

COORDINATOR

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COURSE DESCRIPTION

Infectious disease epidemiology monitors the occurrence of infectious diseases and develops strategies for preventing and controlling disease. It requires the use of traditional epidemiologic methods as well as methods that cannot be applied to non-infectious diseases, such as mathematical modeling. In addition to knowing epidemiologic methods, infectious disease epidemiologists need to be familiar with the clinical and biological features of important infectious diseases as well as laboratory techniques for the identification and quantification of infectious agents. 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.

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
- Specify the role of the immune system in population health
- 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

TEXTBOOK

Konrad E. Nelson and Carolyn Masters Williams (eds.) (2007). *Infectious Disease Epidemiology: Theory and Practice*. Second edition. Sudbury: Jones and Bartlett Publishers.

COURSE STRUCTURE

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.

COURSE SCHEDULE

Session 1 – Introduction to Infectious Disease Epidemiology	
Monday Oct. 24 9h-12h	<p><u>Learning Objectives:</u></p> <ul style="list-style-type: none">• Describe the host-pathogen-environment interaction and identify biologic 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 the branches of the immune system• Explain the different immune responses to specific infectious diseases• Describe laboratory testing methodologies used to monitor or detect infectious diseases and determine susceptibility to pathogens• Apply traditional epidemiological study designs including cross-sectional, case-control, and cohort, for the purpose of investigating infectious disease transmission• Compare the respective strengths and limitations of these traditional epidemiological study designs• Explain the assumptions of traditional epidemiological study designs that limit their use in studying infectious disease transmission <p><u>Reading:</u></p> <p>Textbook Chapter 2 : Epidemiology of Infectious Disease: General Principles</p> <p>Textbook Chapter 8: Microbiology Tools for the Epidemiologist</p> <p>Textbook Chapter 10: The Immune System and Host Defense Against Infections</p>

Session 2 – Causal Inference, Mathematical Modeling, and the Development of Public Health Policy: Male Circumcision to Prevent HIV Transmission	
Monday Oct. 24 14h-17h	<p><u>Learning Objectives:</u></p> <ul style="list-style-type: none">• Apply criteria for causality to determine whether a biomedical intervention prevents acquisition of an infectious disease• Describe the key HIV epidemiologic studies that led to the development of the three African randomized controlled trials of male circumcision as an HIV prevention modality• Describe the biological properties that appear to promote HIV acquisition in uncircumcised men compared to circumcised men• Describe how mathematical modeling can determine whether a public health intervention will lead to reductions in infectious disease transmission and prevalence

Reading:

Textbook Chapter 21: Human Immunodeficiency Virus Infections and the Acquired Immune Deficiency Syndrome

Quinn TC. Circumcision and HIV transmission. *Curr Opin Infect Dis* 2007; 20:33-38.

Bailey RC et al. Male circumcision for HIV prevention in young men in Kisumu, Kenya: a randomised controlled trial. *Lancet* 2007;369:643-56.

Hallett TB et al. Understanding the impact of male circumcision interventions on the spread of HIV in southern Africa. *PLoS One* 2008;3:e2212.

Londish GL, Murray JM. Significant reduction in HIV prevalence according to male circumcision intervention in sub-Saharan Africa. *Int J Epidemiol* 2008;37:1246-53.

Assignment: Come to class prepared to discuss the following:

- 1) Applying Hill's criteria for causality, what is the evidence that male circumcision prevents acquisition of HIV?
- 2) Between 1989 and 2004, ecological, observational, and biological studies demonstrated that circumcised men were at decreased risk of acquiring HIV as compared to uncircumcised men. Was it necessary to wait for the randomized clinical trial results in 2007 for public health officials to acknowledge circumcision as a legitimate HIV prevention measure and to embark on adult circumcision HIV prevention campaigns?
- 3) In deciding whether and how best to include male circumcision as part of a HIV prevention program, what are the key questions to be addressed? Which of these can be answered using the clinical trial data and which are best answered by mathematical modeling?

Session 3 – Evaluation of Diagnostic Tests and Treating Latent Infection as a Control Strategy: Tuberculosis

Tuesday
Oct. 25
9h-12h

Learning Objectives:

- Describe how knowledge of the epidemiology of an infectious disease can be used to choose a cut-point for a diagnostic test
- Determine the predictive value of a diagnostic test given the prevalence of disease in the population
- Outline limitations of the use of various tests for the diagnosis of latent tuberculosis infection and identify settings in which use of specific tests or cutpoints would be useful
- Evaluate strategies for TB control that target people with latent TB infection

Reading:

Textbook Chapter 18: Tuberculosis

Pai M et al. Systematic review: T-cell-based assays for the diagnosis of latent tuberculosis infection: an update. *Ann Intern Med* 2008; 149:177-84.

Cailleaux-Cezar M, de A. Melo D, Xavier Gm, et al. Tuberculosis incidence among contacts of active pulmonary tuberculosis. *Int J Tuberc Lung Dis* 2009;13:190-5.

Grant AD et al. Effect of routine isoniazid preventive therapy on tuberculosis incidence among HIV-infected men in South Africa. *JAMA* 2005;293:2719-25.

Assignment: Come to class prepared to discuss the following:

- 1) Based on the data presented by Cailleaux-Cezar et al., do you think the Brazilian government should change its criteria for LTBI treatment? If so, how? What data support your answer? If not, what additional evidence would you require?
- 2) If clinical trials have shown that treatment of LTBI reduces TB incidence among HIV-infected individuals, why did Grant et al. conduct this study? Why did they use the chosen study design? How might the effect size change if only TST-positive persons were eligible for isoniazid?

Session 4 – Infectious Disease Surveillance and Outbreak Investigations

Tuesday
Oct. 25
14h-17h

Learning Objectives:

- Identify sources of data on the occurrence of infectious diseases, and ways in which these sources can be biased
- Describe elements of a good surveillance system and examples of infectious disease surveillance systems
- Describe the limitations of surveillance systems that rely on passive reporting
- List the reasons to investigate an outbreak
- List the steps in the investigation of an outbreak
- Construct and interpret an epidemic curve
- Discuss the appropriate epidemiologic analyses and studies associated with an outbreak investigation
- Identify methodological challenges to investigating an outbreak

Reading:

Textbook Chapter 4: Surveillance

Textbook Chapter 5: Outbreak Epidemiology

Herwaldt BL, Ackers M, and the Cyclospora Working Group. An outbreak of cyclosporiasis associated with imported raspberries. *N Engl J Med* 1997;336:1548-56.

And associated correspondence, available at:

<http://content.nejm.org.ezproxy.cul.columbia.edu/cgi/content/full/337/16/1170>

Multistate Outbreak of Human *Salmonella* Typhimurium Infections Associated with Pet Turtle Exposure—United States. MMWR Morbidity and Mortality Weekly Report 2008; 59(7). Available at: <http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5907a2.htm>.

Assignment: Come to class prepared to discuss the *MMWR* Salmonella outbreak investigation. As you read the article, think about the following:

What is the relationship between surveillance and outbreak investigation? Is there a feedback loop from one to another? That is, does surveillance inform outbreak investigation and outbreak investigation informs surveillance systems?

Session 5 – Molecular Methods used in Infectious Disease Epidemiology and Healthcare-Associated Infections: Methicillin Resistant *Staphylococcal aureus*

Wednesday
Oct. 26
9h-12h

Learning Objectives:

- Describe the typing methods used in the practice of hospital epidemiology, field epidemiology, and infectious diseases
- Describe the benefits and challenges of applying molecular techniques to study the epidemiology of infectious agents and their affected hosts
- Describe molecular epidemiologic methods for surveillance and investigating outbreaks of MRSA
- Design studies that make use of molecular techniques to test strategies for preventing transmission of healthcare-associated and community-associated MRSA

Reading:

Textbook Chapter 9: Molecular Epidemiology and Infectious Diseases

Textbook Chapter 14: Nosocomial Infections

Humphreys H, Grundmann H, Skov R, Lucet JC, Cauda R. Prevention and control of methicillin-resistant *Staphylococcus aureus*. Clin Microbiol Infect 2009;15:120-4.

Shinefield HR, Ruff NL. Staphylococcal infections: a historical perspective. Infect Dis Clin N Am 2009;23:1-15.

Saiman L et al. An outbreak of methicillin-resistant *Staphylococcal aureus* in a neonatal intensive care unit. Infect Control Hosp Epidemiol 2003;24:317-21.

Elie-Turenne MC, Fernandes H, Mediavilla JR, et al. Prevalence and characteristics of *Staphylococcus aureus* colonization among healthcare professionals in an urban teaching hospital. Infect Control Hosp Epidemiol 2010;31:574-580.

Deleo FR, Otto M, Kreiswirth BN, Chambers HF. Community-associated methicillin-resistant *Staphylococcus aureus*. Lancet 2010;375:1557-68.

Assignment: Come to class prepared to discuss the following:

- 1) What were the molecular techniques used in the studies by Saiman and Elie-Turenne, and what information did they provide?
- 2) What infection control strategies were implemented to contain the outbreak in the Saiman study, and what parameter(s) in the basic reproductive number equation did they target?

Session 6 – Epidemiologic Methods for Measuring Transmission and Control of Vector-borne Infections: Malaria

Wednesday
Oct 26
14h-17h

Speaker:

Dr. Jacques LeBras Malaria French Reference Centre (CNR Palu), University Paris

Learning Objectives:

- Discuss the limitations of epidemiologic methods used to measure the burden of malaria in the population
- Describe the control strategies used for malaria

Reading:

Textbook Chapter 26: The Epidemiology and Control of Malaria

Session 7 – Epidemiologic Methods for Measuring Transmission and Control of Respiratory Infections: Influenza A (H1N1)

Thursday
Oct 27
9h-12h

Learning Objectives:

- Identify sources of surveillance data used to monitor influenza activity, and the ways in which these sources can be biased
- Describe available influenza mitigation strategies, and how they affect transmission
- Describe how complexity can be added to basic SIR models for evaluating pandemic policy strategies
- Describe how model assumptions can alter the interpretation of model output

Reading:

Textbook Chapter 15: Epidemiology and Prevention of Influenza

Sullivan SJ, Jacobson RM, Dowdle WR, Poland GA. 2009 H1N1 Influenza. Mayo Clin Proc 2010;85:64-76.

Lessler J, Reich NG, Cummings DAT and the New York City Department of Health

and Mental Hygiene Swine Influenza Investigation Team. Outbreak of 2009 pandemic Influenza A (H1N1) at a New York City school. N Engl J Med 2009;361:2628-36.

Coburn BJ, Wagner BG, Blower S. Modeling influenza epidemics and pandemics: insights into the future of swine flu (H1N1). BMC Medicine 2009;7:30.

Ferguson NM, Cummings DAT, Fraser C, et al. Strategies for mitigating an influenza pandemic. Nature 2006;442:448-452.

Assignment: Come to class prepared to discuss the following:

- 1) What kind of influenza mitigation strategies are available, and how might these interventions affect transmission (think of this in terms of the equation for R_0)?
- 2) In the paper by Ferguson et al, what assumptions did the authors make? Do you think they were reasonable?
- 3) From a public health perspective, why might we be interested in looking at the effect of an intervention on the peak daily attack rate, rather than the overall attack rate?

Session 8 – Epidemiologic Methods for Measuring Transmission and Control of Viral Hepatitis

Thursday
Oct 27
14h-17h

Learning Objectives:

- Identify appropriate prevention strategies for viral hepatitis based upon the epidemiology of the disease in the targeted population
- Evaluate the impact of Hepatitis B vaccination strategies in the US and globally
- Assess the impact of risk behaviors and preventive measures on HBV and HCV prevalence

Reading:

Textbook Chapter 22: Viral Hepatitis

Burt RD, Hagan H, Garfein RS, Sabin K, Weinbaum C, Thiede H. Trends in hepatitis B virus, hepatitis C virus, and human immunodeficiency virus prevalence, risk behaviors, and preventive measures among Seattle injection drug users aged 18-30 years, 1994-2004. J Urban Health 2007;84:436-54.

Chang MH, Chen CJ, Lai MS for the Taiwan Childhood Hepatoma Study Group. Universal hepatitis B vaccination in Taiwan and the incidence of hepatocellular carcinoma in children. N Engl J Med 1997;336:1855-9.

Liang X, Bi S, Yang W et al. Evaluation of the impact of hepatitis B vaccination among children born during 1992-2005 in China. J Infect Dis 2009;200:39-47.

Assignment: Come to class prepared to discuss the following:

- 1) What were the outcomes used to determine the effectiveness of Hepatitis B vaccination programs in the papers by Chang et al and Liang et al? What are the pros and cons of each approach?
- 2) What risk behaviors and preventive measures were assessed in the paper by Burt et al? How could differences in study design among the included studies have influenced the findings?

**Session 9 – Choosing Biologic Outcomes and Developing Immunization Policy:
The Human Papillomavirus Vaccine to Prevent Cervical Cancer**

**Friday
Oct 28
9h-12h**

Learning Objectives:

- Explain human papillomavirus (HPV) natural history and its link to cervical cancer
- Discuss how the diversity of HPV types necessitates development of broad spectrum immunologic vaccines
- Discuss the strengths and weaknesses of various biologic outcomes used to monitor the impact of HPV vaccination
- Explain the expected public health benefits and potential risks of widespread HPV vaccination

Reading:

Wacholder S. Statistical issues in the design and analysis of human papillomavirus and cervical neoplasia. J Natl Cancer Inst Mongr 2003;31:125-30.

Steben M, Duarte-Franco E. Human papillomavirus infection: Epidemiology and pathophysiology. Gyn Oncol 2007;107:S2-5.

Schiffman M et al. Human papillomavirus and cervical cancer. Lancet 2007;370:890-907.

Koutsky LA et al. A controlled trial of human papillomavirus type 16 vaccine. N Engl J Med 2002;347:1645-51.

Garland SM et al. Quadrivalent vaccine against human papillomavirus to prevent anogenital diseases. N Engl J Med 2007;356:1928-43.

The Future II Study Group. Quadrivalent vaccine against Human Papillomavirus to prevent high grade cervical lesions. New Engl J Med 2007;356:1915-27.

Giuliano AR et al. Epidemiology of human papillomavirus infection in men, cancers other than cervical and benign conditions. Vaccine 2008;26S:K17-28.

Assignment: Come to class prepared to discuss the following:

- 1) In the papers by Koutsky, Garland and the Future II Study Group, what was the primary endpoint? What was the rationale for choosing the endpoints, and what were its limitations?
- 2) Should HPV vaccination be mandatory for girls entering sixth grade?
- 3) What are the benefits of male HPV vaccination at the individual level? The population level?

Session 10 – Epidemiologic Methods for Sexually Transmitted Infections: Effect of Chlamydia Screening on Reproductive Sequelae

Friday
Oct 28
14h-17h

Learning Objectives:

- Explain the natural history of *Chlamydia trachomatis* infection and its link to infertility
- Compare the benefits and limitations of different organizational approaches to chlamydia screening, including register-based screening and opportunistic screening
- Describe the methodological challenges related to measurement of outcomes in studies of the effectiveness of chlamydia screening

Reading:

Textbook Chapter 23: Sexually Transmitted Diseases

Johnson RE, Berman SM. Sexual Transmission: *Chlamydia trachomatis*. In: Kramer A, Kretzschmar M, Krickeberg K (eds). *Modern Infectious Disease Epidemiology*. New York: Springer; 2009:357-380.

Haggerty Cl, Gottlieb SM, Taylor BD, Low N, Xu F, Ness RB. Risk of sequelae after *Chlamydia trachomatis* genital infection in women. *J Infect Dis* 2010; 201 (Suppl 2):S134-S155.

Gottlieb SL, Berman SM, Low N. Screening and treatment to prevent sequelae in women with *Chlamydia trachomatis* genital infection: how much do we know? *J Infect Dis* 2010; 201 (Suppl 2):S156-S167.

Low N, Bender N, Nartey L, Shang A, Stephenson JM. Effectiveness of Chlamydia screening: systematic review. *Int J Epidemiol* 2009; 38:435-48.

Master of Public Health - Semester 3

Week 43: from Monday 24th to Friday 28th of October 2011

Module 210 Minor A: “Infectious Disease Epidemiology”

Coordinator: Dr. Andrea HOWARD

Location: Reid Hall 4 rue de Chevreuse – 75006 PARIS

Monday October 24th	Tuesday October 25th	Wednesday October 26th	Thursday October 27th	Friday October 28th
<p>9h Introduction to Infectious Disease Epidemiology</p> <p>Andrea Howard, Columbia University</p>	<p>9h Evaluation of Diagnostic Tests and Treating Latent Infection as a Control Strategy: Tuberculosis</p> <p>Andrea Howard, Columbia University</p>	<p>9h Molecular Methods used in Infectious Disease Epidemiology and Healthcare Associated Infections: Methicillin Resistant <i>Staphylococcal aureus</i></p> <p>Andrea Howard, Columbia University</p>	<p>9h Epidemiologic Methods for Measuring Transmission and Control of Respiratory Infections: Influenza A (H1N1)</p> <p>Andrea Howard, Columbia University</p>	<p>9h Choosing Biologic Outcomes and Developing Immunization Policy: The Human Papillomavirus Vaccine to Prevent Cervical Cancer</p> <p>Andrea Howard, Columbia University</p>
12h : Lunch	12h : Lunch	12h : Lunch	12h : Lunch	12h : Lunch
<p>14h Causal Inference, Mathematical Modelling and the Development of Public Health Policy: Male Circumcision to Prevent HIV Transmission</p> <p>Andrea Howard, Columbia University</p> <p>17h</p>	<p>14h Infectious Disease Surveillance</p> <p>Outbreak Detection and Investigation of Foodborne Illness</p> <p>Andrea Howard, Columbia University</p> <p>17h</p>	<p>14h Epidemiology and Control of Malaria</p> <p>Jacques Lebras, Malaria French Reference Centre (CNR Palu), University Paris</p> <p>17h</p>	<p>14h Epidemiologic Methods for Measuring Transmission and Control of Viral Hepatitis</p> <p>Andrea Howard, Columbia University</p> <p>17h</p>	<p>14h Epidemiologic Methods for Sexually transmitted Infections: Effect of Chlamydia Screening on Reproductive Sequelae</p> <p>Andrea Howard, Columbia University</p> <p>16h30: Module evaluation 17h</p>