Syllabus Module : 210 Infectious disease epidemiology

N° 210	Infectious disease epidemiology
UE coordinator	Tiffany G. Harris, PhD, MS Associate Professor of Epidemiology at CUMC Mailman School of Public Health, Columbia University New York, NY, USA Email: th2604@cumc.columbia.edu
Dates	16 to 20 November 2020
ECTS	3 ECTS
Duration	5 days
Location	EHESP 20 Avenue George Sand 93210 LA PLAINE ST DENIS
Description	Infectious disease epidemiology studies the occurrence of infectious diseases; factors leading to infection by an organism; factors affecting transmission of an organism; and factors associated with clinically recognizable disease among those who are infected. It requires the use of traditional epidemiologic methods as well as methods unique to infectious disease epidemiology, such as mathematical modeling. In addition to knowing epidemiologic methods, infectious disease epidemiologists need to be familiar with the biological features and clinical manifestations of important pathogens as well as laboratory techniques for the identification and quantification of infectious organisms. This course is designed to provide an introduction to infectious disease epidemiology. It will focus on the tools and methods used in identifying, preventing, and controlling infectious diseases to improve public health. Case studies based on the literature and the work of faculty members will be used to illustrate the real-world application of these tools and methods to address public health problems.
Prerequisites	None
Course learning objectives	Students who successfully complete this course will be able to: ▪ Discuss the key concepts of infectious disease transmission and control, and the differences with non-infectious diseases ▪ Apply biological principles to development and implementation of disease prevention, control or management programs ▪ Apply epidemiologic tools and methodologies to understand the transmission dynamics and control of infectious diseases ▪ Critically appraise and interpret the findings of infectious disease epidemiology papers
Structure (details of sequences: title/speaker/date/duration)	Specific leaning objectives are noted for each session. At the end of each session, students should know and be able to accomplish the session's learning objectives. • Session 1. Introduction to Infectious Disease Epidemiology • Session 2. Measuring the Effectiveness of HIV Prevention Interventions in Generalized and Concentrated Epidemics • Session 3. Mathematical Modeling: Introduction to Concepts in Transmission and Dynamics • Session 4: Epidemiologic Methods for Foodborne and Waterborne Diseases • Session 5. Epidemiology and Control of Sexually Transmitted Infections and Viral Hepatitis • Session 6. Epidemiology, Prevention, and Control of Influenza and COVID-19 • Session 7. Epidemiology and Control of Vectorborne Diseases • Session 8. and Assessing the Epidemiological Burden of TB and the Impact of TB Control: Population-based TB Prevalence Surveys • Session 9. Epidemiologic Methods in Vaccinology • Session 10. Group presentations
Resources	Assigned journal articles

Course requirement	Read required readings before each session, attend each session, and participate in discussions
Grading and assesment	10%: Surveillance exercise 10%: Foodborne outbreak exercise 30%: Group project 50%: Final written examination on TBD November 2020
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**: Cell phones MUST be turned off during class time and students are required to conduct themselves according to professional standards.
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.

# 1 Session Title	**Introduction to Infectious Disease Epidemiology (pre-recorded lecture)**
Speaker	Tiffany G. Harris, PhD, MS Associate Professor of Epidemiology at CUMC Mailman School of Public Health, Columbia University New York, NY, USA Email: th2604@cumc.columbia.edu
Session Outline	• Overview of the biological basis of infectious disease epidemiology • Application of fundamental epidemiological study designs to infectious disease • Overview of the immune system, laboratory tests, molecular methods, and surveillance approaches
Learning Objectives	• Describe the host-pathogen-environment interaction and identify factors influencing this interaction • Summarize the epidemiologic classification of infectious diseases • Explain the natural history of infectious diseases • Demonstrate the role of transmission mechanisms in disease control and prevention • Describe components of the immune system that are important in responding to pathogens • Describe laboratory tests used in diagnosing infectious diseases • Describe molecular methods used in infectious disease epidemiology • Identify sources of data on infectious disease occurrence and pros and cons of various sources • Summarize and interpret surveillance data
Duration	3 hours
Training methods	Recorded lecture, group discussion, surveillance exercise
Reading	Required Reading: • Hall HI, Correa A, Yoon PW, Braden CR, Centers for Disease Control and Prevention. Lexicon, definitions, and conceptual framework for public health surveillance. *MMWR Suppl* 2012 Jul 27;61(3):10-14. Optional Reading: • Groseclose SL, Buckeridge DL. Public Health Surveillance Systems: Recent Advances in Their Use and Evaluation. *Annu Rev Public Health* 2017;38:57-79. doi: 10.1146/annurev-publhealth-031816-04434. • Riley RW, Blanton RE. Advances in Molecular Epidemiology of Infectious Diseases: Definitions, Approaches, and Scope of the Field. *Microbiol Spectr* 2018;6. doi: 10.1128/microbiolspec.AME-0001-2018. • Chapter 1: Major Infectious Diseases: Key Messages from *Disease Control Priorities*, Third Edition: https://www.ncbi.nlm.nih.gov/books/NBK525197/
Validation	Surveillance exercise

# 2 Session Title	**Measuring the Effectiveness of HIV Prevention Interventions in Generalized and Concentrated Epidemics**
Speaker	Tiffany G. Harris, PhD, MS Associate Professor of Epidemiology at CUMC Mailman School of Public Health, Columbia University New York, NY, USA Email: th2604@cumc.columbia.edu
Session Outline	• Overview of the natural history and epidemiology of HIV

	• Overview of HIV prevention approaches
Learning Objectives	• Describe the biological mechanisms of HIV treatment as prevention • Apply criteria for causality to determine whether a biomedical intervention prevents acquisition of an infectious disease • Define risk compensation and explain how it can impact the effectiveness of a prevention intervention • Critically analyze journal articles evaluating the effectiveness of public health interventions at the population level
Duration	3 hours
Training methods	Lecture, group discussion
Reading	Required Readings: • Grulich AE, Guy R, Amin J, et al for the Expanded PrEP Implementation in Communities New South Wales (EPIC-NSW) research group. Population-level effectiveness of rapid, targeted, high-coverage roll-out of HIV pre-exposure prophylaxis in men who have sex with men: the EPIC-NSW prespective cohort study. *Lancet HIV* 2018;5:e629-37. • Tanser F, Barnighausen T, Grapsa E, Zaidi J, Newell ML. High coverage of ART associated with decline in risk of HIV acquisition in rural ZwaZulu-Natal, South Africa. *Science* 2013;339:966-71. Optional Reading: • Holmes CB, Hallett TB, Walensky RP, et al. Effectiveness and cost-effectiveness of treatment as prevention for HIV. In: Holmes KK, Bertozzi S, Bloom BR, et al. , eds. Major Infectious Diseases. 3rd edition. Washington (DC): The International Bank for Reconstruction and Development/The World Bank; 2017. Chapter 5. Available from: https://www.ncbi.nlm.nih.gov/books/NBK525180/ doi: 10.1596/978-1-4648-0524-0/ch5. • Deeks SG, Overbaugh J, Phillips A, et al. HIV infection. *Nat Rev Dis Primers* 2015;1(15035).
Validation	NA for this session

# 3 Session Title	**Mathematical Modeling: Introduction to Concepts in Transmission and Dynamics**
Speaker	Pascal Crépey, PhD, Lecturer Departement EPI & Biostats EHESP Pascal.crepey@ehesp.fr
Session Outline	Introduction to concepts in transmission and dynamics based upon mathematical modeling
Learning Objectives	• Describe a basic compartmental model • Identify the parameters to calculate R0 • Explain the concept of and calculate an « epidemic threshold » • Describe the effect of vaccination on the spreading of a disease in a population • Discuss the **roles**, **outcomes** and **limits** of mathematical modeling in public health and characteristics of infectious disease transmission that may limit their use
Duration	3 hours
Training methods	Lecture, group discussion
Reading	Optional Reading:

	• Heesterbeek H, Anderson RM, Andreasen V, et al. Modeling infectious disease dynamics in the complex landscape of global health. *Science* 2015;347(6227):aaa4339.
Validation	NA for this session

# 4 Session Title	**Epidemiologic Methods for Foodborne and Waterborne Diseases**
Speakers	Tiffany G. Harris, PhD, MS Associate Professor of Epidemiology at CUMC Mailman School of Public Health, Columbia University New York, NY, USA Email: th2604@cumc.columbia.edu
Session Outline	Overview of the epidemiology and prevention of foodborne and waterborne diseases
Learning Objectives	• Describe the epidemiology of select foodborne and waterborne disease • Describe the steps involved in detecting and investigating foodborne and waterborne outbreaks • Describe the advantages and disadvantages of using measures of infection based on laboratory tests, clinical criteria, and participant recall • Summarize and interpret surveillance data • Recognize difficulties in balancing public health concerns with consumer and industry considerations in emerging infectious disease issues • Describe ways to reduce foodborne and waterborne illness
Duration	3 hours
Training methods	Lecture, group discussion, outbreak exercise
Reading	Optional Readings : • Havelaar AH, Kirk MD, Torgerson PR, et al. World Health Organization Global Estimates and Regional Comparisons of the Burden of Foodborne Disease in 2010. *PLoS Med* 2015;12:e1001923. • Hoelzer K, Moreno Switt AI, Wiedmann M, Boor KJ. Emerging needs and opportunities in foodborne disease detection and prevention: From tools to people. *Food Microbiol* 2018;75:65-71. • Van Cauteren D, Le Strat Y, Sommen C, et al. Estimated Annual Numbers of Foodborne Pathogen–Associated Illnesses, Hospitalizations, and Deaths, France, 2008–2013. *Emerg Infect Dis* 2017;23(9):1486-1492. https://dx.doi.org/10.3201/eid2309.170081. • Crawford SE, Ramani S, Tate JE, et al. Rotavirus infection. *Nat Rev Dis Primers* 2017;3:17083. • Baker-Austin C, Oliver JD, Alam M, et al. Vibrio spp. infections. *Nat Rev Dis Primers* 2018;4:8.
Validation	Foodborne outbreak exercise

# 5 Session Title	**Epidemiology and Control of Sexually Transmitted Infections and Viral Hepatitis (pre-recorded lecture)**
Speakers	Tiffany G. Harris, PhD, MS Associate Professor of Epidemiology at CUMC Mailman School of Public Health, Columbia University New York, NY, USA Email: th2604@cumc.columbia.edu

Session Outline	Overview of the epidemiology and control of sexually transmitted infections (STIs) and Hepatitis B and C
Learning Objectives	• Describe the epidemiology and natural history of STIs and Hepatitis B and C • Describe STI and hepatitis control approaches • Critically assess the epidemiological methods used to evaluate the efficacy of partner treatment and notification strategies for gonorrhea and chlamydial infection
Duration	3 hours
Training methods	Recorded lecture, group discussion
Reading	Required Reading: • Golden MR, Kerani RP, Stenger M, et al. Uptake and population-level impact of expedited partner therapy (EPT) on *Chlamydia trachomatis* and *Neisseria gonorrheae*: The Washington State community-level randomized trial of EPT. *PLoS Med* 2015;12:e1001777. • Mmeje O, Wallet S, Kolenic G, Bell J. Impact of expedited partner therapy (EPT) implementation on chlamydia incidence in the USA. *BMJ Sex Trans Infect* 2018;94:545-7 Optional Reading: • Marshall BD, Milloy MJ, Wood E, et al. Reduction in overdose mortality after the opening of North America's first medically supervised safer injecting facility: a retrospective population-based study. *Lancet* 2011;377:1429–37. • Platt L, Monozzi S, Reed J, et al. Needle and syringe programmes and opioid substitution therapy for preventing HCV transmission among people who inject drugs: findings from a Cochrane Review and meta-analysis. *Addiction* 2018;113 :545–563. • Yuen MF, Chen DS, Dusheiko GM, et al. Hepatitis B virus infection. *Nat Rev Dis Primers* 2018;4:18035. • Manns MP, Buti M, Gane E, et al. Hepatitis C virus infection. *Nat Rev Dis Primers* 2017;3:17006.
Validation	NA for this session

# 6 Session Title	**Epidemiology, Prevention, and Control of Influenza and COVID-19**
Speaker	Tiffany G. Harris, PhD, MS Associate Professor of Epidemiology at CUMC Mailman School of Public Health, Columbia University New York, NY, USA Email: th2604@cumc.columbia.edu
Session Outline	Overview of influenza and COVID-19 surveillance, epidemiology, prevention and control strategies
Learning Objectives	• Identify sources of surveillance data used to monitor influenza and COVID-19 activity, and the ways in which these sources can be biased • Describe available prevention, mitigation, and containment strategies, and how they affect transmission • Discuss strengths and limitations of study designs used to assess the effect of herd immunity from influenza vaccination
Duration	3 hours
Training methods	Lecture, Group discussions
Readings	Required Readings:

	• Fung ICH, Gambhir M, Glasser JW, Gao H, Washington ML, Uzicanin A, Meltzer MI. Modeling the effect of school closures in a pandemic scenario: exploring two different contact matrices. *Clin Infect Dis* 2015;60(S1)S58-63. • TBD COVID-19 reading Optional Reading: • Brent SE, Pullenayegum E, Russell ML, Loeb M. Effect of seasonal influenza vaccination on influenza symptom severity among children in Hutterite communities: Follow-up study of a randomized trial. *Influenza Other Respir Viruses* 2019. doi: 10.1111/irv.12689. [Epub ahead of print] PubMed PMID:31702876. • Krammer F, Smith GJD, Fouchier RAM, et al. Influenza. *Nat Rev Dis Primers* 2018;4:3.
Validation	NA for this session

# 7 Session Title	**Epidemiology and Control of Vectorborne Diseases (pre-recorded lecture)**
Speaker	Tiffany G. Harris, PhD, MS Associate Professor of Epidemiology at CUMC Mailman School of Public Health, Columbia University New York, NY, USA Email: th2604@cumc.columbia.edu
Session Outline	Epidemiology and control of malaria and other vectorborne diseases
Learning Objectives	• Describe the epidemiology of select vectorborne diseases • Describe the lifecycle of select vectorborne infections • Discuss the implications of limitations of methods to measure infection acquired through vector-borne transmission for epidemiological research • Discuss strengths and limitations of various study designs used to assess the effectiveness of bednet distribution campaigns at the community level • Discuss strengths and limitations of various outcome and process measures used to evaluate community-level interventions to lower malaria morbidity and mortality • Explain why an individual can benefit from an infectious disease intervention received by someone else in the community
Duration	3 hours
Training methods	Recorded lecture, group discussion
Reading	Required Reading: • Stebbins RC, Emch M, Meshnick SR. The effectiveness of community bed net use on malaria parasitemia among children less than 5 years old in Liberia. *Am J Trop Med Hyg* 2018;98:660-6. • Levitz L, Janko M, Mwandagalirwa et al. Effect of individual and community-level bed net usage on malaria prevalence among under-fives in the Democratic Republic of Congo. *Malar J* 2018;17:39. Optional Reading: • Phillips MA, Burrows JN, Manyando C, van Huijsduijnen RH, Van Voorhis WC, Wells TNC. Malaria. *Nat Rev Dis Primers* 2017;3:17050.
Validation	NA

# 8 Session Title	**Assessing the Epidemiological Burden of TB and the Impact of TB Control: Population-based TB Prevalence Surveys**
Speaker	Tiffany G. Harris, PhD, MS Associate Professor of Epidemiology at CUMC Mailman School of Public Health, Columbia University New York, NY, USA Email: th2604@cumc.columbia.edu
Session Outline	• Overview of the natural history and epidemiology of tuberculosis (TB) • Testing for TB
Learning Objectives	• Describe the natural history and epidemiology of TB • Describe the role of inventory studies, capture-recapture methods, and population-based TB prevalence surveys in estimating TB incidence • Discuss the benefits and challenges of utilizing various screening strategies to identify individuals at high risk for TB • Discuss the impact of incorporating various laboratory techniques into the case definition on estimates of TB prevalence • Interpret findings from population-based TB prevalence surveys, to inform the development of strategies that could increase the proportion of TB cases that are diagnosed, and improve the proportion of cases being captured by routine surveillance data
Duration	3 hours
Training methods	Lecture, group discussion
Reading	Required Reading: • Mao TE, Okada K, Yamada, N et al. Cross-sectional studies of tuberculosis prevalence in Cambodia between 2002 and 2011. *Bull World Health Organ* 2014;92:573-81. • Senkoro M, Mfinanga S, Egwaga S, et al. Prevalence of pulmonary tuberculosis in adult population of Tanzania: a national survey, 2012. *Int Tuberc Lung Dis* 2016;20(8):1014-21. Optional Reading: • Pai M, Behr MA, Dowdy D, et al. Tuberculosis. *Nat Rev Dis Primers* 2016; 2:16076. doi:10.1038/nrdp.2016.76.
Validation	NA for this session

# 9 Session Title	**Epidemiologic Methods in Vaccinology**
Speakers	Judith Mueller Lecturer Departement EPI & Biostats EHESP Judith.Mueller@ehesp.fr
Session Outline	Overview of epidemiologic principles of vaccines for disease prevention
Learning Objectives	• Describe study designs for evaluation of vaccines and vaccination strategies • Describe pre-and post-licensure surveillance approaches
Duration	3 hours
Training methods	Lecture and group discussion
Reading	Optional Reading:

	• Halloran ME, Struchiner CJ, Longini IM Jr. Study designs for evaluating different efficacy and effectiveness aspects of vaccines. *Am J Epidemiol* 1997;146(10):789-803. Review. PubMed PMID: 9384199. • Henao-Restrepo AM, Camacho A, Longini IM, et al. Efficacy and effectiveness of an rVSV-vectored vaccine in preventing Ebola virus disease: final results from the Guinea ring vaccination, open-label, cluster-randomised trial (Ebola Ça Suffit!). *Lancet* 2017:505-518. doi: 10.1016/S0140-6736(16)32621-6. Epub 2016 Dec 23. Erratum in: *Lancet* 2017;389(10068):504. *Lancet* 2017;389(10068):504. PubMed PMID: 28017403; PubMed Central PMCID: PMC5364328. • Miranda S, Chaignot C, Collin C, et al. Human papillomavirus vaccination and risk of autoimmune diseases: A large cohort study of over 2 million young girls in France. *Vaccine* 2017;35(36):4761-4768. doi: 10.1016/j.vaccine.2017.06.030. Epub 2017 Jul 24. PubMed PMID: 28750853. • Simondon F, Preziosi MP, Yam A, et al. A randomized double-blind trial comparing a two-component acellular to a whole-cell pertussis vaccine in Senegal. *Vaccine* 1997;15(15):1606-12. PubMed PMID: 9364690. • Rota PA, Moss WJ, Takeda M, de Swart RK, Thompson KM, Goodson JL. Measles. *Nat Rev Dis Primers* 2016;2: 16049. • Gershon AA, Breuer J, Cohen JI, et al. Varicella zoster virus infection. *Nat Rev Dis Primers* 2015;1:15016. doi: 10.1038/nrdp.2015.16. • Schiffman M, Doorbar J, Wentzensen N, et al. Carcinogenic human papillomavirus infection. *Nat Rev Dis Primers* 2016;2:16086.
Validation	NA for this session

# 10 Session Title	**Group presentations**