Syllabus Module 223 Major A: Methods and Design in Epidemiology

N°223	Concepts, methods and design in Epidemiology
Coordinator	Parisa Tehranifar Associate Professor of Epidemiology Columbia University Medical Center pt140@cumc.columbia.edu
Dates	From October 21st to 25th 2019
Credits/ECTS	3 ECTS
Duration or Course Format	30 hours
Location	EHESP 20 Avenue George Sand 93210 LA PLAINE ST DENIS
Description	As a basic science of public health, epidemiology is responsible for the identification of causes of disease that can guide the development of rational public health policies. The accuracy of the information provided by epidemiologic studies is therefore of central concern. Epidemiologic methods are the tools we use to make valid causal arguments. The primary objective is to provide students with the basic tools necessary to design, carry out, and interpret the results from observational epidemiologic studies.
Prerequisites	Advanced core in Biostatistics and Advanced core in Epidemiology
Course learning objectives	Students who successfully complete this course will be able to: • Articulate and apply causal ideas • Develop testable research hypotheses from a causal theory • Articulate the principles of basic observational study designs • Choose study designs that can test research hypotheses • Select basic statistical tests appropriate for the study design and research hypotheses • Identify sources of, and methods to avoid, invalidity in epidemiologic research • Test research hypotheses using basic statistical techniques • Draw and "read" a simple Directed Acyclic Graph • Recognize and explain the effects of non-comparability • Identify the ethical principles in conducting and disseminating epidemiologic research
Structure (details of sessions title/speaker/date /duration)	Each session consists of lectures and in-class exercises and/or group presentation and discussion. Each lecture introduces a new topic and class exercises reinforce the concepts discussed during that lecture.
Resources	The textbook for the course is: Szklo, M and Nieto J. Epidemiology: beyond the basics, 4th ed. Jones & Bartlett Learning 2018
Course requirement	Students are expected to attend all lectures and seminars. Class attendance will be checked accordingly. Students are expected to read and analyse selected papers for the group work before the courses.
Grading and assessment	Each session will be accompanied by a lab exercise to reinforce the concepts discussed during the lecture. The grade for the course is based on two homework assignments (20% each) and a final exam which covers all the material covered in the course (60%). Note also that students will complete a questionnaire that assesses their own and their teammates' contributions to group work. All team members will receive the same grade except if it is clear that a student has not participated effectively (attended and contributed to meetings; made timely, helpful contributions; been constructive, etc.). In that case, the student's grade will be lowered accordingly.

Course policy	**Attendance & Punctuality** **Regular and punctual class attendance is a prerequisite for receiving credit in a course.** Students are expected to attend each class. Attendance will be taken at each class. The obligations of attendance and punctuality cover every aspect of the course: lectures, conferences, group projects, assessments, examinations, as described in EHESP Academic Regulations http://mph.ehesp.fr EHESP Academic Regulation Article. 3). If students are not able to make it to class, they are required to send an email to the instructor and to the MPH program coordinating team explaining their absence prior to the scheduled class date. All supporting documents are provided to the end-of-year panel. Students who miss class are responsible for content. Any student who misses a class has the responsibility for obtaining copies of notes, handouts and assignments. If additional assistance is still necessary, an appointment should be scheduled with the instructor. Class time is not to be used to go over material with students who have missed class. **Lateness**: Students who are more than 10 minutes late may be denied access to a class. Repeated late arrivals may be counted as absences (See http://mph.ehesp.fr EHESP Academic Regulation Article. 3 Attendance & Punctuality) **Maximum absences authorized & penalty otherwise** Above 20% of absences will be designated a fail for a given class. The students will be entitled to be reassessed in any failed component(s). If they undertake a reassessment or they retake a module this means that they cannot normally obtain more than the minimum pass mark (i.e. 10 out of 20) **Exceptional circumstances** Absence from any examination or test, or late submission of assignments due to illness, psychological problems, or exceptional personal reasons must be justified; otherwise, students will be penalized, as above mentioned. Students must directly notify their professor or the MPH academic secretariat before the exam or before the assignment deadline. Before accepting the student's justification, the professor or the MPH academic secretariat has the right to request either a certificate from the attending physician or from a psychologist, or from any other relevant person (See http://mph.ehesp.fr EHESP Academic Regulation Article 4 Examinations). **Courtesy**: <u>All cell phones/pages MUST be turned off during class time</u>. Students are required to conduct themselves according to professional standards, eating during class time is not permitted during class time, such as course or group work.
Valuing diversity	Diversity enriches learning. It requires an atmosphere of inclusion and tolerance, which oftentimes challenges our own closely-held ideas, as well as our personal comfort zones. The results, however, create a sense of community and promote excellence in the learning environment. This class will follow principles of inclusion, respect, tolerance, and acceptance that support the values of diversity. Diversity includes consideration of: (1) life experiences, including type, variety, uniqueness, duration, personal values, political viewpoints, and intensity; and (2) factors related to "diversity of presence," including, among others, age, economic circumstances, ethnic identification, family educational attainment, disability, gender, geographic origin, maturity, race, religion, sexual orientation and social position.
Course evaluation	EHESP requests that you complete a course evaluation at the end of the school year. Your responses will be anonymous, with feedback provided in the aggregate. Open-ended comments will be shared with instructors, but not identified with individual students. Your participation in course evaluation is an expectation, since providing constructive feedback is a professional obligation. Feedback is critical, moreover, to improving the quality of our courses, as well as for instructor assessment.

Day 1: Session 1	**Causal Inference in Epidemiology; Review of Measures of Disease Occurrence and Association**
Speakers	Lecturer: Parisa Tehranifar, DrPH Teaching Assistant: Ayana April-Sanders, MPH
Session Outline	One central goal of epidemiology is to identify causes of disease. Fulfillment of this goal requires a sound understanding of causal inference. In this first session, basic concepts in causal inference will be introduced as a framework for understanding the design and execution of epidemiologic studies. Since the scientific method requires the quantification of our constructs, we will review basic epidemiologic measures of disease frequency (risk, rates, and odds) and disease associations (risk ratios, rate ratios, odds ratios, and risk differences) their interrelationships and relationships to causal inference.
Learning Objectives	• Articulate a counterfactual definition of a cause • Explain the role of counterfactual in causal inference • Formulate a principled argument • Define and calculate risk, odds and rate • Define and calculate ratio and difference measures of associations • Describe the relationship among the different measures
Duration	3 hours
Training Methods	• Lecture 1a and Lab 1a: Causal inference in Epidemiology • Lecture 1b and Lab 1b: Review of measures
Readings	Rothman KJ et al Causation and Causal Inference in Epidemiology AJPH 2005;95:S144-S150. Szklo and Nieto Chapter 2

Day 1: Session 2	**Introduction to Study Designs; Experimental (RCT) and Cohort Studies**
Speakers	Lecturer: Parisa Tehranifar, DrPH Teaching Assistant: Ayana April-Sanders, MPH
Session Outline	The next three sessions will introduce the issues involved in the choice of study design. The benefits and limitations of each design will be discussed in the context of causal inference.
Learning Objectives	• Define the basic study designs used in epidemiologic research • Identify temporality of study design and unit of analysis • Describe the relationship between experimental and cohort study designs • Relate these designs to the counterfactual definition of a cause
Duration	3 hours
Training Methods	• Lecture 2: Experimental and Cohort Studies • Small group work 1: Using published research, describe and discuss causal hypothesis and counterfactual outcome; apply concepts of study designs and measures of association; communicate epidemiologic concepts
Readings	Szklo and Nieto Chapters 1 and 3

Day 2: Session 3	**Study Designs: Cohort Studies and Cross-sectional studies**
Speakers	Lecturer: Parisa Tehranifar, DrPH Teaching Assistant: Ayana April-Sanders, MPH
Session Outline	See Outline for Session 2
Learning Objectives	• Describe the principles and properties of cohort studies • Calculate the probability of disease using Kaplan-Meir methods • Describe methods for dealing with attrition (Person time analyses) • Articulate the assumptions of these methods • Understand the limitations of measures from cross-sectional designs
Duration	3 hours
Training Methods	• Lecture 3: Types of cohort studies, loss to follow-up, cross-sectional studies • Small group work 2: Design a study
Readings	Szklo and Nieto Chapters 1 and 3

Day 2: Session 4	**Study Designs: Case-control and Case-cohort Studies**
Speakers	Lecturer: Parisa Tehranifar, DrPH Teaching Assistant: Ayana April-Sanders, MPH
Session Outline	See Outline for Session 2
Learning Objectives	- Define case-control, nested case-control and case-cohort studies - Describe the relationship between cohort and case-control designs - Relate valid selection of controls in a case-control design to the impact of attrition in cohort studies - Understand the measures of associations that can be obtained with case-control studies - Understand sources of non-comparability in case-control studies -
Duration	3 hours
Training Methods	• Lecture 4 and Lab 4 • Assignment 1
Readings	Szklo and Nieto Chapters 1 and 3

Day 3: Session 5	**Selection Bias and Information Bias; Review of Multivariable Analysis in Epidemiology**
Speakers	Lecturer: Parisa Tehranifar, DrPH Teaching Assistant: Ayana April-Sanders, MPH
Session Outline	This session provides and overview of bias in epidemiologic studies, focusing on the most common selection and information biases and ways to avoid or reduce their occurrence in study design and conduct. Additionally, this session will review multivariable analysis using multiple regression model adjustment and stratification. The goal is to understand the basic concepts and the situations in which these techniques are appropriate, to be able to read and interpret computer printouts and to understand how to evaluate confounding, mediation and effect modification.
Learning Objectives	• Define the concept of bias in epidemiologic studies • Assess selection and information bias • Identify ways to minimize bias in the design of a study • Describe differences in commonly used regression models (linear & logistic regression) • Describe the relationship between stratified analysis and mathematical modeling • Carry out and interpret results from stratified analyses • Interpret results of output from multivariate approaches
Duration	3 hours
Training Method	• Lecture 5a and Lab 5a: Bias in study design and conduct • Lecture 5b and Lab 5b: Multivariate analysis: stratification and adjustment
Readings	Szklo and Nieto Chapters 4 and 7

Day 3: Session 6	**Confounding**
Speakers	Lecturer: Parisa Tehranifar, DrPH Teaching Assistant: Ayana April-Sanders, MPH
Session Outline	This session covers the conceptualization and evaluation of confounding from an epidemiologic standpoint. Methods for avoiding and/or correcting confounding in study design and analysis will also be discussed.
Learning Objectives	• Define confounding and confounders • Discuss methods to control for confounding in study designs • Hypothesize the effect of confounding on the crude association; • Assess the presence of confounding in data, using adjustment and stratification methods • Describe the relationship between stratified analysis and mathematical modeling • Define residual Confounding
Duration	3 hours
Training Method	• Lecture 6 and Lab 6: Identifying non-causal associations (confounding) • Assignment 2
Readings	Szklo and Nieto Chapter 5

Day 4: Session 7	**Effect Measure Modification and Mediation**
Speakers	Lecturer: Parisa Tehranifar, DrPH Teaching Assistant: Ayana April-Sanders, MPH
Session Outline	This session will describe situations in which two or more factors modify the effect of each other on a specified outcome, and introduce strategies for assessing the homogeneity of effect or effect modification. This session will also introduce the concept and definition of mediation and a mediator and its effects on causal associations.
Learning Objectives	• Define and estimate effect measure modification • Evaluate effect measure modification using stratified analyses • Interpret the results of stratified analyses • Assess and articulate scale dependency of effect measure modification through risk ratios and risk differences • Define mediation and mediators • Articulate distinction between confounding and mediators • Estimate the effects of mediation
Duration	3 hours
Training methods	• Lecture 7 and Lab 7: Effect measure modification and mediation
Readings	Szklo and Nieto Chapter 6

Day 4: Session 8	**Graphical Representation of Causal Effects and Approaches to Model Building**
Speakers	Lecturer: Parisa Tehranifar, DrPH Teaching Assistant: Ayana April-Sanders, MPH
Session Outline	This session will introduce a graphical method for depicting hypothesized causal associations and working out appropriate statistical approaches appropriate for the research hypothesis.
Learning Objectives	• Define Directed Acyclic Graph (DAG) • Draw a causal DAG • Deduce associations implied by the DAG • Draw causal DAGs using DAGitty • Understand how to build regression models appropriate for the study question/hypothesis and design • Interpret results of output from stratified analyses, linear regression, logistic regression and survival analyses
Duration	3 hours
Training methods	• Lecture 8: DAGs and model building • Small Group Work 3: Apply concepts of effect modification, mediation, and DAGs to published research
Readings	Greenland, Pearl and Robins Causal Diagrams for Epidemiological Research, Epidemiology 1999; 10:37-38 Shrier I, Platt R. Reducing bias through directed acyclic graphs. BMC Medical Research Methodology 2008; 8: 70.

Day 5: Session 9	**Measurement Error: Consequences and Avoidance**
Speakers	Lecturer: Parisa Tehranifar, DrPH Teaching Assistant: Ayana April-Sanders, MPH
Session Outline	This session provides an introduction to the problem of measurement error and its implications for causal inference. We will examine the effects of measurement error in independent and dependent variables of interest as well as confounders and covariates. Sensitivity and specificity will be covered. We will also describe the sources of measurement error and various techniques to avoid it and tame its consequences.
Learning Objectives	• Define validation and reliability studies • Calculate and interpret sensitivity, specificity, and Kappa • Describe the consequences of different types of measurement error • Identify sources of potential bias in the way information is obtained • Implement strategies to avoid bias in obtaining information
Duration	3 hours
Training Methods	• Lecture 9 and Lab 9: Measurement error
Readings	Szklo and Nieto Chapter 8

Day 5: Session 10	**Translating Epidemiology into Public Health Practice**
Speakers	Lecturer: Parisa Tehranifar, DrPH Teaching Assistant: Ayana April-Sanders, MPH
Session Outline	Epidemiology is the basic science of public health, and epidemiologic research is intended to identify causes of health conditions in the population in order to guide the development of public health programs and policies. This session will discuss the steps involved in formulating evidence-based public health practice and highlight the role epidemiologists can play in the growing field of implementation science.
Learning Objectives	• Understand how to critically evaluate published manuscripts • Understand the application of causality to public health practice • Define meta-analysis • Define implementation science
Duration	3 hours
Training Methods	• Lecture 10: From epidemiologic evidence to public health practice • Review and practice for Final Exam • Final Exam will be distributed
Readings	Szklo and Nieto Chapters 10 Neta G, Brownson RC, Chambers DA. Opportunities for Epidemiologists in Implementation Science: A Primer. American Journal of Epidemiology 2018; 187(5):899-910