

Syllabus Module: 210 Infectious disease epidemiology

N° 210	Infectious disease epidemiology
UE coordinator	Tiffany G. Harris, PhD, MS Associate Professor of Epidemiology at CUMC Director of Strategic Information, ICAP Mailman School of Public Health, Columbia University New York, NY, USA Email: th2604@cumc.columbia.edu
Dates	15 to 19 November 2021
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: <ul style="list-style-type: none"> ▪ 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 learning 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. <ul style="list-style-type: none"> • Session 1. Introduction to Infectious Disease Epidemiology

	<ul style="list-style-type: none"> • Session 2. Mathematical Modeling: Introduction to Concepts in Transmission and Dynamics • Session 3. HIV Epidemiology and Control • Session 4: Outbreak Investigation and Foodborne and Waterborne Diseases • Session 5. Epidemiologic Methods in Vaccinology • Session 6. Epidemiology and Control of Sexually Transmitted Infections and Viral Hepatitis • Session 7. Epidemiology, Prevention, and Control of Influenza and COVID-19 • Session 8. Epidemiology and Control of • Session 9. Malaria Application of Molecular Epidemiology to Tuberculosis Prevention and Control • Session 10. Group presentations
Resources	Journal articles, podcasts, websites
Course requirement	Read/listen to required material before each session, attend each session, and participate in discussions
Grading and assessment	25%: Individual assignments 25%: Group project 50%: Final written examination on Tuesday, 24 November from 15:00-17:00
Course policy	<p>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.</p> <p>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.</p> <p>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)</p> <p>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</p>

	<p>that they cannot normally obtain more than the minimum pass mark (i.e. 10 out of 20)</p> <p>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).</p> <p>Courtesy: Cell phones MUST be turned off during class time and students are required to conduct themselves according to professional standards.</p>
<p>Valuing diversity</p>	<p>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.</p>
<p>Course evaluation</p>	<p>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.</p>

# 1 Session Title	Introduction to Infectious Disease Epidemiology
Speaker	Tiffany G. Harris, PhD, MS
Session Outline	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	Lecture, group discussion, surveillance exercise
Reading	<p><u>Required:</u> https://www.history.com/topics/middle-ages/pandemics-timeline https://www.wnycstudios.org/podcasts/otm/segments/five-micron-mistake</p> <p><u>Optional Reading:</u> Chapter 1: Major Infectious Diseases: Key Messages from <i>Disease Control Priorities</i>, Third Edition: https://www.ncbi.nlm.nih.gov/books/NBK525197/</p> <p>Groseclose SL and Buckeridge DL. Public Health Surveillance Systems: Recent Advances in Their Use and Evaluation. <i>Annual Review of Public Health</i> 2017 March;38:57-9. https://doi.org/10.1146/annurev-publhealth-031816-044348.</p>
Validation	Surveillance exercise

# 2 Session Title	Mathematical Modeling: Introduction to Concepts in Transmission and Dynamics
Speaker	Pascal Crépey, PhD, Lecturer Department EPI & Biostats EHESP Pascal.crepey@ehesp.fr
Session Outline	Introduction to concepts in transmission and dynamics based upon mathematical modeling
Learning Objectives	<ul style="list-style-type: none"> • 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	<p><u>Required:</u> Holmadhl I and Buckee C. Wrong but Useful — What Covid-19 Epidemiologic Models Can and Cannot Tell Us. <i>N Engl J Med</i> 2020;383:303-305. DOI: 10.1056/NEJMp2016822. https://www.nejm.org/doi/full/10.1056/NEJMp2016822</p> <p>Listen to accompanying interview with Dr. Buckee.</p> <p>Heesterbeek H, Anderson RM, Andreasen V, et al. Modeling infectious disease dynamics in the complex landscape of global health. <i>Science</i> 2015;347(6227):aaa4339.</p>
Validation	NA for this session

# 3 Session Title	Epidemiology and Control of HIV
Speaker	Tiffany G. Harris, PhD, MS
Session Outline	<ul style="list-style-type: none"> • Overview of the natural history and epidemiology of HIV • Overview of HIV prevention approaches

<p>Learning Objectives</p>	<ul style="list-style-type: none"> • Describe the biological mechanisms of HIV treatment as prevention • Discuss the different interventions currently available to achieve HIV epidemic control • Understand the different surveillance and recruitment strategies to measure progress on the 95-95-95 targets among the general and key populations • Critically analyze journal articles evaluating the effectiveness of public health interventions at the population level
<p>Duration</p>	<p>3 hours</p>
<p>Training methods</p>	<p>Lecture, group discussion</p>
<p>Reading</p>	<p><u>Required:</u> Gonese E, Musuka G, Ruangtragool L, et al. Comparison of HIV Incidence in the Zimbabwe Population-Based HIV Impact Assessment Survey (2015–2016) with Modeled Estimates: Progress Toward Epidemic Control. <i>AIDS Research and Human Retroviruses</i> 2020;36:656-662. https://doi.org/10.1089/aid.2020.0046.</p> <p>AVERT HIV Timeline. In this interactive timeline, you can explore how different people have been affected by HIV over the past four decades and read, see, and hear how things have changed around the world. https://timeline.avert.org/</p> <p><u>Optional:</u> 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. <i>Major Infectious Diseases</i>. 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/.</p> <p>Deeks SG, Overbaugh J, Phillips A, et al. HIV infection. <i>Nat Rev Dis Primers</i> 2015;1(15035).</p>
<p>Validation</p>	<p>NA for this session</p>

# 4 Session Title	Epidemiologic Methods for Foodborne and Waterborne Diseases
Speakers	Tiffany G. Harris, PhD, MS
Session Outline	Outbreak Investigation and Foodborne and Waterborne Diseases
Learning Objectives	<ul style="list-style-type: none"> • Describe recent changes in the epidemiology of foodborne diseases and the causes of these changes • Describe the steps involved in detecting and investigating an outbreak • Summarize and interpret surveillance and outbreak investigation data • Describe ways to reduce foodborne illness
Duration	3 hours
Training methods	Lecture, group discussion, outbreak exercise
Reading	<p>Required: Read: Hoelzer K, Moreno Switt AI, Wiedmann M, Boor KJ. Emerging needs and opportunities in foodborne disease detection and prevention: From tools to people. <i>Food Microbiol</i> 2018;75:65-71.</p> <p>Optional: America's Food Safety System Failed to Stop a Salmonella Epidemic. It's Still Making People Sick. https://www.propublica.org/article/salmonella-chicken-usda-food-safety</p> <p>Listen: Sickness Transmitted by Food and Water podcast https://podcasts.google.com/feed/aHR0cHM6Ly93d3cyYy5jZGMuZ292L3BvZGNhc3RzL2NyZWZlZjZjcy5hc3A_dD1hJmM9NDk/episode/aHR0cHM6Ly9nb3Y5c2EuZ292L3hBSFNy?sa=X&ved=0CAUQkfYCahcKEwiQ3cbDtt3vAhUAAAAAHQAAAAAQFQ&hl=en</p> <p>Beshearse E, Bruce BB, Nane GF, et al. Attribution of Illnesses Transmitted by Food and Water to Comprehensive Transmission Pathways Using Structured Expert Judgment, United States. <i>Emerging Infectious Diseases</i>. 2021;27(1):182-195. doi:10.3201/eid2701.200316. (paper that goes with podcast)</p> <p>Havelaar AH, Kirk MD, Torgerson PR, et al. World Health Organization Global Estimates and Regional Comparisons of the Burden of Foodborne Disease in 2010. <i>PLoS Med</i> 2015;12:e1001923.</p>
Validation	Foodborne outbreak exercise
# 5 Session Title	Epidemiologic Methods in Vaccinology
Speakers	Judith Mueller Lecturer Department EPI & Biostats EHESP

	Judith.Mueller@ehesp.fr
Session Outline	Overview of epidemiologic principles of vaccines for disease prevention
Learning Objectives	<ul style="list-style-type: none"> Describe study designs for evaluation of vaccines and vaccination strategies including for COVID-19 vaccines Describe pre-and post-licensure surveillance approaches
Duration	3 hours
Training methods	Lecture and group discussion
Reading	<p><u>Optional Reading:</u> Pouwels KB, Pritchard E, Matthews PC, et al. Effect of Delta variant on viral burden and vaccine effectiveness against new SARS-CoV-2 infections in the UK. <i>Nat Med</i> 2021. https://doi.org/10.1038/s41591-021-01548-7.</p> <p>Halloran ME, Struchiner CJ, Longini IM Jr. Study designs for evaluating different efficacy and effectiveness aspects of vaccines. <i>Am J Epidemiol</i> 1997;146(10):789-803.</p> <p>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!). <i>Lancet</i> 2017;505-518. doi: 10.1016/S0140-6736(16)32621-6. Epub 2016 Dec 23. Erratum in: <i>Lancet</i> 2017;389(10068):504. <i>Lancet</i> 2017;389(10068):504. PubMed PMID: 28017403; PubMed Central PMCID: PMC5364328.</p> <p>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. <i>Vaccine</i> 2017;35(36):4761-4768. doi: 10.1016/j.vaccine.2017.06.030. Epub 2017 Jul 24. PubMed PMID: 28750853.</p> <p>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. <i>Vaccine</i> 1997;15(15):1606-12. PubMed PMID: 9364690.</p> <p>Rota PA, Moss WJ, Takeda M, de Swart RK, Thompson KM, Goodson JL. Measles. <i>Nat Rev Dis Primers</i> 2016;2: 16049.</p> <p>Gershon AA, Breuer J, Cohen JI, et al. Varicella zoster virus infection. <i>Nat Rev Dis Primers</i> 2015;1:15016. doi: 10.1038/nrdp.2015.16.</p> <p>Schiffman M, Doorbar J, Wentzensen N, et al. Carcinogenic human papillomavirus infection. <i>Nat Rev Dis Primers</i> 2016;2:16086.</p>
Validation	NA for this session

# 6 Session Title	Epidemiology and Control of Sexually Transmitted Infections and Viral Hepatitis
Speakers	Tiffany G. Harris, PhD, MS
Session Outline	Overview of the epidemiology and control of sexually transmitted infections (STIs) and Hepatitis B and C
Learning Objectives	<ul style="list-style-type: none"> • Describe the epidemiology and natural history of STIs and Hepatitis B and C • Describe STI and hepatitis control approaches • Critically assess evidence for the association of PrEP use with increased STIs
Duration	3 hours
Training methods	Lecture, group discussion
Reading	<p><u>Required:</u> Serpa JA, Huynh GN, Nickell JB, Miao H. Human Immunodeficiency Virus Pre-exposure Prophylaxis and Increased Incidence of Sexually Transmitted Infections in the United States. <i>Clin Infect Dis</i>. 2020 Apr 15;70(9):1884-1890. doi: 10.1093/cid/ciz552. PMID: 31284300.</p> <p>Chapin-Bardales J, Johnson Jones ML, Kirkcaldy RD, et al. Pre-exposure Prophylaxis Use and Detected Sexually Transmitted Infections Among Men Who Have Sex With Men in the United States-National HIV Behavioral Surveillance, 5 US Cities, 2017. <i>J Acquir Immune Defic Syndr</i> 2020;85(4):430-435. doi: 10.1097/QAI.0000000000002482.</p> <p><u>Optional:</u></p> <p>Syphilis is resurging in the U.S., a sign of public health's funding crisis https://www.npr.org/sections/health-shots/2021/11/01/1050568646/syphilis-std-public-health-funding</p> <p>Stewart, J., Baeten, J.M. HIV pre-exposure prophylaxis and sexually transmitted infections: intersection and opportunity. <i>Nat Rev Urol</i> (2021). https://doi.org/10.1038/s41585-021-00527-4.</p> <p>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. <i>Lancet</i> 2011;377:1429–37.</p> <p>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. <i>Addiction</i> 2018;113 :545–563.</p> <p>Yuen MF, Chen DS, Dusheiko GM, et al. Hepatitis B virus infection. <i>Nat Rev Dis Primers</i> 2018;4:18035.</p>

	Manns MP, Buti M, Gane E, et al. Hepatitis C virus infection. <i>Nat Rev Dis Primers</i> 2017;3:17006.
Validation	NA for this session

# 7 Session Title	Epidemiology, Prevention, and Control of Influenza and COVID-19
Speaker	Tiffany G. Harris, PhD, MS
Session Outline	Overview of influenza and COVID-19 surveillance, epidemiology, prevention and control strategies
Learning Objectives	<ul style="list-style-type: none"> 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	<p><u>Required:</u></p> <p>Fung ICH, Gambhir M, Glasser JW, et al. Modeling the effect of school closures in a pandemic scenario: exploring two different contact matrices. <i>Clin Infect Dis</i> 2015;60(S1)S58-63.</p> <p>Walsh S, Chowdhury A, Braithwaite V, et al. Do school closures and school reopenings affect community transmission of COVID-19? A systematic review of observational studies. <i>BMJ Open</i> 2021;11(8):e053371. doi: 10.1136/bmjopen-2021-053371.</p> <p><u>Optional:</u></p> <p>John S Oxford, Douglas Gill. Unanswered questions about the 1918 influenza pandemic: origin, pathology, and the virus itself. <i>Lancet Infect Dis</i> 2018;18(11): e348-e354. https://doi.org/10.1016/S1473-3099(18)30359-1.</p> <p>Listen: Pandemic influenza: 100 years https://www.thelancet.com/journals/laninf/article/PIIS1473-3099(18)30359-1/fulltext#relAudio</p> <p>What We Know About Covid, the Flu and the Air We Breathe https://www.nytimes.com/2021/10/19/opinion/covid-flu-air-transmission.html</p> <p>Krammer F, Smith GJD, Fouchier RAM, et al. Influenza. <i>Nat Rev Dis Primers</i> 2018;4:3.</p>
Validation	NA for this session

# 7 Session Title	Epidemiology and Control of Malaria
Speaker	Tiffany G. Harris, PhD, MS
Session Outline	Epidemiology and control of malaria
Learning Objectives	<ul style="list-style-type: none"> • Describe the epidemiology of malaria • Describe the lifecycle of malaria • 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 bed net distribution campaigns at the community level • Explain why an individual can benefit from an infectious disease intervention received by someone else in the community
Duration	3 hours
Training methods	Lecture, group discussion
Reading	<p><u>Required:</u> 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. <i>Am J Trop Med Hyg</i> 2018;98:660-6.</p> <p>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. <i>Malar J</i> 2018;17:39.</p> <p><u>Reading:</u> Phillips MA, Burrows JN, Manyando C, van Huijsduijnen RH, Van Voorhis WC, Wells TNC. Malaria. <i>Nat Rev Dis Primers</i> 2017;3:17050.</p>
Validation	NA

# 8 Session Title	Application of Molecular Epidemiology to Tuberculosis Prevention and Control
Speaker	Tiffany G. Harris, PhD, MS
Session Outline	<ul style="list-style-type: none"> • Overview of the natural history and epidemiology of tuberculosis (TB) • TB genotyping
Learning Objectives	<ul style="list-style-type: none"> • Describe the burden and trends in TB globally, in the US, and in NYC • Describe the uses of genotyping in TB prevention and control • Explain how genotyping is used in TB cluster investigations
Duration	3 hours
Training methods	Lecture, group discussion
Reading	<p><u>Required:</u> Tuberculosis, Like Covid, Spreads by Breathing, Scientists Report https://www.nytimes.com/2021/10/19/health/tuberculosis-transmission-aerosols.html</p> <p>Perri BR et al. <i>Mycobacterium tuberculosis</i> Cluster with Developing Drug Resistance, New York, New York, USA, 2003–2009. <i>Emerg Infect Dis</i> 2011;17:372–378. doi: 10.3201/eid1703.101002.</p> <p><u>Optional:</u> Bloom BR et al. Chapter 11 – Tuberculosis. https://www.ncbi.nlm.nih.gov/books/NBK525174/.</p> <p>Pai M, Behr MA, Dowdy D, et al. Tuberculosis. <i>Nat Rev Dis Primers</i> 2016; 2:16076.</p> <p>PBS. <i>The Forgotten Plague – Tuberculosis in America</i> (2015). https://www.pbs.org/wgbh/americanexperience/films/plague/</p>
Validation	NA for this session

# 10 Session Title	Group presentations
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