

**University of Pennsylvania  
Perelman School of Medicine**

**Graduate Group in Epidemiology & Biostatistics**

**Faculty and Student Handbook**

**2017-2018**



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# 1 Introduction

This handbook serves as a reference manual for the masters and doctoral programs in biostatistics and the doctoral program in epidemiology at the University of Pennsylvania. It covers the graduate experience, from admission through required course work, examinations, and the MS thesis (biostatistics), and PhD dissertation in both programs. This is a living document; please bring errors and omissions to the attention of the Chair or Vice-Chair of the Graduate Group in Epidemiology and Biostatistics, or to the Chairs of the respective programs.

Many people made essential contributions to this handbook, most prominently: Drs. John Holmes (former GGEB chair), Mary Putt (former GGEB vice-chair), Harold Feldman (Chair of the Department of Biostatistics, Epidemiology and Informatics); Stephen Kimmel (Director, Epidemiology Division); J. Richard Landis (Director, Biostatistics Division), Daniel Heitjan, Phyllis Gimotty, Kathleen Propert, Scarlett Bellamy, Mary Sammel, Amanda Hyre-Anderson, Ebbing Lautenbach, John Farrar, and Theoklis Zaoutis. We would also like to thank Catherine Vallejo (coordinator of GGEB), Marissa Fox, Jennifer Kuklinski, Gabrielle Ostapovich, Thomas Kelly and Ann Facciolo.

Many others contributed in ways large and small, not least the students in the doctoral program, whose many relevant questions and experiences have led us to review our policies, consider their implications, and write them down clearly. We thank them especially and wish them the best in all their endeavors, at Penn and beyond.

*Nandita Mitra, PhD*  
*Professor of Biostatistics*  
*Chair, Graduate Group in Epidemiology and Biostatistics*

*Michael Z. Levy, PhD*  
*Associate Professor of Epidemiology*  
*Vice-Chair, Graduate Group in Epidemiology & Biostatistics*

*Hongzhe Li, PhD*  
*Professor of Biostatistics*  
*Chair, Graduate Program in Biostatistics*

*Marcella Devoto, PhD*  
*Professor of Pediatrics and Epidemiology*  
*Chair, Doctoral Program in Epidemiology*

*Jason Roy, PhD*  
*Associate Professor of Biostatistics*  
*Associate Chair, Graduate Program in Biostatistics*

## **2 Graduate Group in Epidemiology and Biostatistics**

### **2.1 Overview**

The Graduate Group in Epidemiology and Biostatistics (GGEB) is responsible for developing and administering the PhD degree programs in epidemiology and biostatistics as well as the MS program in biostatistics. The PhD programs train individuals to be rigorous and independent academic investigators, who are able to apply and extend the range of approaches available in epidemiology and biostatistics to address questions in biomedical research. The objective of the MS program in biostatistics is to train individuals in the basic theory and applications of statistical methods, especially as applied to problems in the health sciences.

The GGEB is a member of the Biomedical Graduate Studies Program (BGS) in the Perelman School of Medicine of the University of Pennsylvania. It is comprised of faculty from across the university with interests in biostatistics and epidemiology. Notably, many of the members of the Graduate Group have academic appointments within the Department of Biostatistics, Epidemiology and Informatics (DBEI). The Office of Biomedical Graduate Studies provides oversight and coordination for the GGEB and six other graduate groups offering PhD degrees in the biomedical sciences.

Biomedical Graduate Studies (BGS) was established in 1985 and serves as the academic home within the University of Pennsylvania for roughly 700 students pursuing a PhD in the basic biomedical sciences. Although BGS is housed within the School of Medicine, it is composed of more than 600 faculty members across seven Penn schools and several associated institutes. BGS provides training and administration through seven graduate groups, some of which have distinct sub-specialty areas. Each graduate group has its own training mission, leadership, and staff, but there is often significant overlap among the groups in respect to faculty membership, courses offered, policies, and procedures. BGS provides centralized support to the graduate groups for admissions, student fellowships, curricular oversight, record-keeping, and other operations.

Additional, up-to-date information about BGS is available at <http://www.med.upenn.edu/bgs/>.

## **3 Application and Admission**

### **3.1 Affirmative Action**

The GGEB values diversity and seeks talented students from all backgrounds. The GGEB does not discriminate on the basis of color, sex, sexual orientation, religion, national or ethnic origin, age, disability, or status as a disabled or Vietnam Era veteran in the administration of its educational policies, programs or activities, admissions policies and procedures, and scholarship programs. Women and minorities are especially encouraged to apply to the GGEB's educational programs.

## 3.2 The Application Process: All GGEB Programs

Applicants must complete the standard online BGS application form and upload the following documents:

- **Personal Statement** - Please discuss your academic and career objectives. It should be around 500 words in length. Be as specific as you can about the area in which you plan to study and your reasons for wishing to study at the University of Pennsylvania. In addition, if you are applying to a certificate program, your personal statement should include a paragraph (~200 words) reflecting your interest in those programs in addition to the doctoral discipline.
- **Research Statement** - Please provide a description of your research experience(s), including the goals of each project, approaches used, results obtained, and implications of the findings for the project and the field at large. You may choose to describe a single research experience or several experiences, but please limit your statement to around 1000 words in length.
- **Resume/CV** (Please DO NOT include GPA and/or GRE information)
- **Transcripts** - All BGS applicants are required to upload up-to-date unofficial transcripts from all institutions attended. These transcripts must include your Spring 2016 semester grades and indicate the courses you are enrolled in for the Fall 2017 semester. Transcripts from completed programs should show proof of degree conferral. A final, official transcript showing conferral of degree will be required of all accepted students prior to matriculation.
- **Letters of Recommendation** - You will also be prompted to send requests to three (3) people who are able to provide letters of recommendation. They will be sent an email notification with a link to the online recommendation form, which will allow them to upload a PDF of the letter. The letters should identify personal attributes, experiences, accomplishments, and goals relevant to success in graduate study in biostatistics or epidemiology, depending on the program. Applicants who are currently enrolled in a degree program must arrange for at least one letter of recommendation to be sent from a faculty member in that program.
- **Standardized Test Scores** – these should be sent directly from the testing service. BGS requires the general GRE for all applicants and an English proficiency exam (either the TOEFL or the IELTS) for applicants for whom English is not their native language. As part of the review process, we will waive the English Proficiency requirement for applicants who have or will have obtained a degree from a US or other approved English-instructed institution. There are no minimum score requirements. BGS does not require any GRE subject tests. In order for your application to be considered complete, official score reports must be received by the application deadline. In order to ensure that your official scores are received in time, we suggest that you take the exam no later than mid-November.

### 3.2.1 Waiver of Fees for the Application

U.S. citizens and permanent residents may request a waiver in cases of documented financial hardship. To request a waiver, email the admissions coordinator for BGS prior to submitting your application ([bgs@mail.med.upenn.edu](mailto:bgs@mail.med.upenn.edu)). Explain your situation and reasons for requesting a waiver of fees. The coordinator may ask for additional documentation e.g. documentation by the Financial Aid Officer from a relevant undergraduate institution, or, if not applicable, documentation of information about income, assets, family situation, etc. University rules prevent the waiver of application fee for international applicants.

### 3.2.2 Graduate Record Examination (GRE)

All applicants must provide an official score from the Educational Testing Service (ETS) for the Graduate Record Examination (GRE) General Test. We do not require the GRE subject test. GRE scores are valid for five years from the date taken. Students who are currently enrolled in

the GGEB Biostatistics MS program and who are applying for admission to the Biostatistics or Epidemiology PhD programs but do not have a currently valid GRE may request a waiver of the GRE requirement. Our ETS institution code is 2900. Please do not enter a separate department code.

### **3.2.3 Test of English as a Foreign Language (TOEFL)**

All applicants whose native language is not English must arrange for ETS to submit an official TOEFL score as part of the application by the application deadline. The TOEFL requirement is waived for a student who has been enrolled in an English-speaking university for at least two years upon application. TOEFL scores are valid for two years.

### **3.2.4 Application Deadline and Notification**

Students are admitted once per year, for the fall term. Information and application materials are available by October of the preceding year with an application deadline of typically December 1 (please check the on-line application form for the exact date for the year that you are applying). After reviewing the files, the Admissions Committee for the individual programs recommends candidates for the GGEB to the BGS Admissions Committee and the Chair of BGS. Students are usually notified of admissions decisions by the end of March.

### **3.2.5 Initiating an Application**

Those interested in applying for admission to graduate study should contact the Coordinator:

Ms. Catherine Vallejo  
Coordinator, Graduate Group in Epidemiology and Biostatistics  
Perelman School of Medicine at the University of Pennsylvania  
E-mail: [vallejo@mail.med.upenn.edu](mailto:vallejo@mail.med.upenn.edu)

## **3.3 Admission Requirements Specific to the Biostatistics Programs**

Entering students must have completed at least one year of calculus (including multivariable methods), one semester of linear algebra, and have a working knowledge of a programming language. Previous experience with data analysis and statistical packages is desirable but not required. Advanced courses in mathematics are particularly important for students who intend to pursue the PhD degree.

### **3.3.1 Applicants from the MS Program**

Students in our Biostatistics MS program who seek admission to our PhD program must submit a formal application. Typically, such students apply in the fall preceding their projected graduation with the MS. Results on the written qualifications examination are considered in the admission decision (see the section on “Evaluations and Examinations”).

## **3.4 Admission Requirements Specific to the PhD Program in Epidemiology**

Applicants must demonstrate prior training and experience in epidemiology, clinical sciences, or a public health-related field. This requirement can be satisfied by having a Master’s degree in public health, epidemiology, biostatistics, or related field, OR at least two years of relevant work experience. Individuals admitted without clinical or other biomedical training may be



required to take biomedical science courses in addition to the courses required for the PhD in Epidemiology. These courses will not count as electives and must be taken in addition to the required courses and credits. The Admission Committee will determine the need for additional courses at the time of acceptance.

The content of the additional courses required for those admitted without prior clinical or other biomedical training will be determined by a committee consisting of the student's advisor and two additional epidemiologists who are members of the Graduate Group. The advisor will be responsible for identifying those two faculty members. At least one of the three members of this committee must hold a clinical doctorate and at least one member of the committee must hold a doctorate in epidemiology or a related field, without a clinical doctorate. This committee will identify specific courses to be taken on the basis of a review of the candidate's academic record/transcripts and research interests, as well as interactions with the candidate. The candidate will be informed of the additional required courses prior to enrollment. It is likely that this additional coursework will increase the amount of time it takes for the candidate to successfully complete the PhD degree requirements.

Combined degree (MD-PhD, VMD-PhD, and DMD-PhD) applicants are exempt from this requirement since they will have had at least two years of relevant coursework in their professional degree program prior to starting coursework for the PhD.

## **4 Financial Obligations and Support**

Tuition costs are determined each year. The Trustees of the University of Pennsylvania reserve the right to increase tuition and fees and to otherwise amend the regulations concerning tuition and fees at any time and to make such changes applicable to students in the University at that time. PhD students receive up to 21 months of funding from BGS. During the initial 21 months, students identify a PhD advisor and work with the advisor and the program to develop a funding plan for the remainder of their graduate program. Most PhD students receive financial support through one or more of the following sources: assistantships supported by research grants, training grant fellowships, and fellowships from research institutions or private industry. A limited number of teaching assistantships are available. These sources are described in more detail below. Students who receive full-time support may accept no additional employment during the period of the support. Support for Biostatistics MS students depends on the availability of funds, with priority given to PhD students.

### **4.1 Financial Aid**

The University's Office of Student Financial Services provides information on student expenses and billing; processes financial aid applications, awards financial assistance; and administers the Penn Plan payment programs. Students may contact the Office directly at:

Office of Student Financial Services  
University of Pennsylvania  
Room 100 Franklin Building  
3451 Walnut Street  
Philadelphia, PA 19104-6270

## **5 Resources for Students**

### **5.1 PennCard**

The PennCard is the official identification card of the University of Pennsylvania. The PennCard Center is located on the second floor of the Penn Bookstore, 3601 Walnut Street. A valid, government-issued photo I.D. is required in order to pick up a PennCard. The first PennCard is free. Information about the PennCard and its use is provided at <http://cms.business-services.upenn.edu/penncard/home.html>.

### **5.2 PennKey**

The PennKey name and password provides access to PennNet, a Penn e-mail account, and many other essential services managed through the PhD Program. All students are required to have a current, active PennKey and password. Students are issued a PennKey Setup Code when they pick up their PennCard.

### **5.3 The PennPortal**

The PennPortal webpage bundles together links to important information for students. To access the PennPortal ([https://portal.apps.upenn.edu/penn\\_portal/portal.php](https://portal.apps.upenn.edu/penn_portal/portal.php)), students should log in with their PennKey name and password. If the “Graduate Students” tab does not automatically appear, students should click on the “My Tabs” button to add the “Graduate Students” tab from the available tabs.

### **5.4 Black Key**

Like all buildings on the Penn medical campus, Blockley Hall is secured through a building-specific black key and/or via your PennCard. The GGEB coordinator will arrange for a black key and PennCard for each student. Keys are distributed during orientation.

### **5.5 Health Care Coverage**

Penn students are automatically eligible for Penn Student Health Services and Chickering Health Insurance. Once a student is matriculated, the University will assume that this health coverage is needed and they will bill for the service. Students who wish to waive the Penn sponsored insurance should log onto PennPortal at [http://medley.isc-seo.upenn.edu/penn\\_portal/portal.php](http://medley.isc-seo.upenn.edu/penn_portal/portal.php) to do so. It is necessary that students watch their bill to ensure that no health insurance fee is incurred. If one is charged to the student account, the GGEB Coordinator should be notified.

### **5.6 Student Travel Funds**

BGS allows doctoral students to apply for partial reimbursement (currently, up to \$500/year) for travel to professional meetings if they are making a presentation. Applicants must justify the expenses prior to attending the meetings. Dissertation advisors sometimes are able to augment these travel funds. In addition some training grants provide funds for student travel. Information and application are provided at: [http://www.med.upenn.edu/bgs/travel\\_funds.shtml](http://www.med.upenn.edu/bgs/travel_funds.shtml)

## 6 Academic policies

Students in the PhD program are subject to academic policies of BGS ([http://www.med.upenn.edu/bgs/current\\_students\\_policies.shtml](http://www.med.upenn.edu/bgs/current_students_policies.shtml)) as well as the specific policies of the GGEB and PhD program as defined below.

### 6.1 Code of conduct and academic integrity

#### 6.1.1 Code of General Conduct

All BGS students must conduct themselves at all times in a mature and responsible manner. The rights and property of all persons are to be respected regardless of time or place. For dual degree students (MD-PhD, VMD-PhD), or graduate students who conduct research in a clinical venue, this also includes compliance with rules, procedures and accepted practices in the clinical setting. In addition, BGS students must comply with the University's code of general conduct and other University policies related to student conduct that are described in The Penn Book: Policies and Procedures Handbook of the University of Pennsylvania (<http://www.vpul.upenn.edu/osl/pennbook.html>). These policies include, but are not limited to, policies on sexual harassment, acquaintance rape and sexual violence, open expression, drug and alcohol usage, and the drug-free workplace. The judicial charter contained within that document is not applicable to BGS students; rather, BGS students are subject to the Charter of Biomedical Graduate Studies Student Judicial System which can be found on the BGS website.

#### 6.1.2 Code of Academic Integrity

The most fundamental value of any academic community is intellectual honesty; accordingly, all academic communities rely upon the integrity of each and every member. Students are responsible not only for adhering to the highest standards of truth and honesty but also for upholding the principles and spirit of the following Code. Violations of this Code include but are not limited to the following acts:

- A. **Cheating:** using or attempting to use unauthorized assistance, material or study aids in examinations or any other academic work, or preventing, or attempting to prevent another from using authorized assistance, material, or study aids.
- B. **Plagiarism:** using the ideas, data or language of another without specific and proper acknowledgment.
- C. **Fabrication:** submitting contrived or altered information in any academic exercise.
- D. **Multiple Submission:** submitting, without prior permission, any work submitted to fulfill another academic requirement.
- E. **Misrepresentation of Academic Records:** misrepresenting or tampering with, or attempting to tamper with, any portion of one's own or any other person's transcripts or academic record, either before or after coming to the University of Pennsylvania.
- F. **Facilitating Academic Dishonesty:** knowingly helping or attempting to help another violate provisions of this Code.
- G. **Unfair Advantage:** attempting to gain unauthorized advantage over fellow students in an academic exercise.

Note that it is the policy of the GGEB that students may collaborate on homework/coursework solutions but must submit their own independent response to any homework assignment. Exceptions to this policy may be made explicitly and in writing by the course instructor.

Given our daily reliance on numerous sources of information, it is essential for faculty and students alike to understand their responsibilities in adhering to the University's Code of Academic Integrity. To ensure that each student's work represents the effort envisioned by faculty for a given assignment, these two principles must be observed:

1. It is essential for faculty to indicate in writing for each assignment the parameters for completing that assignment. This should be a statement of exactly what is allowed and what is not allowed in terms of the use of outside material, consultation with other students or faculty, and the use of material previously created by the student for another course.
2. Students must be sure they understand the parameters for every assignment. While the instructor is responsible for providing a clear description of these parameters, it is the student's responsibility to understand them, and to discuss with the instructor any concerns or questions about them.

The Penn library website has excellent resources on this topic. The links below provide resources on the specific topic of plagiarism:

[http://gethelp.library.upenn.edu/PORT/documentation/plagiarism\\_policy.html](http://gethelp.library.upenn.edu/PORT/documentation/plagiarism_policy.html)

<http://gethelp.library.upenn.edu/PORT/documentation/avoidingplagiarism.html>

### **6.1.3 Code of Clinical Conduct**

The relationship of modern biomedical research to the clinical setting may place BGS students in direct contact with patients, patient medical records, or health care workers. BGS students must behave with paramount concern for patients' welfare and with respect for the rights of patients. The expectations of BGS students' conduct in the clinical setting include the following:

- A. adherence to appropriate standards of behavior in the presence of patients;*
- B. adherence to appropriate standards of confidentiality with respect to information about patients;*
- C. honesty in interactions with clinical colleagues and in recordkeeping;*
- D. respect for the limits of responsibility and activity set forth by supervisors;*
- E. appropriate interactions with colleagues and co-workers.*

## **6.2 Academic standards**

### **6.2.1 Course grades and Academic Probation**

Grades for all formal courses are assigned as follows: "A," distinguished; "B," good; "C," unsatisfactory; "D," poor; "F," failure. Course directors may award pluses and minuses at their discretion. Grades of B- or above are considered acceptable; grades of C+ or below are unacceptable. A student who receives an unacceptable grade (C+ or lower) in any course is automatically placed on academic probation, an enrollment status that indicates an unsatisfactory level of academic performance. A student who is on probation may take other courses and exams but may not graduate. The probation is automatically lifted when the

student has made up the deficient work by receiving an acceptable grade. The student must arrange with the chair of the course in question a program of study that will accomplish this end. One option is to redo the assignments or exams that led to the unsatisfactory grade. Another is to take the course again during the next semester in which it is offered. In any event, a student who fails to redress the deficiency within one year of being placed on academic probation will be dismissed and considered ineligible for re-admission. If a student receives a second unacceptable grade in another course while already on academic probation, the Graduate Group Chair will convene a committee to review the case. The committee, which will consist of the student's academic advisor and two other members of the Graduate Group faculty, is authorized to recommend either immediate dismissal or continuation of the probationary status, subject to approval by the Graduate Group Chair and BGS.

### 6.2.2 Incompletes

In order to graduate, students must satisfactorily complete their course work. There may be times when, for some reason, a student cannot complete the course work within the allotted time. In this case, the student must formally request, in writing, a grade of Incomplete (I) for the course. Requests for Incompletes are not automatically granted, and the course director must agree to enter the grade for that course. **Students and faculty should be aware that incompletes become permanent after a period of one year.** Thus, course requirements must be completed and a grade reported within one year or the student will not receive credit for the course even though tuition was paid. **If the incomplete is not resolved within the one-year period, then the student will be required to take an additional course to complete the requirements of the curriculum. The student must obtain approvals for the replacement course from the advisor and the respective Program Chair prior to registering for it.**

### 6.2.3 Individual Development Plans (IDPs)

BGS requires an annual IDP for all pre-doctoral students (PhD, MD-PhD, and VMD-PhD). The goals of the IDP are to make sure students and mentors are communicating openly and that students are working proactively toward developing the skills they will need to succeed in their program. Separate forms are used by pre-thesis and thesis level students. Please see <https://www.med.upenn.edu/bgs/idp.shtml> for specific requirements regarding the IDP and examples of completed IDP forms.

## 6.3 Additional Academic Requirements and Policies

### 6.3.1 Collaborative Institutional Training Initiative (CITI) Training Program

This program is mandatory for all School of Medicine faculty, clinical care associate physicians, physicians at affiliated hospitals, and research staff working with physicians who conduct patient-oriented research. Researchers conducting clinical studies with federal funding are also required to take human subjects research training. The Office of the Provost of Research has identified online training devices provided by the CITI program as the accepted standard for fulfilling the requirement for training certification in human research protections. Penn's IRB requires that researchers conducting clinical trials complete patient-oriented research training, and the CITI program can also fulfill this requirement.

### **6.3.2 Health Insurance Portability and Accountability Act (HIPAA) training**

HIPAA is a federal law that provides for the protection of the confidentiality of patient health records. All students must complete a University-approved course in HIPAA compliance.

### **6.3.3 Responsible Conduct of Research**

Students are required to take training in the responsible conduct of research (RCR) every academic year. First-year students satisfy this requirement by participating in an on-line Bioethics Symposium. Second-, third-, and fourth-year students attend small-group workshops in which relevant case studies are discussed. Students whose studies extend beyond four years must continue to participate in a yearly training session of their choice. Such students can satisfy the responsible conduct of research requirement by participating in various University-sanctioned bioethics courses and symposia or by serving as an assistant facilitator in a workshop for second-, third-, and fourth-year students.

Faculty must dedicate at least two meetings (1-2 hrs each) per year to RCR training. To this end, Faculty have access to case studies to use as discussion pieces, in addition to their own resources or examples from their own experience. The expectation is for these events to be interactive discussions that ideally include all project personnel, but minimally explicitly include all graduate students who work on that project. After each such event, the Faculty member is expected to fill out the online form found here:

[http://www.med.upenn.edu/bgs/RCR\\_FORM.shtml](http://www.med.upenn.edu/bgs/RCR_FORM.shtml)

### **6.3.4 Course evaluations**

Students are requested to submit their feedback promptly and completely at the end of each course throughout their time in graduate training. We take seriously what students say about a course and try hard to improve every year based on students' feedback.

Students should also be aware that faculty promotions can be affected by how they are evaluated. This is not meant to dissuade students from honestly rating the course faculty, but rather as an invitation to take this seriously and be thoughtful about how they rate the faculty's effort, skill, and teaching abilities. Constructive criticism is helpful and truly appreciated by both faculty and the graduate group. Disparaging comments are less helpful and are discouraged. The Program Chairs are always ready to discuss in person any concerns that students may have.

### **6.3.5 Leaves of absence**

During the period prior to dissertation status, the University allows graduate students to take leaves of absence with the permission of the PhD program and BGS. Dissertation level students are allowed leaves of absence only with permission, most notably for medical reasons and for parental leave in association with the birth of a child. Student stipends are suspended during a medical leave period and are re-instated upon return as long as the student is in good academic standing. A student who wishes to take a leave of absence must submit a written request to the Program Chair and the GGEB chair at least one month prior to the beginning of the first semester of the proposed leave. If the leave is for medical reasons, the request must include a note from the student's doctor. Leaves of absence are granted for



no more than one year. The university's leave of absence policy is provided in the Graduate Catalog Rules and Regulations: <http://www.upenn.edu/VPGE/rules.html>

### **6.3.6 Vacation and Time Away**

Graduate fellowships provide tuition, fees, health insurance, and a stipend for eligible full-time doctoral students in residence who remain in good academic standing. A student who accepts a full-time funded position is expected to devote full time to graduate study. BGS and GGEB offer a 12-month annual training program for funded students. Students are expected to work full-time toward the degree and are entitled to take University and GGEB staff holidays and two weeks per year for personal vacation time. The timing of the vacation must be approved by the supervisor of the entity that provides financial support for the student. Students who have not yet passed the candidacy exam (see below) must receive permission from the Chair of the GGEB for any additional time away from the University. A student who has passed the candidacy exam may schedule time away only with the prior approval of his or her dissertation advisor, the individual who is supporting his or her assistantship or traineeship, the Program Chair and the GGEB Chair.

## **6.4 Transfer of credit**

At least twelve course units must be completed while enrolled in a degree program at Penn; for the PhD degree, a maximum of eight units may be transferred from graduate work done at other institutions. Transfer of credit must be approved by the respective Program Chair, Graduate Group Chair, and the BGS Chair. If the requested transfer of credit is for a required core course, then the current course instructor must approve the transfer as well.

### **6.4.1 Transfer from other graduate groups**

Students who are currently enrolled in another graduate group within BGS may apply for transfer into the GGEB by submitting an application for admission to either the PhD Program in Epidemiology or the MS or PhD programs in Biostatistics. Students wishing to transfer must inform their original program of their intent. The student should have the chair of the original program sign a "Transfer of Graduate Group Form" to release the student from the original graduate group and then have the chair of the new program sign the same form to accept the student into the new graduate group. The GGEB will then request that the student's academic file be transferred from the former graduate group office. A similar procedure will be used for students transferring from other graduate programs within the university.

## **6.5 Residency, time limits, and fees**

Students must complete all course requirements, pass the required examinations, and complete the dissertation within ten years of matriculation. A student who fails to complete the dissertation within the time limit must petition a committee — composed of the student's academic advisor, the Program Chair (or a designated surrogate if the Chair is also the advisor), and a third member of the faculty designated by the GGEB Chair — to be recertified as a PhD candidate. The petition must name the student's dissertation advisor and committee members, describe a plan to finish the research needed to complete the dissertation, and indicate an expected date for the defense and deposit of the dissertation. Should the committee support the petition, it will submit a detailed recertification plan for review and approval by the Director of BGS, as specified in the University-Wide Academic Rules for Graduate Degrees.

In addition, PhD candidates must complete the dissertation within five years of passing the Qualifications Examination or being admitted into the PhD program (the latter if admitted to the PhD program after passing the Qualifications Examination at the PhD level as an MS student). A student who does not complete the degree within five years must petition the GGEB for an extension of the time limit. The petition must indicate a detailed plan for completing the PhD research, including anticipated dates for defending and depositing the dissertation. The petition will be considered by a committee that includes the student's academic advisor, the Program Chair (or a surrogate as indicated above) and a third faculty member designated by the GGEB Chair.

A candidate who withdraws from the PhD program after reaching dissertation status and subsequently applies for re-admission must pay the dissertation fees that would otherwise have been due during the withdrawal period.

## **7 Graduate Training Programs in Biostatistics**

***This version of the biostatistics portion of the handbook applies to students who entered the program in the fall of 2016 or thereafter. For students who matriculated prior to this, please refer to the previous version of the handbook that may be found at [http://www.med.upenn.edu/ggeb/GGEB\\_Handbook.shtml](http://www.med.upenn.edu/ggeb/GGEB_Handbook.shtml). Questions about the program for any cohort should be referred to the student's academic advisor, the Program Chair, or the GGEB Chair.***

The PhD program in biostatistics is designed to prepare students to be independent researchers in the development of statistical methodologies and in the appropriate and innovative application of these methodologies to biomedical research problems. In the first five semesters of the program, students complete a series of courses in both theory and applied methodology, engage in individually mentored research experiences, explore statistical collaboration, and complete the qualifications examination. Within this period, students also identify a dissertation research problem and an advisor and present a research proposal as part of the candidacy examination. Students typically defend their dissertations and graduate within five years of matriculation.

The MS program is designed to prepare students to be practitioners of biostatistical methodologies. Some MS students may move to enter the PhD program. The MS program closely parallels the first two years of the PhD program and requires four full-time semesters of course work, exploration of practical aspects of collaboration, and an independent research project which serves as the MS thesis.

### **7.1 Elements Common to MS and PhD Programs**

#### **7.1.1 Academic Advisor**

Each incoming student is assigned an academic advisor who serves as the student's primary mentor, advising in course selection and related academic matters. The program attempts to match students to advisors who have similar backgrounds and interests. A



student may change advisors at any time by request to the Program Chair. A PhD student's dissertation advisor, once selected, assumes the role of academic advisor during the later years of study. Furthermore, at any time a student may refer questions about his or her program to the chair of the Academic Advising Committee.

At the beginning of the academic year, each student, in collaboration with his/her advisor, prepares a proposed academic program, the Individual Development Plan (IDP), including courses to be taken, courses to be transferred, and timelines for examinations and dissertation preparation.

### **7.1.2 Non-Credit Requirements**

The department hosts a weekly biostatistics research seminar that invites speakers from other universities, industry, and government. All students are expected to attend at least six seminars per semester, provided there is no conflict with courses. Other non-credit requirements include Responsible Conduct of Research, CITI, and HIPAA training. These requirements are described in detail in Section 6.3. Biostatistics in Practice I and II, as well as, for PhD students, serving as a teaching assistant, are also non-credit requirements (see Sections 7.3.9 and 7.5, respectively).

### **7.1.3 Transfer of Credit**

Only courses considered at the graduate level may be transferred from previous training. At least eight and a half course units of the total program required for the MS degree must be completed while enrolled in a graduate program at UPenn. Because the MS program requires only 12.5 total course units, no more than four may be satisfied by transfer credit. A maximum of eight units may be transferred from previous training towards the PhD degree. Courses proposed for transfer credit must be relevant to training in biostatistics and may include courses in theory, methods, or towards a minor (see Section 7.3.6 regarding minors). Transfer of credit must be approved by the Program Chair and the GGEB Chair.

### **7.1.4 Auditing**

Auditing a course is not allowed for any students in the PhD program. For MS students, auditing of a course is strongly discouraged. If a MS student wishes to audit a course he/she must consult their academic advisor, the course director, and prepare a written request to the Program Chair explaining reasons for the proposed course audit. Final approval must be obtained from the GGEB Chair.

## **7.2 Master of Science (MS) in Biostatistics**

### **7.2.1 Course Requirements**

Candidates for the MS degree must complete 12.5 units of course credit and prepare a Master's thesis. Required courses cover probability, mathematical statistics, and statistical methods including categorical data analysis, linear models, survival analysis, and applied data analysis. All students also take a course in epidemiology. MS students will have the option to take the written qualifying exam but it is not required to obtain a masters in biostatistics.

The MS in Biostatistics typically requires four semesters of formal course work. Students must complete nine units of required courses, three units of electives, and the Biostatistics in Practice and project requirements (see Section 7.3.9). The required courses are described below. The courses in **bold** type are the “core” courses for the MS degree that are covered on the written qualifications examination.

Theory:

**BSTA 620** Probability (1 unit)

**BSTA 621** Statistical Inference I (1 unit)

Methods:

**BSTA 630** Methods I (1 unit)

**BSTA 632** Statistical Methods for Categorical and Survival Data (Methods II) (1 unit)

**BSTA 651** Introduction to Linear Models & Generalized Linear Models (1 unit)

BSTA 656 Longitudinal Data Analysis (1 unit)

BSTA 660 Design of Observational Studies (1 unit) OR BSTA 661 Design of Interventional Studies I (1.0 unit)

BSTA 670 Statistical Computing (1 unit)

Applications:

**BSTA 509** Introductory Epidemiology (1 unit)

BSTA 511: Biostatistics in Practice (1 unit)

**7.2.1.1 Electives**

Students in the MS program choose three additional units from a list of advanced courses in biostatistics and related topics. At least two of these courses must be quantitative; the third may be in a related scientific field subject to approval by the Program Chair and GGEB Chair. A partial listing appears under the section on electives for the PhD program (Section 7.3.3). In addition to these electives, BSTA 622 Inference II and BSTA 754 Advanced Survival Analysis, which are required courses for the PhD program, may be used as advanced electives for the MS program. Courses not described here may be used as advanced electives for the MS program upon receiving approval from the Program Chair and GGEB Chair.

**7.2.2 Biostatistics in Practice and the MS Thesis**

All MS students must participate in Biostatistics in Practice and complete a Biostatistics in Practice project, which serves as the MS thesis. The project may be completed in any semester. See the description of the Biostatistics in Practice requirements in Section 7.3.9.

**7.2.3 Typical Course Sequence for Full-Time Students in the MS Program**

	Semester	Required Credit Courses (units)
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Year 1	Fall	FT Courses: BSTA 620: Probability (1) BSTA 630: Statistical Methods and Data Analysis I (1) BSTA 509: Introduction to Epidemiology (0.5) BSTA 511: Biostatistics in Practice I (0.5)
	Spring	FT Courses: BSTA 621 Statistical Inference I (1) BSTA 632 Statistical Methods for Categorical and Survival Data (Methods II) (1) BSTA 651: Linear Models and Generalized Linear Models (1) BSTA 511: Biostatistics in Practice (0.5)
	Summer	Written Qualifications Examination <i>(Optional for MS Students)</i>
Year 2	Fall	FT Courses: BSTA 670: Statistical Computing (1) Advanced Electives (2) Biostatistics in Practice Project / MS Thesis
	Spring	FT Courses: BSTA 656: Longitudinal Data Analysis (1) BSTA 660: Design of Observational Studies (1) or BSTA 661 Design of Interventional Studies (1) Advanced Elective (1) Biostatistics in Practice Project / MS Thesis Presentation

## 7.3 Doctor of Philosophy (PhD) in Biostatistics

### 7.3.1 Funding Policies

Full-time PhD students are eligible for funding in the form of traineeships, fellowships, and research and teaching assistantships. The work associated with these sources of support is an essential part of the graduate training program.

At the beginning of the academic year, each funded student receives a letter describing sources of support and associated obligations. All doctoral students admitted to the program receive support from BGS for up to 21 months. During this time students take courses and explore research opportunities with faculty in the department. Once students decide on a dissertation advisor, the advisor, the student and the Program chair will work to develop a sustained funding plan that will cover the student's time during the remainder of their graduate program. A number of funding opportunities are available including federally funded research and training grants, partial TAs and funding through partnerships with industry. The typical length of time in the program is five years. Students in good academic standing have occasionally received funding for up to six years in the program.

### 7.3.2 Course Requirements

The PhD in Biostatistics typically requires five to six semesters of coursework and additional semesters devoted to dissertation research. This is usually accomplished in four to five years of full-time study. The standard course sequence for PhD students consists of 3 units in theory, 7 units in statistical methods, 0.5 unit of epidemiology, 1.0 unit of Biostatistics in Practice, 2 units toward a minor and 4 units of electives in advanced theory and methods. In addition, a minimum of three units of credit including one unit of independent study (BSTA 999), two units of guided research (BSTA 920 and BSTA 995) and three semesters of lab rotations (BSTA 699) are required. In general, students are expected to have completed all required courses by the end of their 4th year (or equivalent for those who enter with a Masters

degree). In rare cases substitutions may be made. Such alternatives must be pre-approved by the chair of the Curriculum Committee, the Program Chair, GGEB Chair and the director of the course being waived, who is in the best position to evaluate whether the necessary skills are met by the substitution.

Below are the required core courses; the courses in **bold** type are PhD “core” courses that are covered on the written qualifying examination.

Theory:

**BSTA 620** Probability (1 unit)  
**BSTA 621** Statistical Inference I (1 unit)  
BSTA 622 Statistical Inference II (1 unit)

Methods:

**BSTA 630** Statistical Methods and Data Analysis I (1 unit)  
**BSTA 632** Statistical Methods for Categorical and Survival Data (Methods II) (1 unit)  
**BSTA 651** Introduction to Linear Models & Generalized Linear Models (1 unit)  
BSTA 656 Longitudinal Data Analysis (1 unit)  
BSTA 660 Design of Observational Studies (1 unit) **OR** BSTA 661 Design of Interventional Studies I (1.0 unit)  
BSTA 670 Statistical Computing (1 unit)  
BSTA 754 Advanced Survival Analysis (1 unit)

Applications:

**BSTA 509** Introductory Epidemiology (0.5 unit)  
BSTA 511: Biostatistics in Practice (1 unit)

### 7.3.3 Electives and Independent Study

Students are required to take 4 additional advanced electives; a partial listing of such courses is given below. In addition to this list, other courses offered by departments outside of Biostatistics and Epidemiology may be appropriate advanced electives and may be used as an advanced elective for the PhD program upon receiving approval from the student’s academic advisor and the Program Chair. Independent study or reading courses (BSTA 999) are reserved for doctoral students who have passed the written qualifications examination and are either choosing a dissertation topic or undertaking the early stages of dissertation research. At most one of the four required advanced electives may be a reading course, and only on a topic not offered as a formal course with a year.

STAT 530 Probability (1 unit)  
STAT 531 Stochastic Processes (1 unit)  
STAT 921 Observational Studies (1 unit)  
STAT 925 Multivariate Analysis: Theory (1 unit)  
OPIM 930 Stochastic Models II (1 unit)  
BSTA 751 Statistical Methods for Neuroimaging (1 unit)  
BSTA 771 Applied Bayesian Analysis (1 unit)  
BSTA 774 Statistical Methods for Evaluating Diagnostic Tests (0.5/1 unit)

BSTA 775/STAT 920 Sample Survey Methods (1 unit)

BSTA 782 Statistical Methods for Incomplete Data (1 unit)

BSTA 783 Multivariate and Functional Data Analysis (1 unit)

BSTA 785 Statistical Methods for Genomic Data Analysis (1 unit)

BSTA 786 Advanced Topics in Clinical Trials (1 unit)

BSTA 787 Methods for Statistical Genetics in Complex Human Disease (1 unit)

BSTA 788 Functional Data Analysis (1)

BSTA 789 Big Data (1)

BSTA 790 Causal Inference in Biomedical Research (1 unit)

BSTA 820/STAT 552 Statistical Inference III (1 unit)

BSTA 852/STAT 910 Forecasting and Time Series (1 unit)

BSTA 854/STAT 927 Bayesian Statistical Theory and Methods (1 unit)

### **7.3.4 Applied Research Requirement, Equivalent of MS Thesis**

All PhD students must participate in Biostatistics in Practice and complete a Biostatistics in Practice project, a requirement that students typically satisfy during the first or second year. See Section 7.3.9 for further details.

### **7.3.5 Teaching Practicum**

All students in the PhD program must provide teaching support for a course or courses offered by the Department of Biostatistics and Epidemiology or related programs. This is discussed in detail in Section 7.5.

### **7.3.6 Minor**

Students must complete a two-unit minor sequence in one or more areas of science relevant to biomedical research. Some possible subject areas for minor courses include epidemiology, genetics, biology, psychology, economics, computer science, and bioengineering. Minor courses are typically taken outside of the GGEB, with the exception of advanced epidemiology courses (beyond BSTA 509) which may also be counted toward the minor. The two-unit minor sequence must be approved by the curriculum committee chair and the program chair.

### **7.3.7 Examinations**

The PhD program requires the successful passing of three examinations: the written Qualifications Evaluation, the oral Candidacy Examination, and the Dissertation Examination. Later sections outline the procedures for each of these.

### **7.3.8 Lab Rotations**

#### **Goals and Objectives**

The overall goal of the rotations is to expose students to biomedical research, and in particular research related to statistical methodology early in their training. In addition, students will rotate through a number of different labs, in order to get a broad perspective on research and faculty. This will also assist the students in identifying their research interests and dissertation topic earlier in their educational process. In addition, both the students and faculty can assess whether they are a good match for possible dissertation advisor/advisee relationships. By the end of 21 months of training (summer of year 2) students who were initially funded by BGS will

identify their dissertation advisor, have a foundation for the first topic in their dissertation work, and move off of BGS funding and onto funding that is related to their dissertation work. Students will normally identify their PhD mentor through working with them on a lab rotation. Students who are funded by a training grant during their first 21 months in the program will remain on the training grant throughout their program. Students who are currently funded or who have interests in receiving funding during their dissertation research from a training grant should discuss how to structure their lab rotations with the training grant director. Lab rotations that offer research experience in areas relevant to our training grants will be available each year.

### **Lab Rotation Content**

Laboratory rotations should focus on statistical research as opposed to simple data analysis or service/project work. Ideas include implementation of a method from the literature, literature review of methods, running and summarizing simulations, or the analysis of a complicated dataset. It is recognized that, depending upon the background of the students matriculating into the program, the first lab rotation may need to be a lighter introduction to the methodological area such as focusing on literature review, study design, logistics, and data management and/or data analysis.

### **Duration and Number of Individual Rotations and Dissertation Advisor Choice**

Students are expected to participate in 3-5 rotations in total with a minimum of 2 different mentors. First year students will have 3 rotations: fall, spring, and summer. Students can expect to spend 20+ hours per week during the fall/spring semesters and full time 40+ hours during the summer. In the second year it is expected that students will settle into a relationship with a potential PhD dissertation advisor with the goal of focusing their research in an area of research related to that of the advisor. Nevertheless, if needed, a fourth or even fifth lab rotation may occur in the second year to help the student decide on a research topic and mentor. In many cases the MS thesis (Biostatistics in Practice project) will be related to the dissertation for a PhD student. In addition to determining an area of research interest, the dissertation advisor must show willingness to, at least partially, support the student.

### **Laboratory Rotation Assignments**

Prior to the arrival of the new students, interested faculty mentors will submit a short summary describing their proposed laboratory rotation (similar to a course description). During new student orientation and the first week of classes, faculty who are interested in serving as a mentor for the upcoming semester will make a brief presentation of their projects. Faculty mentors can also distribute a handout with a more detailed project description to interested students. Next, the students will rank their choice of projects and the rankings will be reviewed by members of the Academic Advising Committee. Each student will be encouraged by the committee to meet with individual faculty of 2 or 3 potential collaborations. This should occur within a short period of time so that assignments can be made and begin in a timely fashion for the Fall semester. After those meetings, participating biostatistics faculty will also rank their student preferences. The Academic Advising Committee will take this information and facilitate matching students to faculty. It is important to note that each student will be working in three labs during their first year, so students and faculty will have ample opportunity to work with each other over the course of the program and initial matches do not preclude options for other collaborations. It is the responsibility of faculty mentors to make sure any required IRB

approvals are obtained, and that students have the requisite CITI training to work with any data related to their laboratory rotation project.

### **Evaluation**

At the initiation of each new lab rotation, the advisor and mentee will write a short summary of the goals and expectations for the particular laboratory rotation. This document will be submitted to the Academic Advising Committee for review. Laboratory rotations are taken for credit (1 unit, BSTA 699) and students receive both a written evaluation and a letter grade. Summer rotations also receive a letter grade; however, these will not appear on the formal transcript. In addition, each student will present a 15-minute (shorter for 1<sup>st</sup> rotation) oral presentation of their laboratory rotation work annually during a brown bag format “chalk talk”. Attendance will be required for all students participating in various lab rotations and encouraged for upper class students as well as faculty.

### **Laboratory Rotation Lab Notebook**

PhD students are required to keep a formal record/notebook of work being conducted during mentored laboratory rotations as part of the first 21 months in the PhD programs. The lab notebook should be a shared document between the mentor and mentee. This document should be stored in a location that both mentor and mentee can access such as a project directory or a shared PENN Box folder. Both mentor and mentee should continue to have access to the shared folder once the lab rotation has been completed.

The lab notebook should contain dated entries including a list of the goal(s) for each week, and a summary of progress towards those goals. The notebook progress should be reviewed at weekly meetings between the mentee and mentor with new goals set for the following week.

A copy of the lab notebook along with all work products should be retained by the mentor at the end of each rotation.

## **7.3.9 Biostatistics in Practice**

### **Biostatistics in Practice Workshop**

Participation in Biostatistics in Practice is required for both the MS and PhD degrees. This year-long 1-unit course covers practical aspects of utilizing biostatistics in multi-disciplinary research teams. Didactic lectures address both the substantive and communications aspects of consulting, with student participation in class discussions considered critical. In addition, each student attends 2-3 consulting sessions between a biostatistics faculty member and his/her collaborators. For PhD candidates, Biostatistics in Practice may be waived if the student 1) has previously achieved an MS in Biostatistics or Applied Statistics and 2) can demonstrate exposure to an equivalent curriculum in their previous degree program. Such a waiver requires the approval of the Program Chair and GGEB Chair.

### **Biostatistics in Practice Project**

The Biostatistics in Practice project offers the student an opportunity to acquire and demonstrate proficiency in statistical collaboration and data analysis. The project is defined by several elements: A scientific question or hypothesis arising in medical research; the statistical methodology needed to address the question; the development of a study design and/or analysis of a relevant data set; and a summary of the results of these

analysis. In most cases, a collaborating medical scientist provides the research question and the data. The student, under the supervision of a biostatistics faculty member, identifies the appropriate statistical methods and conducts the analysis. The analysis should be sufficiently extensive and detailed to support a manuscript publishable in the medical literature.

The project consists of two parts. The first is a written report including: a description of the research question; background and significance; a description of the statistical methods applied; the results of the analysis; and summary of the major findings and conclusions. The written report should describe the study in a format suitable for publication in a scientific journal. Students may use this Biostatistics in Practice project write-up as their MS thesis. The second part is a short (15 minute) oral presentation of the project to the biostatistics faculty and students.

The project must be completed by the end of the second semester of Biostatistics in Practice (end of April).

**All data analyses done as part of the Biostatistics in Practice project must have IRB approval. In most cases this requirement is satisfied if the research objectives are part of an existing protocol of the participating medical research collaborator, as long as the student is added to the protocol according to the standard modification procedures required by the IRB.**



### 7.3.10 Typical Course Sequence for Full-Time Students in the PhD Program

	Semester	Funds	Plans
<b>Year 1</b>	Fall	BGS	FT Courses: BSTA 620: Probability (1) BSTA 630: Statistical Methods and Data Analysis I (1) EPID 509: Introduction to Epidemiology (0.5) BSTA 511: Biostatistics in Practice (0.5) BSTA 699: Lab Rotation
	Spring	BGS	FT Courses: BSTA 621: Statistical Inference I (1) BSTA 632: Statistical Methods for Categorical and Survival Data (Methods II) (1) BSTA 651: Linear Models and Generalized Linear Models (1) BSTA 511: Biostatistics in Practice (0.5 continued) BSTA 699: Lab Rotation
	Summer	BGS	Written Qualifications Examination BSTA 699: Lab Rotation
<b>Year 2</b>	Fall	BGS	FT Courses: BSTA 622: Statistical Inference II (1) BSTA 670: Statistical Computing (1) BSTA 754: Advanced Survival Analysis (1) BSTA 699: Lab Rotation Biostatistics in Practice Project / MS Thesis
	Spring	BGS	FT Courses: BSTA 660: Design of Observational Studies or BSTA 661: Design of Interventional Studies (1) BSTA 656: Longitudinal Data Analysis (1) Advanced Electives (1) BSTA 699: Lab Rotation Biostatistics in Practice Project / MS Thesis Presentation
	Summer	BSTA	Oral Candidacy Examination PhD Thesis*
<b>Year 3</b>	Fall	BSTA	BSTA 999: Independent Study (1) Advanced Electives (1) Minor (1) Oral Candidacy Examination (if not completed in summer) F31 Grant Proposal PhD Dissertation
	Spring	BSTA	BSTA 920: Guided Dissertation Research (1) Advanced Electives (1) Minor (1) F31 Grant Proposal (if not completed in fall) PhD Dissertation
	Summer	BSTA	PhD Dissertation
<b>Years 4-5</b>	Fall	BSTA	BSTA 995: Dissertation Research (1) Advanced Electives (1) PhD Dissertation

## **7.4 Evaluation and Examinations**

Evaluation for the MS degree is based on performance in the required and elective courses, and completion of the MS thesis/Biostatistics in Practice project. Evaluation for the PhD degree is based on these criteria plus ongoing interactions with the faculty advisor(s), laboratory rotations, successful performance on the written Qualifications Examination, Candidacy and Dissertation Examinations, and the dissertation itself.

### **7.4.1 The Written Qualifying Examination (MS and PhD)**

The following guidelines refer to the written Qualifications Examination required for all PhD students and optional for MS students in Biostatistics. The Qualifying Examination Committee develops and administers the examination each year and presents the results to the full faculty.

Passing of the written Qualifications Examination is required for continuation in the PhD program. This examination also satisfies the UPenn examination requirements as outlined below.

### **7.4.2 MS Program Examination Requirements**

Students in the MS program in Biostatistics, are not required to take and pass the written qualifying examination. In order to obtain the degree, students will need to write and deposit an MS thesis and conduct an oral presentation of their work on one of the designated Biostatistics in Practice presentation days. MS candidates will have the option to take the exam if they are considering PhD work but it is not required. If the MS student passes the QE at the PhD level and is subsequently admitted to our PhD program, he/she will not need to take the exam again (if they pass one part and not the other and are subsequently admitted to the PhD program, they will need to retake the part of the exam that they did not pass).

### **7.4.3 PhD Program Examination Requirements**

The written Qualifications Examination serves as the university-required “Qualifications Evaluation” as defined in the Graduate Studies catalog. PhD students must pass the written Qualifications Examination as the first step toward full PhD candidacy. The examination is offered each summer, in June, to allow for grading and faculty review such that students will have results before the July 4th holiday each year. All full-time PhD students are expected to sit for the examination after their first year of study, with the option to retake the exam the following year if needed. No student is allowed to take either part of the exam more than twice.

The exam consists of two parts: theory (“Part A”) and methods (“Part B”). Students are given a grade on each part, and have up to two opportunities to take each part. A student must receive a passing score at the PhD level on both parts of the exam to be considered to have passed. Because the exam is offered only once a year, PhD students who do not pass one or both parts of the exam and elect to take it a second time have the opportunity to take two additional semesters of course work between examinations. A PhD student who passes one part of the exam at the PhD level is not required to take that part a second time.

#### **7.4.4 Examination Results and Notification**

All matters pertaining to grading and review of the written qualifications examination by the faculty are confidential, but some general procedures are outlined here.

Once grading is complete (typically two weeks after the exam), the faculty of the Biostatistics program meet to review the examination. The meeting also provides an opportunity to review the progress of all students in the program; grades, performance in lab rotations, and related materials may also be discussed in addition to the exam scores. Because the difficulty of the examination may vary from year to year, there are no absolute cut-offs for passing.

For a PhD student, the examination has four possible outcomes:

1. Pass at the PhD level.
2. Pass *only* Part A (Theory) or *only* Part B (Methods) at the PhD level.
3. Fail.

A PhD student who achieves outcome 1 is eligible to continue working to complete other PhD program requirements and, in particular, should begin the process of selecting a dissertation topic and advisor. As described below, the oral Candidacy Exam is required within 18 months of the successful completion of the written qualifications examination. Students will be strongly encouraged to take it the summer or early fall of the year after passing the written Qualifications Examination, especially if they have identified a topic/advisor through their lab rotations. Students who do not meet this deadline will be on "academic probation".

A PhD student who achieves outcome 2 must re-take and pass the failed part at the next opportunity in order to continue in the PhD program. A PhD student who has outcome 3 must re-take the entire exam, and pass both parts, at the next opportunity in order to continue in the PhD program.

Each student who takes the exam receives written notification of his or her outcome as soon as possible after the faculty grading meeting. No other information is made available before that time. The letter notifies the student of the outcome of the exam, recommendations for continued study, and the process for discussion of the exam with the Examinations Committee.

#### **7.4.5 MS Students Applying to the PhD Program**

Students enrolled in the MS program who wish to apply to the PhD program must submit a formal application. As the written qualifications examination is typically administered in the summer after the first year of study, it is likely that the results will be known to the Admissions Committee. The Admissions Committee determines how to use the results of the written examination in the admissions process.

MS students who pass both parts of the written qualifying examination at the PhD level on the first attempt and are admitted to the PhD program are not required to take a second examination. MS students who pass only one part of the exam and are admitted to the

PhD program are required to take the deficient part of the examination a second time and pass in order to continue in the PhD program.

#### **7.4.6 Review of the Examination**

A student who does not pass one or both parts of the examination at the intended level may request to review his/her exam paper with the Qualifying Examination Committee (QEC) chair and, optionally, his/her academic advisor. The purpose of such a review is to help the student evaluate the types of mistakes made, identify areas where further study is needed, etc. The QEC retains the graded exam papers and does not return them to the students.

A student may appeal the outcome of the qualifying examination to the QEC Chair, who together with the QEC membership evaluates the appeal and judges whether it has merit. A grade can only be changed in cases of a specific error in scoring. The QEC refers any grade change that could affect the student's exam outcome to the full Biostatistics faculty, who decide whether to revise the exam outcome.

Because a minor revision of the score is unlikely to change the exam outcome, a student should only initiate a formal appeal if there were one or more egregious errors in the problem or in its grading, the correction of which would likely lead to a substantial increase in the score. The QEC Chair can advise the student on the prospects for success of a proposed appeal. A student who seeks a formal review must request it, in writing, from the QEC Chair within one week of the issuance of the letter notifying the student of the exam result.

#### **7.4.7 Sickness Policy**

A student who has declared an intention to sit for the exam, but at the time of the exam is too ill to attend, may request a deferment by contacting both his/her academic advisor and the Chair of the QEC. A deferment can be granted only if the student provides a note from a medical doctor excusing him or her from the exam as a result of the illness. The student may then be allowed to take the exam on or before the first business day when the note indicates that the student may return to work. The decision to request a deferment must be made before taking the exam. A student who takes any part of a day's exam will be considered a complete exam and graded accordingly.

#### **7.4.8 The PhD Candidacy Examination**

In order to advance to candidacy for the PhD degree in Biostatistics, a student must successfully pass a candidacy examination. This examination satisfies the requirements of the University's required "Candidacy Examination" defined in the Academic Rules on the Provost website: <https://provost.upenn.edu/policies/pennbook/2013/02/13/academic-rules-for-phds-and-research-master-s-degrees>

The purpose of the candidacy examination is to evaluate whether the student is qualified to proceed to dissertation research. Although the examination is structured around the dissertation proposal, it may also cover any material in the student's course work. This includes the core courses and other requirements, as well as the minor courses. The examination should emphasize the student's qualification to continue as well as the content

of the dissertation proposal. Committee members are encouraged to communicate to both the student and the dissertation advisor suggestions regarding the proposed research, as well as the feasibility of completing the project in a reasonable time.

### **Candidacy Examination Committee Membership**

The committee will consist of a minimum of three members, not counting the advisor(s), of whom two must be faculty members of the GGEB, and one must be an external (non GGEB) member. A GGEB faculty member will be appointed as the Chair of the committee by the student's advisor. The role of the Chair is to run committee meetings and to oversee the candidacy examination and final defense. Committee members will be collectively responsible for administering and evaluating the oral Candidacy Examination, reading the dissertation, and evaluating the final defense. Additional content experts from within or outside the GGEB may be added to the committee as needed. The initial constituency and any changes in the membership must be approved by the Program Chair and the Graduate Group Chair. This Committee will be in place at all times during the dissertation phase. If for some reason, a student changes to a different area of research, a new Dissertation Committee must be appointed immediately and must meet within three months to discuss new plans for the dissertation research.

### **Candidacy Examination Scheduling**

To maintain good academic standing, students must advance to candidacy by 18 months after passing their written qualifications examination. In typical cases this will occur no later than the beginning of the student's fifth (spring) semester, although students are encouraged to complete their candidacy examination within one year of passing the written qualifications examination. It is the responsibility of the dissertation advisor to work with the student to schedule the candidacy exam once the dissertation research has been clearly outlined. The Program Chair will schedule the candidacy examination for any student who has not met this deadline.

### **Content of the Dissertation Proposal**

The student should provide a written dissertation proposal to the committee at least two weeks prior to the scheduled examination date. The members review the proposal and prepare questions for the exam.

The dissertation proposal should include a review of the literature relevant to the topic to be studied. The proposal may, but need not, include preliminary research results. The paper should be primarily a true proposal and should typically not exceed twenty pages.

The examination lasts up to two hours and typically includes three parts: First, the student gives a formal presentation of the proposal, generally not to exceed 45 minutes (which may be extended if there are questions during the talk). Next, committee members question the student on the proposal or on topics in biostatistics or the minor. Once all committee members are satisfied that the questioning is complete, the student is asked to leave the room. The committee then discusses the examination, votes the outcome (see below), and makes recommendations (if any) for future research and study. The student is then readmitted and informed of the outcome. The committee chair ensures that necessary forms are signed and returned to the graduate program office.

## **Candidacy Examination Outcomes**

The candidacy exam has four potential outcomes:

- a) Pass. The student has sufficiently mastered the material and advances to PhD candidacy.
- b) Conditional pass. Additional evidence of mastery of the material is required, the nature of this evidence to be determined by the committee. An example would be a revised dissertation proposal that better represents the nature of the problem to be studied. Once all committee members agree that the additional requirements have been met, the outcome of the examination is changed to a “Pass”. The student is not required to retake the candidacy exam.
- c) Fail with possibility of retaking the examination. The student has not mastered the required material and must retake the examination within 6 months in order to progress to PhD candidacy.
- d) Fail without possibility of retaking the examination. The student has not mastered the required material and the committee determines that the student should not continue in the program.

## **Retaking the Candidacy Examination**

A student who fails the candidacy exam after taking it a second time, or who does not make a second attempt within six months of the first (unsuccessful) attempt, is automatically withdrawn from the program.

A student who has passed the candidacy exam but wishes to change dissertation topics must prepare a new proposal and submit it to his or her committee. A discussion of the new proposal should be scheduled within three months of its submission. If there is no substantial change in the statistical content area, the candidacy exam need not be retaken, and the committee need not be reconstituted. If there is a substantial change in the statistical content area, the full committee determines whether an additional candidacy exam is required. The student, the advisor for the new proposal, and the other members of the committee also decide on any changes in the composition of the committee.

### **7.4.9 Review of “Lab Notebook”**

BGS mandates that the student’s dissertation committee review the student’s “lab notebook” at each of its meetings. The Biostatistics PhD program interprets this to mean that the student should make available for faculty review, upon request, primary documentation of any substantial element of the dissertation. Such a review takes place at the candidacy exam and any subsequent meetings of the committee, and following the closed session of the dissertation defense. Examples of materials subject to review include the statement and formal proof of a key theorem; the code and results of a simulation study; or the data, code and results of a data analysis. Prior to the meeting, the student’s advisor, in consultation with the dissertation committee, designates a short list of such items that the student makes available in electronic or hard-copy format. The committee chair sets aside time at the meeting for the review of this material. In keeping with the BGS policy, there is no expectation that the committee should scrutinize all such documents “in their entirety”; rather, the review should be sufficient to satisfy the committee that the student’s research records are “complete and well managed”.

### **7.4.10 Frequency of Dissertation Committee Meetings**

Once a student has advanced to candidacy, his/her dissertation committee must meet at least once every six months to review goals and progress. A review of the “lab notebook” (see above) must accompany each such meeting. The advisor, working with the chair of the committee, schedules the meetings. The student is responsible for providing any review materials needed by the committee in a timely fashion, typically at least two weeks before a meeting.

### **7.4.11 PhD Dissertation Examination**

This section provides guidelines for the content of the dissertation and the format of the defense. The Biostatistics Program follows the regulations described by BGS. The final steps toward the PhD degree are the preparation of an acceptable dissertation and the dissertation defense. Refer to the Academic Rules on the Provost website:

<https://provost.upenn.edu/policies/pennbook/2013/02/13/academic-rules-for-phds-and-research-master-s-degrees>

#### **Permission to Write and Defend the Dissertation**

The dissertation committee must formally grant permission to write the dissertation. Students must submit the dissertation to the graduate group within six months of receiving permission to write.

If the student will not meet the six-month deadline, s/he must meet with the committee again before the end of the six months. The committee will review the student’s progress and set a new deadline for the submission of the dissertation. Under normal circumstances, no more than one additional month will be granted. If the student does not submit the dissertation or meet with the committee during the six-month period, the graduate group will put the student on academic probation. The graduate group’s academic review committee will determine whether the student should be given permission to defend the dissertation, and under what circumstances, or whether the student should be withdrawn from the program or offered a terminal Masters degree.

After the student submits the dissertation, the committee has up to one month to review it. If the committee determines that the student must revise the dissertation prior to defending it, the student will have one month to make the revisions.

Once the committee approves the dissertation, the student will have one month in which to finalize the defense arrangements. It is expected that the student will make tentative arrangements for the defense before this point.

#### **Students Leaving the Department Prior to Defending the Dissertation**

Refer to [http://www.med.upenn.edu/bgs/dissertation\\_policies.shtml](http://www.med.upenn.edu/bgs/dissertation_policies.shtml)

#### **Dissertation Level Students Changing Mentors**

Refer to [http://www.med.upenn.edu/bgs/dissertation\\_policies.shtml](http://www.med.upenn.edu/bgs/dissertation_policies.shtml)

#### **Scheduling**

The dissertation defense should be scheduled when the candidate and the dissertation advisor agree that the research is near completion and the draft dissertation is in a format

suitable for distribution to the committee. As soon as a date and time are fixed, the graduate program coordinator reserves a room (for at least two hours) and prepares the necessary public announcements. In order to accommodate space and scheduling constraints, the date of the exam should be set at least one month before it will take place. All dissertation committee members must attend the exam in person.

### **Content and Format of the Dissertation**

A typical dissertation consists of five chapters: The first is an introduction and brief literature review; in many cases, this is similar to the dissertation proposal. The next three cover the three main topics of the dissertation; these may be written in a format suitable for submission as individual articles to peer-reviewed journals. The final chapter summarizes the dissertation findings and indicates possible future research directions. There are no upper or lower limits on the length of the document. It is the expectation that at least two of the three middle chapters will be methodological and have been submitted to peer-reviewed journals at least two weeks prior to the dissertation defense. Exceptions to this submitted paper requirement would need prior approval from the dissertation committee and the Chair of the Graduate Program.

### **Content and Format of the Defense**

At least four weeks prior to the exam, the student should provide each committee member with a copy of the full dissertation. The committee members review the dissertation and prepare exam questions based on it. The defense consists of two parts:

- a) Open session. The advisor or chair introduces the student and describes the process to all attendees. The candidate then presents his/her research in the style of a departmental colloquium. Typically, the candidate presents one chapter in depth, with a very brief overview of the others. This presentation should not exceed 45 minutes. At the close of the formal presentation the candidate takes questions from the audience. To leave sufficient time for the closed portion of the exam, the chair has the right to terminate the open session if it goes on beyond one hour.
- b) Closed session. In this part of the exam, attended only by the student and the committee, committee members ask specific questions related to the dissertation. Because the committee members have read the entire dissertation, this is their opportunity to ask questions about any part of it, including chapters not presented in detail in the open session. Once all committee members are satisfied that the questioning is complete, the student is asked to leave the room. The committee then discusses the exam and votes an outcome (see below). The student is then readmitted and informed of the outcome. The committee chair sees that necessary forms are signed and returned to the graduate program office.

### **Dissertation Examination Outcomes**

The dissertation exam has three potential outcomes:

- a) Pass. The student has completed the dissertation requirements for a PhD in biostatistics. The student then works with the graduate program coordinator to ensure that all other requirements are met prior to deadlines for the proposed graduation date.



- b) Conditional pass. The defense was satisfactory but additional requirements must be met. Commonly, the student is asked to address specific questions raised at the defense, or to incorporate edits proposed by committee members. The dissertation advisor typically oversees these changes, but other committee members may also review changes at their discretion. Once the additional requirements are met, the student is considered to have completed the dissertation. The student is not required to defend the dissertation again.
- c) Fail. The student must defend the dissertation again.

## **7.5 Teaching Assistants**

### **7.5.1 Courses That Receive Teaching Assistants**

The program assigns TAs to courses in the biostatistics graduate program, the Masters of Science in Clinical Epidemiology, and programs outside of the department such as the Biomedical Graduate Studies program, the Masters of Public Health, or the Masters of Science in Health Policy. The Program Chair assigns TAs to courses based on course needs and student qualifications.

### **7.5.2 Students Who Serve as Teaching Assistants**

All doctoral students are required to spend the equivalent of six hours per week for one semester serving as a TA (1 course unit). Some students serve as full-time TAs during a single half-semester, full semester, or the entire academic year as part of their financial support. In this case the expected workload is 14 to 20 hours per week during the semester. Other students are assigned to serve as part-time TAs or graders, in addition to their RAship, for a lesser number of hours. Full-time doctoral students may be asked to teach in additional semesters to meet the needs of the department's educational programs. Students who are fully supported on research assistantships or traineeships are eligible to receive supplementary compensation for additional teaching. Teaching must be completed outside of the hours required for a student's research assistantship, and must be approved by the Director of Biomedical Graduate Studies.

### **Benefits and duties of Serving as a Teaching Assistant**

In addition to being a degree requirement for all doctoral students, the teaching experience is an opportunity to work closely with a faculty member in the department, review and deepen understanding of the material being taught, and acquire and sharpen teaching skills.

TA duties typically include some or all of the following:

- Attend regular meetings with the course instructor
- Attend lectures
- Hold office hours
- Assist in or teach lab sessions
- Assist in the preparation of written course materials, exams and solution sets
- Grade assignments or exams and record the grades
- Coordinate access to computing facilities, online data sets, and web applications

Timeliness in the completion of these duties is essential. The course instructor and TA should communicate regularly to discuss duties, to share feedback from the students, and to ensure that the TA's time is being used efficiently. A student who feels s/he is spending on average more than the designated number of hours on teaching activities should speak to the instructor or, if concerns remain, with the Program Chair. Both instructors and TAs should recognize that time pressures can vary greatly over the course of a semester. Open communication is the key to a successful teaching experience.

In cases where TA duties include assisting in the grading of exams, course instructors should provide the TA with clear guidance on how to assign points. Instructors should also recognize that some students may feel awkward evaluating their peers.

TAs should share their e-mail addresses and mailbox locations with their students. TAs are not on call for their students; nevertheless, students should expect reasonable access to TAs, particularly in the days leading up to exams and project due dates.

TAs are encouraged to speak with the instructor, their academic advisor and the Program Chair about their teaching experiences, particularly if difficulties arise. A potential conflict can often be avoided if its warning signs are recognized early and the situation is handled thoughtfully.

## **7.6 Other Policies**

### **7.6.1 Student Travel**

BGS allows doctoral students to apply for partial reimbursement (currently, up to \$500/year) for travel to professional meetings if they are making a presentation. Applicants must justify the expenses prior to attending the meetings. Dissertation advisors sometimes are able to augment these travel funds. In addition, some training grants provide funds for student travel.

### **7.6.2 International Students Travelling Abroad**

Students are entitled to two weeks of vacation per year. Unfortunately it is sometimes difficult for international students leaving the US to re-enter in a timely fashion, often due to visa issues. While the program understands that these issues are largely out of the control of our international students, it also puts a strain on financial sponsors when students are unavailable to carry out the obligations of their research assistantships in person. International students who leave the country for vacation must make a plan with their sponsor in advance to address the possibility of delayed re-entry. The written plan must be approved by both the research sponsor and the Program Chair. Sponsors are not required to allow students to work remotely and, in particular, are not expected to fund students to work remotely for indefinite periods of time. International students should expect that funding will be suspended if suitable arrangements are not made and/or if students are absent for more than two weeks.

### **7.6.3 Registration in Biostatistics Courses**

Any student who does not have dissertation status and who wishes to take a course in Biostatistics must formally register for the course. The University reserves the term

“auditor” for a student who registers for a course without the intention of receiving a grade and academic credit. BGS PhD students are not allowed to audit a course. MS students may request a waiver of this policy from the Chair of the GGEB.

A student with dissertation status (i.e., who is paying dissertation fees and therefore does not pay for course units) may sit in on a course without registering for it. Students who intend to participate in a course in this way must agree to participate in the course in a manner defined by the instructor, and must obtain the instructor’s prior approval.

## 7.7 Committees

Six committees provide governance and administrative leadership to the Biostatistics graduate programs. Membership is subject to change annually.

The *Admissions Committee* is responsible for the application and admission process. Responsibilities include developing admission policies; identifying qualified students; reviewing applications; selecting students interviews; ranking students for admission; and reviewing applications from students in other BGS programs who seek to transfer into Biostatistics. Admission decisions are subject to approval by the GGEB Executive Committee (a committee of the whole) and the BGS Admission Committee. The chair of the Admission Committee, together with a designated representative from the Epidemiology PhD program, represents the GGEB in the BGS Admission Committee.

The *Curriculum Committee* is responsible for all rules and policies related to courses, MS theses and doctoral dissertations. Responsibilities include developing policies related to course content; reviewing requirements for MS theses and PhD dissertations; approving proposals for the creation of new courses; and reviewing student course evaluations.

The *Academic Advising Committee* was created to facilitate the assignment of academic advisors, lab rotation mentors and to insure that each student is meeting program requirements in a timely fashion. This committee works closely with the curriculum committee to insure that all faculty mentors are up-to-date on curriculum and requirement

The *Qualifying Examination Committee* conducts the Program’s written qualifications exam. Responsibilities include developing guidelines, policies and procedures for the exam; soliciting questions for the exam; reviewing and selecting questions; creating the exam itself; managing its grading; presenting results to the faculty; and evaluating the merits of appeals of exam results. Decisions on the outcome of the exam are made by the Biostatistics faculty assembled as a committee of the whole.

The *Student Recruitment Committee* conducts outreach to establish and maintain a pipeline of talented undergraduate students to apply to the GGEB MS and PhD programs in biostatistics. Activities include informational presentations to undergraduate departments of mathematics and statistics in Greater Philadelphia and additional targeted areas, attendance and recruitment at national undergraduate research conferences, creation and national circulation of program announcements, and communication with prospective applicants. The

Student Recruitment Committee also aims to increase awareness and enrollment in Penn's summer undergraduate research opportunities in biostatistics.

The *Student Awards Committee* explores opportunities and supports applications for student awards. The Committee chooses the award winner for the Saul Winegrad Award for Best Dissertation. In addition, along with students in the program, the Committee nominates an outstanding faculty member for the Jane M. Glick Graduate Student Teaching Award.

## **8 PhD in Epidemiology Program**

### **8.1 Overview**

The mission of the PhD Program in Epidemiology is to train independent researchers in the development and application of epidemiologic methods and to prepare them for positions as scientific leaders in academia and industry. The PhD is a research degree; it indicates the highest attainable level of scholarship, and a commitment to a research career. The PhD does not represent merely the accumulation of course credits, but rather, the development and completion of a well-designed and conscientious program of scientific investigation that makes a unique contribution to the field of epidemiology.

The PhD Program in Epidemiology requires basic and advanced courses in epidemiology, statistical methods, as well as electives drawn from other departments and schools that serve the student's research interests. The program also requires written qualifications and oral candidacy examinations, and the successful defense of a doctoral dissertation, in accordance with University of Pennsylvania policy.

The PhD program typically requires the equivalent of at least four years of full-time study, in three defined phases: *coursework*, *pre-candidacy*, and *candidacy*. The coursework phase typically takes two years of full time study, and is intended to provide the student with the knowledge needed to pursue advanced, independent study and investigation in epidemiologic research. This phase culminates in the written Qualifications Examination, normally taken after most or all of the student's coursework has been completed. The pre-candidacy phase focuses on the preparation of a scientifically unique, methodologically sound, and feasible dissertation proposal. This phase ends with passing the oral Candidacy Examination, at which time the student is recognized as a Candidate for the PhD and focuses his or her effort on performing the research for and writing the dissertation. A successful public defense of the dissertation then completes the academic requirements for the PhD.

### **8.2 Academic advisor**

At the time of admission, each incoming student will be assigned an academic advisor who serves as the initial student's primary mentor, advising in course selection and related academic matters. A student may change advisors by request to the Program Chair. A PhD student's dissertation advisor, once selected, normally assumes the role of academic advisor during the later years of study. At the beginning of the academic year, each student, in collaboration with his/her advisor, prepares a proposed academic program including courses to be taken, courses to be transferred, and timelines for examinations and dissertation preparation.

### 8.2.1 Policy on advisors

Mentors for students pursuing a PhD in epidemiology will be expected to have extensive training and experience in epidemiologic research. Generally, they will have a PhD (or equivalent) in epidemiology or related field, *OR* an MD *and* Master's degree in epidemiology or related field, and experience as an independent investigator, as demonstrated through receipt of funding as principal investigator *and* significant contributions to the epidemiologic literature. Previous experience as a mentor to at least one student in epidemiology at the Master's level or beyond, including advising through all phases from protocol development to submission of thesis or dissertation, is desirable. Faculty members who do not fulfill all of the criteria may be approved in individual cases by the Graduate Group Chair, in consultation with the Graduate Group Executive Committee. Advisors should expect to dedicate considerable time and effort to one-on-one student supervision.

Mentors not holding the PhD are strongly urged to work closely with the Program Chair and other PhD faculty throughout the student's program in order to ensure sensitivity to the special and intensive demands of mentoring PhD students.

## 8.3 Course requirements

The PhD in Epidemiology typically requires the equivalent of four to six semesters of coursework plus additional semesters devoted to dissertation research. This can be accomplished in the equivalent of four to five years of full-time study, although depending on the student's research program, as many as six or even seven years may be needed to complete the program. The current standard course sequence for PhD students consists of up to 9 core courses (see below). 10.5 additional course units are taken in electives (advanced epidemiology and/or biostatistics courses and courses outside the department and school, as needed to serve the student's specific interests). In addition, a minimum three semesters of lab rotations (EPID 699) and one unit of dissertation research (EPID 995) are required. *However, the PhD curriculum is currently under review and these requirements may change; these changes will be reflected in a subsequent version of the Handbook, pending approval by the Graduate Group and Biomedical Graduate Studies. Students are subject to the course requirements in place at the time of admission.*

Course descriptions are provided at <http://www.cceb.med.upenn.edu/course-descriptions>

The core courses required for all PhD students are:

- Introduction to Epidemiologic Research (EPID 701), 1.0cu
- Advanced Topics in Epidemiology (EPID 640), 1.0cu
- EPID 600: Data Science for Biomedical Informatics 1.0cu
- Measurement of Health in Epidemiology (EPID 542), 1.0cu
- Doctoral Seminar (EPID 700), 1.0cu for each semester (a minimum of 2 semesters)
- Biostatistics for Epidemiologic Methods I (EPID 526), 1.0cu
- Biostatistics for Epidemiologic Methods II (EPID 527), 1.0cu
- Ethics course 1.0cu (or MSCE workshops)

### 8.3.1 Electives

PhD students are required to take additional elective courses, totaling at least 10.5 course units. At least two of these courses must be advanced courses in statistical applications, such

as (but not limited to) EPID 621: Longitudinal and Clustered Data, EPID 622: Applied Regression Models for Categorical Data, EPID 623: Survival Data Analysis, and EPID 680: Causal Inference in Epidemiology. Students meeting additional prerequisites in biostatistics may satisfy this requirement through advanced courses in statistical methods, such as (but not limited to) BSTA 754: Advanced Survival Analysis, BSTA 656: Longitudinal Data Analysis, and BSTA 790: Causal Inference in Biomedical Research.

Elective courses include advanced courses in epidemiology and biostatistics, as well as advanced courses in related disciplines, such as biostatistics, statistics, demographics, sociology, anthropology, economics, and psychology. Students may also arrange to take independent study courses taught by members of the Graduate Group faculty or courses taught elsewhere in the University. However, it is important to select independent study courses carefully, since it is assumed that students will have completed the core at the time of the Qualifications Examination. The student and faculty member will design the activity and the form of the evaluation for the independent study course. Any such proposed independent study course must be approved in advance by the PhD Program Chair. Finally, all electives will be chosen in consultation with the trainee's faculty advisor.

### **8.3.2 Research rotations**

In order to provide doctoral students with as much exposure as possible to a broad range of research activities and opportunities during their first year of study, they are required to engage in project rotations with GGEB faculty. This will assist the students in identifying their research interests and thesis topic earlier in their educational process. In addition, students will normally identify their PhD mentor through working with them on a lab rotation, during which both the students and faculty can assess whether they are a good match for possible dissertation advisor/advisee relationships. This document describes the procedures for engaging in these rotations.

- Each student is required to complete three rotations during the first year in the doctoral program: fall, spring, and summer.
- Each rotation will last 12 weeks. Students can expect to spend approximately 20+ hours per week during the fall/spring semesters and full time 40+ hours during the summer.
- Each August, the epidemiology faculty in the GGEB will be provided with a short description of each new student's interests and background by the Graduate Group Coordinator, and will be asked to confirm their willingness to serve as a rotation preceptor.
- Students will be informed by the Graduate Group Coordinator of the names and contacts of the faculty members who agreed to serve as rotation preceptors. The students will then contact the faculty members whose research matches their interests to discuss the details of a potential rotation. Once an agreement is reached between the student and the faculty member, they will submit a short proposal describing the content and goals of the rotation for approval by the Academic Review Committee.
- Laboratory rotations should focus on epidemiological research as opposed to simple data analysis or service/project work. Ideas include implementation of a method from the literature, literature review of methods, or the analysis of a complex dataset. It is recognized that, depending upon the background of the students matriculating into the program, the first lab rotation may need to be a lighter introduction to the

methodological area such as focusing on literature review, study design, logistics, and data management and/or data analysis.

- Laboratory rotations are taken for credit (0.33 unit per rotation, 1 unit total) and students receive both a written evaluation and a letter grade.
- At the end of each rotation, the supervising faculty member will provide a brief summary of the student's involvement in the project, including any scholarly output such as abstracts and manuscripts. In addition, the faculty member will indicate his or her desire to mentor the student, **as well as willingness to take on the financial responsibilities associated with mentoring.**

#### **8.4 Doctoral seminar**

All PhD students are required to participate in the Doctoral Seminar (EPID 700). Advanced students will be expected to present their work and take a leadership role in organizing each session. Students who are in the early stage (coursework phase) of their program will be expected to participate and present selected literature for discussion. The goal of the Doctoral Seminar is to expose all students to a wide variety of epidemiologic research. The seminar meets weekly.

#### **8.5 Course plans**

All students are expected to develop and maintain a current course plan with their advisor. This course plan must be approved by the advisor and the Program Chair and filed with the department's Office of Graduate Programs. The course plan will be reviewed annually in order to monitor the student's progress and identify potential delays in completing the program. Typical course plans are shown below.

**Sample course plan for an entering PhD students starting Fall 2017**

<b>Year</b>	<b>Term</b>	<b>Course</b>	<b>c.u.</b>
<b>Year 1</b>	<b>Fall</b>	EPID 701: Introduction to Epidemiologic Research	1.0
		EPID 542: Measurements of Health	1.0
		EPID 526: Biostatistics for Epidemiologic Methods I	1.0
		EPID 527: Biostatistics for Epidemiologic Methods II	1.0
		EPID 600: Data Science for Biomedical Informatics (if placed out of 526/527)	1.0
		EPID 699: Lab Rotation	0.33
	<b>Spring</b>	EPID 640: Advanced Topics in Epidemiology	1.0
		EPID/Other: Epidemiology or other elective	1.0
		EPID 700: Doctoral seminar	1.0
		EPID 699: Lab Rotation	0.33
	<b>Summer</b>	EPID 699: Lab Rotation	0.33
<b>Year 2</b>	<b>Fall</b>	EPID/Other: Epidemiology or other elective	1.0-3.0
		Ethics course or MSCE Workshops	0-1.0
		EPID 699: Lab Rotation or EPID 899: Pre-Dissertation Lab Rotation (for those who have selected a dissertation mentor)	0.33-3.0
		EPID 600: Data Science for Biomedical Informatics (if not taken in year 1)	1.0
	<b>Spring</b>	EPID/Other: Epidemiology or other elective	1.0-3.0
		EPID 700: Doctoral seminar	1.0
		EPID 699: Lab Rotation or EPID 899: Pre-Dissertation Lab Rotation (for those who have selected a dissertation mentor)	0.33-3.0
<b>Summer</b>	<b>Qualifications Examinations</b>		
<b>Year 3</b>	<b>Fall</b>	EPID/Other: Epidemiology or other elective	1.0-3.0
		EPID 899: Pre Dissertation Lab Rotation	0.33-3.0
	<b>Spring</b>	EPID/Other: Epidemiology or other elective	1.0-3.0
		EPID 899: Pre-Dissertation Lab Rotation	0.33-3.0
	<b>Summer</b>	<b>Candidacy Examination</b>	
	<b>Year 4</b>		EPID 995: Dissertation Research
		<b>Dissertation Defense</b>	



Sample course plan for an entering MD-PhD student			
		MEDICAL SCHOOL	GRADUATE SCHOOL
Year 1	Fall	Pre-clinical MD curriculum	Indep study (or course if avail)
	Spring	Pre-clinical MD curriculum	Indep study (or course if avail)
	Summer		~8 weeks for ft research
Year 2	Fall	Pre-clinical MD curriculum	Case Studies in Translational Research or indep study (or epid course if avail)
	Spring	Clinical Clerkships	
	Summer	Clinical Clerkships and Step 1	Typically begin research mid-Aug, slightly before grad semester starts
Year 3	Fall		4-5 Epidemiology course units Epi lab rotation, Epidemiology seminar; work on selecting advisor
	Spring		4-5 Epidemiology course units; work Epi lab rotation, Epidemiology seminar
	Summer		2-3 Epidemiology course units
Year 4	Fall	Clinical Connections	2-3 Epidemiology course units
			Submit F30
	Spring		2-3 Epidemiology course units Qualifications examination
	Summer		Oral candidacy examination
Year 5	Fall	Clinical Connections	Dissertation research
	Spring		Dissertation research
	Summer		Dissertation research
Year 6	Fall	Clinical Connections	Dissertation research
	Spring		Dissertation research
	Summer		Dissertation defense
Year 7	Fall	Clinical courses (after defending)	
	Spring	Clinical courses	
	Summer	Clinical courses	
Year 8	Fall	Clinical courses; boards 2	
		Clinical courses; Dean's letter OCT 1	
		Residency interviews (~Nov-Jan)	
	Spring	Clinical courses and/or research	
		GRADUATION	

## 8.6 PhD Examinations

In addition to course-specific examinations, there are three PhD examinations required in order to ensure rigorous, appropriate evaluations during the phases of a student's program. These examinations are described below.

### 1. Written Qualifications Examination

- a. The Qualifications Examination will be taken after the equivalent of two years of course work.
- b. The Qualifications Examination will be open-book and consist of two parts, administered over a one-week period:
  - i. General epidemiology
    1. A series of questions and problems to assess competency in basic and advanced epidemiologic concepts, critical appraisal, and measurement
  - ii. Research methods
    1. A series of questions and problems to assess competency in biostatistical and quantitative and qualitative epidemiologic methods.
- c. Questions for the qualifications examination will be written and graded by the PhD Program Examination Committee.
- d. Students must pass all both parts of the Qualifications Examination in order to advance to the next phase of the PhD program. Those who fail one or more parts of the examination may re-take those parts once, but a passing grade on both parts must be attained before the end of the second year of study.
- e. Transfers from the MSCE program must take the PhD Qualifications Examination, even if the MSCE comprehensive examination was taken previously.
- f. Grandfathering: MSCE students who have transferred to the PhD program before January 1, 2009 are exempt from this policy. These students will have taken the MSCE comprehensive examination as their qualifications exam, and will be required to take another written examination, comparable in difficulty to the PhD qualifications exam and in addition to the oral exam, prior to being admitted to candidacy status, as has been done historically in the PhD program.
- g. Review of the examination
  - i. A student may request to review his exam paper in company with the Examination Committee Chair. The purpose of such a review is to help the student evaluate the types of mistakes made, identify areas where further study is needed, etc. The Examination Committee retains the graded exam papers and does not return them to the students.
- h. Appeal process
  - i. A student may appeal the outcome of the Qualifications Examination to the Examination Committee Chair, who together with the full committee will evaluate the appeal and judge whether it has merit. A grade can only be changed in cases of a specific error in scoring. The Examination Committee refers any grade change that could affect the student's exam outcome to the full GGEB Executive Committee, who decides whether to revise the exam outcome.
  - ii. Because a minor revision of the score is unlikely to change the exam outcome, a student should only initiate a formal appeal if there were one or more egregious errors in the problem or in its grading, the correction of which would likely lead to a substantial increase in the score. A student who seeks a formal review must request it, in writing, from the Examination Committee Chair within one week of the issuance of the letter notifying the student of the exam result.

## **2. Candidacy Examination**

- a. The Candidacy Examination must be passed within 18 months of the Qualifications Examination.
- b. The Candidacy Examination is administered by the Dissertation Committee (see Section 8.8.2).
- c. The focus of the Candidacy Examination is on the student's proposed dissertation research, but other material may be included as desired by the student's committee.
- d. The Candidacy Examination will consist of two parts:
  - i. **Written:** dissertation proposal, submitted to the student's committee at least one month prior to oral proposal defense, and approved by the committee prior to the oral proposal defense
  - ii. **Oral:** Oral defense of proposal (non-public) before the committee with the inclusion of additional pertinent material at the discretion of committee
- e. Students must pass both parts of the Candidacy Examination in order to advance to the final phase of the PhD program. Those who fail the Candidacy Examination may re-take it once, at the discretion of the committee.

### 3. Dissertation Defense

- a. The final oral examination is the Dissertation Defense. The defense must be announced by public advertisement at least four weeks in advance using such venues as the GGEB website, posted announcements in Penn Medicine spaces (as allowed), and electronic mail.
- b. The defense should be scheduled when the candidate and the dissertation advisor agree that the research is near completion and the draft dissertation is in a format suitable for distribution to the committee. As soon as a date and time are fixed, the graduate program staff reserves a room (for at least two hours) and prepares the necessary public announcements.
- c. *All dissertation committee members should be present for the final defense. In emergencies, one member may participate in the defense by telephone. That member cannot be the committee chair or the student's advisor. If one or more committee members are absent (i.e., not present or not participating by telephone) from the final defense, it cannot proceed and must be rescheduled.*
- d. Format of the defense
  - i. At least two weeks prior to the exam, the student should provide each committee member with a copy of the full dissertation. The committee members review the dissertation and prepare exam questions based on it. The defense consists of two parts:
    1. Open session. The chair describes the process to all attendees and introduces the candidate. The candidate then presents his/her research in the style of a departmental colloquium. Typically, the candidate presents one chapter in depth, with a very brief overview of the others. *This presentation should not exceed 45 minutes.* At the close of the formal presentation the candidate takes questions from the audience. The chair has the right to terminate the open session if it goes beyond one hour.
    2. Closed session. In this part of the examination, attended only by the student and members of the committee, the student is asked specific questions pertaining to the dissertation. Because the committee members have read the entire dissertation, this is their opportunity to ask any questions about any part of it, including

material not presented in the open session. Once the committee members are satisfied that the questioning is complete, the student is asked to leave the room and the committee deliberates in closed session. During this time, the committee reviews the student's work, draws up a list of recommendations, and votes an outcome. The student is then readmitted to the room, informed of the outcome, and is provided with any recommendations. The committee chair sees that necessary forms are signed and returned to the graduate program office.

- ii. The defense will be coordinated by the dissertation committee chair. This individual will be responsible for maintaining order and the sequence and timely completion of the examination.
- e. The dissertation exam has three potential outcomes:
  - i. **Pass.** The student has completed the dissertation requirements for a PhD in epidemiology. The student then works with the graduate program staff to ensure that all other requirements are met prior to deadlines for the proposed graduation date.
  - ii. **Conditional pass.** The defense was satisfactory but additional requirements, usually minor, must be satisfied. Commonly, the student is asked to address specific questions raised at the defense, or to incorporate edits proposed by committee members. The dissertation advisor typically oversees these changes, but other committee members may also review changes at their discretion. Once the additional requirements are met, the student is considered to have completed the dissertation. The student is not required to defend the dissertation again.
  - iii. **Fail.** The student must defend the dissertation again; only one additional attempt at the final defense is allowed.
- f. Dissertation acceptances must be unanimous, in writing, and signed by all members of the dissertation committee. Approved dissertations must be submitted to the Graduate Council of the Faculties in a format that meets the style standards established by the Vice Provost for Graduate Education.

## 8.7 Preparing the dissertation

### 8.7.1 Dissertation advisor

PhD in Epidemiology students must carry out their dissertation research under the mentorship of a faculty member of the GGEB. The dissertation advisor is the most important individual the student will interact with in the course of their graduate training. For this reason, students should carefully evaluate their interests and experiences in choosing the advisor. The student's dissertation advisor may not be the Dissertation Committee chair, but may be (and is usually) the student's academic advisor.

### 8.7.2 Dissertation Committee

Each student will organize a Dissertation Committee according to the following constituency. The committee will consist of a minimum of three members, not counting the advisor(s), of whom two must be faculty members of the GGEB, and one must be an external (non GGEB) member. A GGEB faculty member will be appointed as the Chair of the committee by the student's advisor. The role of the Chair is to run committee meetings and to oversee the candidacy examination and final defense. For students in the Epidemiology Ph.D. program, at

least one member of the Dissertation Committee must be a member of the faculty in the Division of Epidemiology and ordinarily at least one other should be a member of the faculty in the Division of Biostatistics or Division of Informatics. Committee members will be collectively responsible for administering and evaluating the oral Candidacy Examination, reading the dissertation, and evaluating the final defense. Additional content experts from within or outside the GGEB may be added to the committee as needed. The initial constituency and any changes in the membership must be approved by the Program Chair and the Graduate Group Chair. This Committee will be in place at all times during the dissertation phase. If for some reason, a student changes to a different area of research, a new Dissertation Committee must be appointed immediately and must meet within three months to discuss new plans for the dissertation research.

### **8.7.3 Additional biostatistics support**

The biostatistics faculty member(s) on the Dissertation Committee will provide advice and collaborate on the scientific design and statistical analyses required for the dissertation research, but it is the student's responsibility to perform such analyses. If appropriate, it may be possible to substitute the GGEB biostatistics faculty member with biostatistics faculty from another department at Penn or from outside the University, upon approval by the Program Chair and the GGEB Chair. If a student's dissertation research area requires additional statistical expertise, appropriate biostatistics faculty should formally be added to the Dissertation Committee.

### **8.7.4 Computing, programming, and database support**

The student is responsible for writing all parts of the dissertation, including any methodological sections, and for conducting or directing all analyses; this ordinarily includes obtaining, preparing, and maintaining data needed for the research. Depending on the student's research program, additional (non-faculty) assistance with computing, programming, and database development may be requested by the student. However, to ensure that the student gains the maximum possible experience with these critically important skills, this request must be approved by the dissertation advisor and the Program Chair. Upon approval, the student should make arrangements with the Biostatistics Analysis Center (BAC), the Clinical Research Computing Unit (CRCU), or other computing group or consultant as needed. The student and dissertation advisor are responsible for obtaining the necessary funding to defray non-faculty support costs.

### **8.7.5 Frequency of dissertation committee meetings**

Once a student has advanced to candidacy, his/her Dissertation Committee will review goals and progress twice each year. The committee chair should complete the Dissertation Committee Meeting Report form and submit this to the Program Chair within 15 days of each committee meeting.

### **8.7.6 Laboratory notebook**

BGS mandates that the student's Dissertation Committee, at each of its meetings, review the student's "lab notebook". The PhD Program in Epidemiology interprets this to mean that the student should make available for faculty review, upon request, primary documentation of any substantial element of the dissertation. Such a review takes place at the Candidacy Exam and any subsequent meetings of the committee prior to, but not including, the dissertation defense. Examples of materials subject to review include the statement and investigation of a research question; the code and results of a simulation study; or the data, code and results of a data

analysis. Prior to the meeting, the student's advisor, in consultation with the Dissertation Committee, designates a short list of such items that the student makes available in electronic or hard-copy format. The committee chair sets aside time at the meeting for the review of this material. In keeping with the BGS policy, there is no expectation that the committee should scrutinize all such documents "in their entirety"; rather, the review should be sufficient to satisfy the committee that the student's research records are "complete and well managed".

### **8.7.7 Content and format of the dissertation**

The dissertation must be a scholarly work, providing a written account of an independent investigation of an epidemiologic question or series of related epidemiologic questions. It will be in the form of a monograph, containing one or more research questions about the epidemiology of a particular health topic or disease. Within this monograph, there will be at least three separate manuscripts of publishable quality, one of which must offer a novel methodologic approach to a question in epidemiologic research. It will include the formulation of one or more hypotheses, a review of the appropriate literature, a description of the project, data collection, data analysis, data interpretation, discussion of the findings, and limitations of the work. If the dissertation involves the investigation of more than one question, each question must focus on an epidemiologic or methodologic issue related to the health topic or disease under investigation. The dissertation project should demonstrate that the candidate has a command of the subject and a thorough knowledge of the research methodology used to investigate the question(s).

## **8.8 Non-credit requirements**

### **8.8.1 Teaching practicum**

Students in the PhD program must spend one semester providing teaching support as a Teaching Assistant (TA) for an Epidemiology or Biostatistics course. In addition to being a degree requirement for all doctoral students, the teaching experience is an opportunity to work closely with a faculty member, to review and deepen understanding of the material being taught, and to acquire and sharpen teaching skills. TAs are usually assigned to core courses in the Master of Science in Clinical Epidemiology program, but students may find teaching in one of the elective courses, or other epidemiology-related courses in other departments to be of interest as well. The Program Chair assigns TAs to courses based on course needs and student qualifications, in consultation with the course director, the student, and his/her advisor. Upon assignment, students must prepare a teaching assistance plan in writing, signed off by the course director and approved by the chair, for TA activities related to the course. This plan must be completed at least four weeks prior to the start of the course.

TA duties typically include some or all of the following:

- Attending lectures
- Holding office hours
- Running lab sessions
- Assisting in the preparation of handouts, exams and solution sets
- Grading homework and recording the grades
- Helping to grade exams and recording the grades
- Coordinating access to computing facilities, online data sets, and web applications
- Attending regular meetings with the course instructor(s).

*Please note that merely serving as a grader in a course does not fulfill the TA requirement for the doctoral program. The student must make a substantive contribution to the course.*

Timeliness in the completion of these duties is essential. The course instructor(s) and TA should communicate regularly to discuss duties, to share feedback from the students, and to ensure that the TA's time is being used efficiently.

Both instructors and TAs should recognize that time pressures can vary greatly over the course of a semester. For instance, TA duties usually are light at the start of the course, heavy in the middle, and then light again toward the end (unless assistance is required grading exams).

Experience shows that grading homework and preparing and directing lab or discussion sessions are the two items that occupy most of a TA's time, especially for first-time TAs. TAs should not hesitate to request specific direction on what to present in lab or discussion sessions. Although the success of a course is ultimately the instructor's responsibility, students should recognize that instructors cannot be expected to solve problems that they don't know exist. Open communication is the key to a successful teaching experience. In cases where TA duties include assisting in the grading of exams, course instructors should provide the TA with clear guidance on how to assign points. Instructors should also recognize that some students may feel awkward evaluating their peers.

The course director may provide the opportunity for the TA to prepare and deliver at least one lecture. In this case, the course director should allow the TA sufficient time to prepare the lecture and should offer any necessary guidance about what is to be covered. Whenever possible, the TA's lecture will be videotaped and reviewed with the course director and his/her mentor in order to identify strengths and weaknesses.

To ease communication, TAs should share their e-mail addresses and mailbox locations with their students. TAs are not on call for their students; nevertheless, students should expect reasonable access to TAs, particularly in the days leading up to exams and project due dates.

### **8.8.2 Weekly seminar**

A fundamental component of the PhD program is attendance at the weekly Center for Clinical Epidemiology & Biostatistics Seminar, at which faculty and researchers within and outside of Penn present their work or discuss timely issues in epidemiology. All PhD students are required to attend this seminar series weekly, unless excused due to scheduling conflicts, illness, or other reason. Excuses should be made with the Academic Coordinator, either before or as soon as possible after a missed seminar. Advanced PhD students are also welcome to present at this seminar. However, slots fill up early in the academic year, so it is best to discuss any plans to present with the advisor and the Chair of the Seminar Committee. Students are also encouraged to suggest experts from the field as potential seminar speakers to the Seminar Committee.

## **8.9 General program policies**

### **8.9.1 Transfer of Credit**

Only courses considered at the graduate level may be transferred from previous training. A maximum of eight units may be transferred from graduate work. Courses proposed for transfer of credit must be relevant to training in epidemiology and may include courses in theory, methods, or related to the student's specific research interests. Transfer of credit must be approved by the Program Chair and the GGEB Chair.

### **8.9.2 Auditing**

Auditing a required course is routinely allowed for students who are transferring credit for that course. In all other cases, auditing of a course is strongly discouraged. If a student wishes to audit a course he/she must consult their academic or dissertation advisor, the course director, and prepare a written request to the Program Chair explaining reasons for the proposed course audit.

### **8.9.3 Exemptions and modifications**

Trainees may place out of the following courses if they previously attended equivalent courses: EPID 526: Biostatistics for Epidemiologic Methods I, and EPID 527: Biostatistics for Epidemiologic Methods II. The student should justify the request to place out of a course, and the request should be accompanied by reprints, abstracts from meetings, course syllabus, or other appropriate material. Such requests are made in writing as a letter to the Academic Review Committee and **should be made before the end of the first semester in the program.**

### **8.9.4 Terminal master's degree**

The PhD Program in Epidemiology does not admit students for study towards a Master's degree.

### **8.9.5 Student memberships**

All PhD students in Epidemiology are encouraged to join one or more professional societies, but especially the American College of Epidemiology as an Associate or the Society for Epidemiologic Research as a Student Member.

## **8.10 Facilities**

### **8.10.1 Program web-resource**

The PhD Program will use Canvas to provide student-related forms, resources and web links. These pages can be accessed by logging in to <https://canvas.upenn.edu/>

### **8.10.2 Student Space**

The PhD program has space for students on the first floor of Blockley Hall with carrels and lockers. There is also wireless connectivity throughout the first floor of Blockley Hall. Administration of the carrels and locker assignments is managed by the Graduate Group Coordinator (627 Blockley Hall).