

Graduate Group in Epidemiology and Biostatistics
EPID 701.001
Introduction to Epidemiologic Research (EPID 701)
John H. Holmes
Fall 2021

Overview

This course is intended to provide in-depth, exposure to the theory and methods of epidemiologic research. Topics to be covered include causal inference, measures of disease frequency and association, study design, bias and confounding, validity, and epidemiologic analysis. The course is designed for students entering the PhD program in Epidemiology. However, students from other graduate groups are welcome, as long as they meet the pre-requisites; such students are welcome during any year of study.

Learning outcomes

After completing this course, students will be able to:

- Describe the science of epidemiology
- Demonstrate ability to develop a variety of observational and analytic study designs
- Discuss in detail the quantitative foundations of epidemiologic theory and methods
- Describe current approaches to epidemiologic research
- Identify sources of bias and ways to address them
- Critically assess epidemiologic literature
- Formulate study designs to address specific problems in population health

Participating faculty

Course directors:

Ricardo Castillo-Neyra, PhD, DVM, MSPH (cricardo@penntestmed.upenn.edu)

Kelly Getz, PhD (Kelly.Getz@penntestmed.upenn.edu)

Course units

This is a 1.0cu course.

Course structure

The course is designed around four modules, each focusing on a major area of epidemiologic research principles. Each module consists of a series of four lectures and class sessions which are dedicated to a specific topic or method:

- Basic concepts
- Study design and conduct
- Epidemiologic data analysis
- A special topic to be selected
- Final project presentation, specific to each student's interest area

Class structure

Each class will generally follow the same schedule.

- Prior to class: Lecture Online (~60-90 minutes)
 - The lecture will be posted as a narrated Powerpoint presentation on Canvas in the Files section, along with the readings for the week. The lecture for the next week's class will

be posted by 9am each Tuesday morning, and will be available for the duration of the semester.

- In-class (90-120 minutes)
 - Discussion of lecture
 - We will discuss any questions you have about the lecture, and I will ask a few questions of you to stimulate discussion.
 - Journal Club
 - We will discuss each paper that is up for review for the week's journal club. I will call upon one of you to review the paper, offering a brief summary as well as a critical appraisal of its strengths and weaknesses. If more than one student chooses to review a single paper, I will ask you to trade off on the summary and appraisal during the discussion
 - Discussion of problem set for the week
 - Introduction of next week's material

Course materials and resources

- Texts
 - Rothman, Lash, and Greenland: *Modern Epidemiology*, Fourth Edition.
 - Weiss and Koepsell: *Epidemiologic Methods: Studying the Occurrence of Disease*, Second Edition.
- Selected readings from the epidemiologic literature for journal club and reading journals are provided in the Files folder on Canvas, in the subfolder for each week.
- Problem set assignments are located in the Files|Problem Sets folder on Canvas, along with a helpful tips and tricks document for attacking the sets.
- Sample concept papers for specific study designs are located in Files|Sample Concept Papers on Canvas.
- This syllabus is located in Files|Syllabus, along with a grading rubric for the reading journal.

Pre-requisites

Students are expected to have quantitative proficiency. It is expected that all students will have some knowledge and/or experience in working in biomedical research or a clinical domain.

Evaluation of student performance

The grade for the course will be based on the following:

- *Reading journal (20%)*. The journal will consist of a brief (one 1-2 page) "reaction paper," that will demonstrate your understanding of the article's content and its place in the epidemiologic literature. We will be reviewing your journal in class at that time as well. The reading journal is not an abstract; rather, it should represent your own synthesis of the issues that the article addresses or attempts to address. The format of the journal is as follows; please follow this format, using the section headings provided here:
 - *Citation*. Bibliographic citation of the paper you are reacting to
 - *Summary*. Provide a brief summary of the paper, in your own words. (4-5 sentences)
 - *Critical review*. Identify the key positive and negative points raised in the paper. (1-3 paragraphs)
 - *Opinion*. Provide your opinion of the value of the work to data scientists. (1 paragraph)
 - *Personal reflection*. Discuss the value of the work to you, answering the questions such as whether the paper was worth reading, whether or not you could see using the work described in the paper in the future, and if you would recommend the paper to others. (1 paragraph)

Note: Reading journals are due in Canvas (Assignments folder) not later than 12noon Friday before the next class!

- *Problem sets (60%)*
 1. Causation
 2. Confounding and Descriptive Study Designs
 3. Cohort Studies
 4. Case-control Studies
 5. Intervention Studies
 6. Bias, confounding, and instrumental variables

Note: Problem set assignments are due in Canvas (Assignments folder) not later than 12noon Friday before the next class!

- *Final project (20%)*
 - Each student will deliver a 15-minute presentation including:
 - Description of the problem domain
 - Background/prior work
 - Formulation of a research question
 - Specific aims for a project to address the research question
 - Outline of methods to address the research question
 - Study design
 - Target population
 - Data source(s)
 - Sampling methods (if needed)
 - Analysis plan
 - 5 minutes will be allowed for questions
 - Students will submit a written report on their project, using the above outline as structure
 - Group projects are allowed and encouraged, but the work must reflect the effort of all students in the group. Extra time will be allotted for the presentation, proportional to the number of students in a group.

Note: The completed final project is due 11:59pm, December 22.

Class Schedule

Module	Week	Lecture, Lab, and Guided Literature Review	Instructor	Module Coordinator
EPID 701: Fall Semester Co-Directors: Getz and Castillo-Neyra				
Module 1: Measuring Public Health	1	Course Overview/Historical Development/Basic principles of epidemiology	Holmes	Naj
	2	Measures of morbidity and mortality/Incidence vs. Prevalence/Calculating Person-Time	Naj	
	3	Direct Standardization/Absolute and Relative Effect Measures/Sources of Public Health Data	Getz	
	4	Linear and Logistic regression modeling	Naj	
Module 2: Basic Epidemiologic Study Designs	5	Cross Sectional Studies/Ecologic Studies	Holmes	Leonard
	6	Prospective/Cohort Studies/Case Cohort	Leonard	
	7	Case-Control Studies	Leonard	
	8	Experimental Studies: Randomized Controlled Trials	Schisterman	
Module 3: Random Error	9	Hypothesis Testing/P-values/Confidence Intervals	Naj	Harhay
	10	Sampling Strategies/Precision	Schnellinger	
	11	Power and Sample Size/Multiple Hypothesis Testing	Schnellinger	
	12	Screening (Sensitivity/Specificity/PPV/NPV)	Leonard	
Module 4: Causal Inference and Impactors on Inference	13	Causal Inference and Directed Acyclic Graphs (DAGs)	Getz	Getz
	14	Sources of Bias/Missing Data	Naj	
	15	Confounding and Measurement Error	Harhay	
	16	Effect Modification, Interaction, and Stratification	Getz	