identify flaws, but

will not provide positive feedback on how to fix the flaws. Students will have one full week to revise and resubmit the essay. Resubmitted essays will be graded as pass or fail.

• Fail. Essays will be failed if they contain fatal flaws, problems that cannot be remedied within the current framework for the essay. Students who fail will retake the written exam, on a new topic, the following semester. . The new essay will be graded using the same three grading options as the original submission (pass, revise and resubmit, or fail). In the event that the exam is failed a second time, the student will be ineligible to progress further in the PhD program. After the student has passed the written examination, an oral examination with the Board will take place, lasting 90 minutes.

The purpose of the oral examination is to assess the student's "integration of knowledge across the discipline." In particular, students are expected to demonstrate mastery of the PhD curriculum. To this end, as part of his or her application to the oral examination, the student must provide the Board with a comprehensive exam reading list comprised of all required readings indicated in the syllabus of each course completed in the PhD program.

After the oral exam, the Board will provide a grade of "Pass with Distinction" or "Pass" or "Fail". Students will not be told the number of pass or fail grades received. If students pass the written exam but fail the oral exam, the oral exam may be taken again. Ordinarily, students may take the oral exam twice with the permission of the Associate Provost for Graduate Education. Once students have successfully passed both the written and the oral comprehensive examinations, they are eligible to submit a dissertation proposal following CHCE policies.

DISSERTATION

Upon successful completion of the comprehensive exams, trainees request a dissertation director and two readers appointed by the Center Director who form the Doctoral Dissertation Committee. In the dissertation prospectus, the PhD candidate must present substantial evidence of ability to extend the knowledge base in the major field and demonstrate how the research competencies in the program are to be integrated with the proposed research of the dissertation. As the student writes the full dissertation, drafts of sections and chapters will be sent to the mentor and readers (through the mentor) for feedback and requests for revisions, a process that will likely be repeated multiple times as the student makes revisions. Once the student has produced a draft of the dissertation that satisfies the mentor and the readers, the student will schedule an oral defense of the doctoral dissertation in an open forum before the interdisciplinary faculty and students in the program. The defense will last for 90 minutes and will be divided into two parts: approximately 30 minutes for an oral presentation of the dissertation followed by 60 minutes for questions and discussion, beginning with the readers and mentor, then the faculty, then the students and others in the audience. At the conclusion of the defense, the Doctoral Dissertation Committee will meet privately to evaluate the presentation. They may either pass the student or require revisions and possibly an additional oral defense. The Center Director will inform the student and Graduate Education of the committee decision formally in writing.

SUMMARY OF COURSEWORK REQUIRED:

Pre-requisites: MD/PhD students must complete a graduate-level Foundations of Ethics and applied ethics course. Students may satisfy this requirement as a directed reading course during the summer between the first and second years of medical school. Applicants to the Health Care Ethics program must provide a sample of writing in health care ethics that demonstrates the ability to do doctoral level coursework in the field.

Required PhD Coursework:

HCE 6010: Methods in Philosophical Ethics (3 credit hours): A study of the methodological issues in philosophy that concern the nature and justification of fundamental ethical norms.

HCE 6020: Methods in Religious Ethics (3 credit hours): A study of the hermeneutical

significance of different religious methods in religious ethics and a critical analysis of the

hermeneutical implications of these methods for the development of ethical theory.

HCE 6040: Interdisciplinary Methods (3 credit hours): A study of the scope, concerns and methods of interdisciplinary research in Health Care Ethics.

One of the following: HCE 6050 Philosophical Foundations in Ethics

HCE 6060 Psychosocial Foundations in Ethics

HCE 6070 Foundations of Catholic Morality

HCE 6120: Bioethics and the Law (2 credit hours): This course examines legal issues in health care decision making in areas typically considered a part of bioethics.

HCE 6130: Clinical Ethics (3 credit hours): Fundamental skills and core knowledge essential for clinical ethics consultation, integrating process and outcomes to identify, analyze and resolve ethical dilemmas in patient care, including skills and knowledge in ethics mediation and cultural competency.

HCE 6140: Research Ethics (3 credit hours): This course introduces students to a range of topics and issues in research ethics, focusing on academic human subjects research.

9 credit hours of elective courses, taught both within and outside of HCE

More details regarding the PhD program in Health Care Ethics can be found at: http://www.slu.edu/bioethics/phd-program

THE M.D./PH.D. CURRICULUM IN HEALTH & CLINICAL OUTCOMES RESEARCH

Saint Louis University's Department of Health and Clinical Outcomes Research, School of Medicine (HCOR) is a scholarly community of faculty, staff, and students committed to strengthening the delivery and outcomes of medical care through education and training programs, innovative research, and consulting services. We are engaged in state-of-the-science evaluations of the services, medications, devices, and diagnostics that can optimize individual health and well-being. HCOR is also committed to translating research into policies and practices to improve health outcomes across the population. As a national leader in research and education, HCOR improves the health of our communities by informing health care and policy decisions with scientific information about quality and effectiveness.

DIVERSITY STATEMENT

The mission of the department of Health and Clinical Outcomes Research (HCOR) is to serve as the collaborative bridge between divisions, departments, and colleges/schools across medicine and the health sciences. We support methodologically rigorous research to solve complex health problems and improve various health and clinical outcomes.

HCOR is a scholarly community of faculty, staff, and students committed to strengthening the delivery and outcomes of medical care through education and training programs, innovative research, and consulting services. We welcome students, staff, and faculty of all races, nationalities, religions, genders, sexual orientation, physical abilities, backgrounds, philosophies, and world views. Our purpose and mission are to support the members of our community in their professional work, personal development, and growth through research and practice.

REQUIRED EXAMINATIONS

Students must pass comprehensive written and oral Comprehensive Exams to proceed to candidacy. The purpose of the written exam is to demonstrate proficiency in methodological and statistical skill necessary to complete the doctoral dissertation. The written exam covers learning objectives and competencies from the Required Courses shown below. The following process will be followed for the Written Exam. One week prior to the scheduled exam background material may be given to the students taking the examination. Students will be notified in advance if materials will be distributed. HCOR's Associate Director for Academic Affairs will coordinate the development, administration, and grading of the exam. A HCOR faculty member designated by the HCOR Curriculum Committee will coordinate the development of the examination questions and detailed grading criteria in conjunction with relevant faculty from core courses. Upon completion, the exam questions and grading criteria will be sent to the Associate Director who will distribute them to the Curriculum Committee for review. The Associate Director will provide students with the name of the faculty writing the exam questions so that students can meet with these faculty members and ask questions concerning content and format

prior to the exam. Grading of the written exam will be conducted by a committee of three faculty members. The author of the exam and one additional reader will independently grade the exam as Pass/Fail without any consultation and provide their grades to the Associate Director. In the event of a tie, the third reader will independently grade the exam and break the tie. In the event that the written exam is failed, the student may re-take the failed portion of the exam the following semester following the same procedure. In the event that the exam is failed a second time, the student will be ineligible to progress further in the Ph.D. program.

The purpose of the oral examination is to focus on the proposal of the dissertation. The oral exam presentation consists of a statement of the problem, literature review, and proposed research design for the dissertation. The exam is structured to assess the student's comprehensive knowledge of literature in the field of study, the ability to integrate and synthesize information across the discipline, and to design an appropriate analytic approach that expands the current body of knowledge. The oral exam cannot be taken until successful completion of the written exam. Once the student and his/her mentor have determined that the student is sufficiently prepared to take the oral exam, he/she will work to schedule the exam with his/her committee. The student is also responsible for reserving a room large enough to accommodate the committee and observers. In addition to the three committee members, the Associate Director will arrange for two at-large members to join the committee for the exam. After the oral exam, the committee will provide a grade of "Pass" or "Fail". If the student fails the oral exam, the oral exam may be taken again according to specifications of Graduate Education. If the student does not pass the second oral examination, he/she will no longer be allowed to progress through the program.

Students who have passed both the written and oral examinations are expected to request a dissertation director and two additional members to be appointed as the Doctoral Dissertation Committee. After completing the dissertation research and with the approval of the dissertation committee, students schedule and Oral Defense of the Dissertation. This public defense lasts 90 minutes and is divided into two parts: 60 minutes for oral presentation and 30 minutes for discussion of questions, first from the dissertation committee, then from other departmental faculty and attendees.

SUMMARY OF COURSEWORK REQUIRED

The Saint Louis University School of Medicine, Department of Health and Clinical Outcomes Research (HCOR) offers a Ph.D. program in Health Outcomes Research for the M.D./Ph.D. trainee. A minimum of 50 graduate credits is required for the Ph.D. This ordinarily includes 29 didactic credits (see below) and 12 credits of dissertation research. HCOR accepts 9 credits from M.D. Phases 1 and 2: Principles of Pharmacology (3); Epidemiology and Biostatistics (1); Elective in Clinical Research (1); Health Care Ethics (1); and a relevant Organ System (3). All remaining coursework, comprehensive exams, dissertation, and the public defense of the dissertation must be completed during the three years of Ph.D. study.

Prerequisites: In addition to the 9 credits transferred from M.D. Phases 1 and 2 (see above), M.D./Ph.D. trainees must complete a graduate-level inferential statistics course. They may satisfy this requirement during the summer between the first and second years of medical school by taking ORES 5010 Introduction to Biostatistics for Health Outcomes Research.

Required Courses during Ph.D. Training Years:

Curriculum Requirements

The M.D./Ph.D. program includes 50 credit hours:

29 credit hours of coursework, drawn from required courses (23 credits) and electives (6 credits)

12 credit hours of dissertation research

9 credit hours accepted from MS1/MS2 of the M.D. curriculum

Required Courses (23 required credit hours)

HDS.5310 Analytics and Stats Programming (3)

ORES 5160 Data Management (3)

ORES 5300 Foundations of Outcomes Research I (3)

ORES 5320 Scientific Writing & Communication (3)

ORES 5430 Health Outcomes Measurement (3)

HDS 5320 Inferential Modeling (4)

PHS 6060 Applied Research Skills II: Grant Writing (3)

Elective Courses (Students choose 6 credit hours)

ORES 5400 Pharmacoeconomics (3)

ORES 5410 Evaluation Sciences

ORES 5260 Pharmacoepidemiology (3)

ORES 5440 Comparative Effectiveness Research (3)

HCE 6120 Bioethics and the Law (3)

ORES 6980 Graduate Readings Course (1-3)

BCH-G628 Intro to Bioinformatics and Genomics (3)

BCH-G625 Preparation and Evaluation of Scientific Research Proposals (3)

HDS 5230 High Performance Computing

HDS 5330 Predictive Modeling and Machine Learning

HDS 5130 Healthcare Organization, Management, and Policy (3)

PHS 6060 Applied Research Skills II: Grant Writing (3)

Dissertation Research (12 credit hours)

ORES 6990 Dissertation Research

9 credit hours accepted from the MS1/MS2 of the MD curriculum, as follows:

Principles of Immunology, Pharmacology, and Therapeutics (3)

Molecular Foundations of Medicine (3)

Epidemiology and Biostatistics (1)

Elective in Clinical Research (1)

Foundation in Health Care Ethics (1)

Please consult the website for additional details: https://www.slu.edu/medicine/health-and-clinical-outcomes-research/degrees/health-outcomes-research-phd.php Course Descriptions (Updates at https://www.slu.edu/medicine/health-and-clinical-outcomes-research/degrees/courses.php)

ORES 5160 Data Management (3 credits) This course is an introduction to the design, maintenance and management of data involving human or animal subjects for research and analytic purposes.

ORES 5300 Foundations of Outcomes Research I (3 credits) This course will assist students in understanding outcomes research and provide a background in the basic tools used in outcomes studies.

ORES 5320 Scientific Writing and Communication (3 credits) This course develops the essential skills necessary for writing and communicating scientific information to both professional and lay audiences.

ORES 5430 Health Outcomes Measurement (3 credits) This course provides students with an understanding of the principles of instrumentation and measurement of health outcomes.

ORES 5260 Pharmacoepidemiology (3 credits) This course is an introduction to pharmacoepidemiology, which is the study of the use of and the effects of drugs in large numbers of people.

ORES 5400 Pharmacoeconomics (3 credits) Pharmacoeconomics involves the assessment of the costs and benefits associated with pharmaceutical interventions. The purpose of this course is to introduce the student to the concepts associated with pharmacoeconomic analyses.

ORES 5410 Evaluation Sciences (3 credits) This course deals with the application of research methods to judge the success of health programs. The course focus is public health programs and health services, although the concepts and methods are equally relevant to other sectors.

ORES 5440 Comparative Effectiveness Research (3 credits) This course will cover the fundamental concepts of Comparative Effectiveness Research-research evaluating the benefits and harms of alternate treatment methodologies.

HDS 5130: Health Care Organization, Management and Policy The course is designed to give students frameworks, analytic tools, informational resources, and specialized expertise in health administration and health policy. This background will prepare students for professional work in the health sector in medical and health settings, as researchers, managers or program developers, or as professionals responsible for analysis, evaluation, or advocacy. The course emphasizes knowledge of the organization and financing of health care, politics, the influence of Medicare and Medicaid policies, and the implications of health policy for diverse populations.

HDS 5310: Analytics and Statistical Programming This course will serve as the foundation for all subsequent coursework. Students will learn statistical concepts of probability theory, sampling theory, null hypothesis significance testing, and Bayesian estimation. They will develop expertise in the R statistical programming language and Markdown syntax and learn to collaborate with one another using the git and github version-tracking/sharing tools. By the end of this course, students will have a basic knowledge of statistical concepts, be able to execute analyses in R, share work with collaborators, and document their results.

HDS 5320: Inferential Modeling of Health Outcomes Students will learn to conceptualize research questions as statistical models and parameterize those models from real-world data. The course will start by introducing the linear model, then expand into generalized linear models, nonlinear models, mixed and multilevel models, and Cox survival models. Students will have a working knowledge of how to use statistical models to gain an understanding of the influence of individual predictor variables on health outcomes.

HDS 5330: Predictive Modeling and Machine Learning In contrast to the statistical modeling course which focuses on understanding the influence of variables on outcomes, this course will

focus on predicting individual health outcomes using modern automated model development algorithms. By the end of this course, students will be able to create predictive analytics using popular machine learning packages in R and Python.

HDS 5210: Programming for Data Scientists Students will be introduced to concepts in computer programming using the Python programming language. Students will learn to conceptualize steps required to perform a task, manipulate files, create loops, and functions. By the end of this course, students will have a basic understanding of computer programming, a working knowledge of the Python programming language, and they will be able to share their scripts to collaborate with other team members.

GENERAL GUIDELINES FOR PUBLIC DEFENSE OF THE DOCTORAL DISSERTATION

INTRODUCTION

The Saint Louis University Graduate Council and the University's Board of Graduate Studies mandate a public oral presentation and defense of Ph.D. dissertations. The Council and the Board approved this policy for two reasons. First, Saint Louis University wishes to increase public awareness of the high quality of its research efforts. The opportunity for Saint Louis University colleagues and their peers from outside the University to attend these presentations provides an open forum for our doctoral research accomplishments across scientific disciplines. Second, the general scrutiny of all pre-doctoral research by faculty colleagues and peers promotes both quality assurance and accountability to due process among all Ph.D. degree programs.

PROCEDURE

It is the responsibility of the student and the Ph.D. mentor to ensure that the dissertation is properly formatted and that substantive disagreements among committee members have been discussed prior to scheduling its public defense. It is also presumed that the candidate will be evaluated on the dissertation's content and the level of preparation for its presentation, rather than on a student's public speaking ability. At least three weeks before the proposed date, the Graduate Education Doctoral Candidacy Advisor must be notified in writing that an oral defense has been scheduled, accompanied by two copies of an advanced draft of the dissertation. One copy is retained in the Office of Graduate Education office for review by all interested persons but may not be removed. The Candidacy Advisor formally evaluates the second copy.

The Office of Graduate Education prepares a four-page program for each defense unless the Ph.D. department wishes to provide one. In addition to copies of the draft dissertation, candidates must also submit the following items at least three weeks before the proposed date. Those items include: the student's full name and SLU identification number; the proposed date, time, and location of the defense; a disk copy of the dissertation digest (< 300 words); and a brief biographic statement for the program. The Office of Graduate Education distributes an announcement of the defense to a primary mailing list provided by the Ph.D. department for all of its dissertations. This list includes appropriate University deans, chairs, center/institute directors, all departmental faculty, and SLU faculty in related disciplines. A second list provided by the Ph.D. department for a specific defense may include organizations and individuals from the local scientific or business communities who are associated with the candidate or with the specific research topic. Individuals on this second list may be invited by the Ph.D. department, or by the Office of Graduate Education if so desired, whose invitations will be sent electronically when feasible. As a courtesy, the Office of Graduate Education also invites to each defense the University President, Provost, and Deans. The Ph.D. department should invite its own graduate students, fellows, and staff to the defense.

A representative of the Office of Graduate Education is assigned to attend each presentation to ensure that the examination is conducted according to an established protocol. This representative must be a member of the Graduate Faculty but may not be a member of the candidate's dissertation committee. The representative then submits a brief report to the Graduate Education Dean as to the duration, attendance, and adherence to guidelines that the Ph.D. department has previously had approved by the Office of Graduate Education. In general, the candidate's presentation should be 30-60 minutes in length, followed by a period for questions from the audience and answers by the candidate. The entire presentation/defense should not exceed two hours. In addition, each department must prepare a brief written protocol for dissertation defenses by all of its Ph.D. candidates. This protocol should include expectations of student performance during the defense, and it should be included in the department's graduate student handbook. The document should also explain any acceptable variations from its own guidelines and must be submitted to the Graduate Education Dean for approval. Approved protocols typically include the following points:

1. The dissertation committee chair should introduce the candidate and may provide a brief oral biography of the student. The candidate may use audiovisual or other appropriate materials and should conclude the presentation prior to questioning. If the department permits spontaneous questioning, this should be clearly stated in the department's protocol for the defense that has been made available to its students.

2. All questions from the audience should be recognized by the dissertation committee chair, who is expected to control this phase of the defense and who has sole authority to recognize those wishing to ask questions or make comments.

3. The dissertation committee meets immediately after the public defense to conclude evaluating the candidate and dissertation. Ballots of committee members are then completed, collected by the committee chair, and submitted to the Doctoral Candidacy Advisor with final copies of the dissertation. If minor revisions are required following the public defense, ballots should be withheld until all committee members are ready to cast their final votes. Unanimous affirmation by the dissertation committee whose signatures appeared on the candidate's approved prospectus is necessary for final approval of the dissertation.

4. Should the candidate not be approved for graduation because of one negative vote from a dissertation committee member, the Candidate may appeal. The appeal process is described in the current catalog of the Office of Graduate Education.

MD PhD Steering Committee

Member	Department	Term
Daniel Hawiger, M.D., Ph.D.	Molecular Microbiology & Immunology	7/23-6/25
Vincenza Cifarelli, Ph.D	Pharmacology & Physiology	7/23-6/25
Leslie Hinyard, Ph.D.	Health &Clinical Outcomes Research	7/23-6/25
Paula Buchanan, Ph.D.	Health &Clinical Outcomes Research	7/23-6/26
Ryan Teague, Ph.D.	Molecular Microbiology & Immunology	7/23-6/26
Yuna Ayala, Ph.D.	Biochemistry & Molecular Biology	7/23-6/26
Kyle Karches, Ph.D.	Health Care Ethics	7/23-6/26
Erica Salter, Ph.D.	Health Care Ethics	7/23-6/27
Anutosh Chakraborty, Ph.D	Pharmacology & Physiology	7/23-6/27
Kyle McCommis, Ph.D.	Biochemistry & Molecular Biology	7/23-6/27
Member	**Role**	**Term**
Jane McHowat, Ph.D.	MD PhD Program Director	Ex officio
Chad Miller, M.D.	Senior Associate Dean of Undergraduate Medical Education	Ex officio
Duane Moore, M.D.	Assistant Dean SOM Diversity, Equity & Inclusion	Ex officio
Hiral Choksi, M.D.	Associate Dean for Admissions, and Assistant Professor	Ex officio
W.K. Rick Samson, M.D.	Director, Core Program in Biomedical Sciences	Ex officio
Member	**Role**	**Term**
Jacob Adler	M1/2 Student Representative	7/23-7/24
Andy Wu	Ph.D. Student Representative	7/23-7/24
Jess Bourque	M3/M4 Student Representative	7/23-7/24

Admissions Committee

Member	Department	Term
Jane McHowat, Ph.D.	MD PhD Program Director	Ex officio
Andy Lechner, Ph.D	Pharmacology & Physiology	7/23-6/24
Reza Dastvan, Ph.D.	Biochemistry & Molecular Biology	7/23-6/24
Daniel Hawiger, M.D., Ph.D.	Molecular Microbiology & Immunology	7/23-6/25
Vincenza Cifarelli, Ph.D	Pharmacology & Physiology	7/23-6/25
Leslie Hinyard, Ph.D.	Health &Clinical Outcomes Research	7/23-6/25
Paula Buchanan, Ph.D.	Health &Clinical Outcomes Research	7/23-6/26
Ryan Teague, Ph.D.	Molecular Microbiology & Immunology	7/23-6/26
Kyle Karches, Ph.D.	Health Care Ethics	7/23-6/26
Erica Salter, Ph.D.	Health Care Ethics	7/23-6/27
Kyle McCommis, Ph.D.	Biochemistry & Molecular Biology	7/23-6/27