TITLE	**EPI 570R** Concepts and Methods in Infectious Disease Epidemiology
CREDIT HOURS	2
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SEMESTER	Fall 2017
SCHEDULE	Meeting for 2 hours each week of Fall semester
FORMAT	Combination of lectures and student-led discussions.

BRIEF COURSE DESCRIPTION

The epidemiology of infectious diseases differs in a fundamental way from the epidemiology of non-infectious diseases: one person's disease status affects the risk of others in the population. This course will provide an overview of the history, concepts and analytical methods that specifically apply to the study of infectious diseases. One of the key assumptions that underlies many classical epidemiologic methods is that events are independent. Clearly, this is not the case for infectious diseases. Therefore, dedicated concepts and methods are required for their study. This course covers a range of methodological approaches and concepts for infectious disease epidemiology including: natural history, household transmission studies; concepts of dynamic modeling; sero-epidemiology; vaccines and vaccine epidemiology; molecular epidemiology and pathogen strain dynamics; and emerging infectious diseases. The course will be a combination of instructor-led lectures and student-led presentations. All students will be expected to take an active role.

SUSTAINABILTY

Infectious diseases result from the interplay of the human host, the pathogen and the environment in which both the host and pathogen live (or die). sustainability and climate change influence the environment and, in turn, disrupt patterns of infectious diseases. The Piedmont Project has crystalized my thinking about how to integrate these issues into my syllabus and concepts in this course. As an example, habitat destruction and deforestation are a driving force behind the emergence and re-emergence of infectious diseases such as the Ebola Virus outbreak in West Africa and the global spread of Zika. For some great writing on this, see David Quammen's piece on Ebola. In addition to the environment, most infectious diseases transmit from person-to-person. The frequency and intensity of human contact is a social process, partly governed by our built environment, with major implications for how infectious diseases spread. Infectious disease epidemiology is fundamentally a quantitative science, concerned with what can be measured. However, these underlying drivers, including climate change and sustainability, will be considered in this course. To this end, we are incorporating a session on 'Environmental determinants of Infectious Diseases' and inviting guest speakers to talk about 'Economics of Infectious Diseases and Sustainable Financing' and 'Human Contact and infectious Disease Transmission'.

PREREQUISITES AND REQUIREMENTS

- EPI/GLEPI students have priority registration.
- Class prerequisites are EPI 540/GH 517 and concurrent enrollment in EPI 740, or permission of the instructor.
- Course is offered to students planning a thesis or practicum related to infectious disease epidemiology. on an infectious disease topic.

COMPETENCIES

SCHOOL LEVEL

- Use analytic reasoning and quantitative methods to address questions in public health and population-based research.
- Describe environmental conditions, including biological, physical, and chemical factors that affect the health of individuals, communities, and populations.
- Describe the use of epidemiological methods to study the etiology and control of disease and injury in populations.
- Describe behavioral, social, and cultural factors that contribute to the health and well-being of individuals, communities, and populations.

DEPARTMENT LEVEL

- Describe public health problems in terms of magnitude, time, place, person and their associated risk factors
- Identify major epidemiologic problems of importance
- Identify key sources of data for epidemiologic purposes
- Differentiate between descriptive and analytic epidemiologic methods
- Critically evaluate the strengths and weaknesses of different study designs with respect to a given research question
- Calculate basic epidemiologic measures
- Interpret epidemiologic results in a causal framework
- Evaluate the strengths and weaknesses of the epidemiologic literature
- Communicate epidemiologic information in a scientific report

LEARNING OBJECTIVES ASSOCIATED WITH THE COMPETENCIES

- To be able to identify unique challenges and appropriate methods for assessing the burden of infectious diseases.
- Understand direct and indirect effects of vaccination and methods for evaluating vaccines.
- To be able to identify the factors that determine a pathogen's outbreak potential and transmission characteristics.
- To understand how time series analysis can be used to study infectious diseases.
- To understand essential concepts in infectious disease transmission modeling.

TEXTBOOK

Required
Infectious Disease Epidemiology
Ibrahim Abubakar, Helen R. Stagg, Ted Cohen and Laura C. Rodrigues.
Oxford University Press. 2016

EVALUATION

- **Student presentations (30%)** The second half of the class each week will be student-led presentations. Each student, alone or in pairs, will prepare a summary of an assigned reading and present in 'journal club' format. The student(s) will then lead a discussion about the paper.
- **In-class participation (30%)** All students will have the opportunity and be expected to contribute to the weekly discussions. Discussions will be initiated by presenting student and then will then be opened to all.
- **Take-home group project (40%)** This will be a semester long project. Students will identify an infectious disease problem and select an appropriate methodology for its investigation. Grade will be split between a proposal due in the middle of the course (10%) and final report (30%).

WEEK 1	**The unique epidemiology of infectious diseases**
Readings	Lessler J, Cummings DA. Mechanistic Models of Infectious Disease and Their Impact on Public Health. Am J Epidemiol. 2016 Mar 1;183(5):415-22. Goldstein E, Pitzer VE, O'Hagan JJ, Lipsitch M. Temporally Varying Relative Risks for Infectious Diseases: Implications for Infectious Disease Control. Epidemiology. 2017 Jan;28(1):136-144.
WEEK 2	**Studying the natural history of infections**
Readings	Lessler J, Reich NG, Brookmeyer R, Perl TM, Nelson KE, Cummings DA. Incubation periods of acute respiratory viral infections: a systematic review. Lancet Infect Dis. 2009 May;9(5):291-300.
WEEK 3	**Infectious disease dynamics and mathematical models** **Guest lecturer: Molly Steele**
Readings	Garnett GP, Cousens S, Hallett TB, Steketee R, Walker N. Mathematical models in the evaluation of health programmes. Lancet. 2011 Aug 6;378(9790):515-25.
WEEK 4	**What is a contact for an infectious disease? (incl network epidemiology)**
Readings	Mossong J, Hens N, Jit M, Beutels P, Auranen K, Mikolajczyk R, Massari M, Salmaso S, Tomba GS, Wallinga J, Heijne J, Sadkowska-Todys M, Rosinska M, Edmunds WJ. Social contacts and mixing patterns relevant to the spread of infectious diseases. PLoS Med. 2008 Mar 25;5(3):e74.
WEEK 5	**Studying transmission in households and beyond**
Readings	Longini IM Jr, Koopman JS, Monto AS, Fox JP (1982) Estimating household and community transmission parameters for influenza. Am J Epidemiol. 115(5): 736-751. Zelner JL, King AA, Moe CL, Eisenberg JNS (2010) How Infections Propagate After Point-Source Outbreaks: An Analysis of Secondary Norovirus Transmission. Epidemiology. 21(5): 711-718.
WEEK 6	**Advanced molecular detection: how is it changing our understanding of IDs?**
Readings	Liu J, Platts-Mills JA, et al. Use of quantitative molecular diagnostic methods to identify causes of diarrhoea in children: a reanalysis of the GEMS case-control study. Lancet. 2016 Sep 24;388(10051):1291-301.
WEEK 7	**Vaccines I: direct, indirect and total effects**
Readings	Fine P, Eames K, Heymann DL. "Herd immunity": a rough guide. Clin Infect Dis. 2011 Apr 1;52(7):911-6. Ali M, Emch M, von Seidlein L, Yunus M, Sack DA, Rao M, Holmgren J, Clemens JD. Herd immunity conferred by killed oral cholera vaccines in Bangladesh: a reanalysis. Lancet. 2005 Jul 2-8;366(9479):44-9.
WEEK 8	**Vaccines II: designing vaccine studies**
Readings	Smith PG, Rodrigues LC, Fine PE. Assessment of the protective efficacy of vaccines against common diseases using case-control and cohort studies. Int J Epidemiol. 1984 Mar;13(1):87-93. Rodrigues LC, Smith PG. Use of the case-control approach in vaccine evaluation: efficacy and adverse effects. Epidemiol Rev. 1999;21(1):56-72.
WEEK 9	**Sero-epidemiology**
Readings	Wilson SE, Deeks SL, Hatchette TF, Crowcroft NS. The role of seroepidemiology in the comprehensive surveillance of vaccine-preventable diseases. CMAJ. 2012 Jan 10;184(1):E70-6. Miller E, Hoschler K, Hardelid P, Stanford E, Andrews N, Zambon M. Incidence of 2009 pandemic influenza A H1N1 infection in England: a cross-sectional serological study. Lancet. 2010 Mar 27;375(9720):1100-8.

	Teunis PF, Falkenhorst G, Ang CW, Strid MA, De Valk H, Sadkowska-Todys M, Zota L, Kuusi M, Rota MC, Simonsen JB, Mølbak K, Van Duynhoven YT, Van Pelt W.Campylobacter seroconversion rates in selected countries in the European Union. Epidemiol Infect. 2013 Oct;141(10):2051-7.
WEEK 10	**Pathogen evolution, strain replacement and multi strain models of disease**
Readings	Pitzer VE, Patel MM, Lopman BA, Viboud C, Parashar UD, Grenfell BT. Modeling rotavirus strain dynamics in developed countries to understand the potential impact of vaccination on genotype distributions. Proc Natl Acad Sci U S A. 2011 Nov 29;108(48):19353-8. Smith DJ, Lapedes AS, de Jong JC, Bestebroer TM, Rimmelzwaan GF, Osterhaus AD, Fouchier RA. Mapping the antigenic and genetic evolution of influenza virus. Science. 2004 Jul 16;305(5682):371-6.
WEEK 11	**Human host genetics and infectious disease dynamics**
Readings	Lopman BA, Trivedi T, Vicuña Y, Costantini V, Collins N, Gregoricus N, Parashar U, Sandoval C, Broncano N, Vaca M, Chico ME, Vinjé J, Cooper PJ. Norovirus Infection and Disease in an Ecuadorian Birth Cohort: Association of Certain Norovirus Genotypes With Host FUT2 Secretor Status. J Infect Dis. 2015 Jun 1;211(11):1813-21. Glass RI, Holmgren J, Haley CE, Khan MR, Svennerholm AM, Stoll BJ, Belayet Hossain KM, Black RE, Yunus M, Barua D. Predisposition for cholera of individuals with O blood group. Possible evolutionary significance. Am J Epidemiol. 1985 Jun;121(6):791-6.
WEEK 12	**Analytical challenges with emerging infectious diseases**
Readings	Wallinga J, Teunis P. Different epidemic curves for severe acute respiratory syndrome reveal similar impacts of control measures. Am J Epidemiol. 2004 Sep 15;160(6):509-16. Blake IM, Martin R, Goel A, Khetsuriani N, Everts J, Wolff C, Wassilak S, Aylward RB, Grassly NC. The role of older children and adults in wild poliovirus transmission. Proc Natl Acad Sci U S A. 2014 Jul 22;111(29):10604-9.
WEEK 13	**Time series data and models for infectious diseases**
Readings	Atchison CJ, Tam CC, Hajat S, van Pelt W, Cowden JM, Lopman BA (2010) Temperature-dependent transmission of rotavirus in Great Britain and The Netherlands. Proc R Soc B. 277(1683): 933-942.
WEEK 14	**Assessing severity and reporting pyramids**
Readings	Reed C, Angulo FJ, Swerdlow DL, Lipsitch M, Meltzer MI, Jernigan D, Finelli L. Estimates of the prevalence of pandemic (H1N1) 2009, United States, April-July 2009. Emerg Infect Dis. 2009 Dec;15(12):2004-7.