EPIDEMIOLoGY OF MICROBIAL DISEASES

[ EMD 512, Immunology for Epidemiologists ]
This course is designed to introduce students to the fundamentals of immunology including antigens, antibodies, methods for detecting antibodies, cells of the immune system, products of such cells, and immune mechanisms. Experience is gained in the analysis of primary research papers with relevance to immunologic aspects of epidemiologic studies. Prerequisite: two terms of college biology.  1 Course cr

EMD 517a, Principles of Infectious Diseases I  Melinda Pettigrew
This course explores the epidemiology and biology of infectious agents and the diseases they cause. Through a theme-based, integrated approach, students learn about the epidemiology, pathogenesis, prevention, and control of bacteria, viruses, and eukaryotic parasites of public health importance. Emphasis is placed on epidemiological methods, routes of transmission, host-pathogen interactions, and mechanisms of virulence. The course also teaches skills for understanding and evaluating the published literature, specifically through class discussions and oral presentations of assigned readings by students. Topics covered include gastrointestinal, respiratory, and sexually transmitted pathogens.

EMD 517b, Principles of Infectious Diseases II  Amy Bei
This course explores the epidemiology and biology of infectious agents and the diseases they cause. Through a theme-based, integrated approach, students learn about the epidemiology, pathogenesis, prevention, and control of bacteria, viruses, and eukaryotic parasites of public health importance. Emphasis is placed on epidemiological methods, routes of transmission, host-pathogen interactions, and mechanisms of virulence. The course also teaches skills for understanding and evaluating the published literature, specifically through class discussions and oral presentations of assigned readings by students. The course builds upon concepts covered in EMD 517 and introduces new topics such as infectious causes of chronic diseases; and vector-borne, zoonotic, and emerging pathogens.

EMD 525a and EMD 526b, Seminar in Epidemiology of Microbial Diseases  Nathan Grubaugh
This is a weekly seminar series offered by EMD faculty. The presentations describe the ongoing research activities in faculty laboratories as well as in EMD-affiliated centers. The talks introduce the department's research activities as well as associated resources in the area. Although no credit or grade is awarded, satisfactory performance will be noted on the student's transcript.  0 Course cr per term

EMD 530b, Health Care Epidemiology: Improving Health Care Quality through Infection Prevention  Louise-Marie Dembry and David Banach
The history, descriptive epidemiology, surveillance methods, risk analysis methods, and economics of nosocomial infections are outlined in this introductory course. In-depth explorations of host, agent, and environmental factors influencing typical nosocomial illnesses in pediatric and adult services are reviewed by clinical faculty. Descriptive and analytical epidemiological methods are emphasized.

EMD 531b, Genomic Epidemiology of Infectious Diseases  Nathan Grubaugh
This course provides an overview of how we can harness microbial evolution to study epidemiology. During the first part of the course, students learn the basic skills to implement next-generation sequencing and phylogenetic approaches to investigate different stages of infectious disease outbreaks. During the second part, students critically evaluate genomic epidemiology case studies to understand the applications and limitations of genomic data, what aspects can be used to inform outbreak responses, and how the information can be communicated to the public. The course consists of lectures, group discussions, computer exercises, and student presentations.

EMD 533a, Implementation Science  J. Lucian (Luke) Davis
Implementation science can be defined as the study of facilitators and barriers to the adoption and integration of evidence-based practices into health care policy and delivery. Examples include comparisons of multiple evidence-based interventions; adaptation of interventions according to population and setting; approaches to scale-up of effective interventions; and development of innovative approaches to improve health care delivery and health. This course explores implementation science using a seminar format; each session begins with a brief presentation of focal topic content followed by critical thinking and dialogue. Students apply the content each week in the development of a potential research project using implementation science in their area of interest and expertise. Throughout the course, faculty and students bring case studies and illustrations from the literature to illustrate key concepts and challenges in the conceptualization and implementation of studies using these methods.

[ EMD 535, Urban Sanitation: The United States and Peru ]
This interdisciplinary course examines the challenges posed by the growing volumes of human waste (urine, feces, menstrual blood) that are generated daily in cities around the world. Topics to be covered include environmental, engineering, and public health aspects of sanitation; the history of sanitation; innovation in sanitation; sewage reuse; cultural and social considerations; and case studies of different centralized and decentralized solutions. The course is organized around two final projects: (1) a spring-break trip to Lima, Peru, where students will observe firsthand some of the components of this complex sanitation system, and will meet with stakeholders ranging from government officials to slum-dwellers to nonprofits pursuing innovative sanitation solutions; and (2) a U.S.-based analysis of a comparable sanitation system. Enrollment limited to twelve students each from the School of the Environment, the School of Public Health, and the Department of Chemical & Environmental Engineering. Prerequisite: EHS 537/EMD 537.  1 Course cr

[ EMD 536, Investigation of Disease Outbreaks ]
This is a course about the investigation of acute disease outbreaks by public health departments in the United States. The focus is on public health practice, not public health research. We expect students to have a basic understanding of epidemiology. Topics include
roles and responsibilities of local, state, and national public health agencies; legal framework for conducting outbreak investigations; public health practice vs. research; confidentiality laws and the need to release identifiable health information to prevent new cases of an infectious disease; crisis and emergency risk communication; incident command; and joint investigations with law enforcement. A theme throughout the course: can epidemiology provide information in real time to guide the implementation of control and prevention measures? Offered every other year. Prerequisite: EPH 508. 1 Course cr

**EMD 537a / EHS 537a, Water, Sanitation, and Global Health**  Ying Chen and Elsio Wunder
Water is essential for life, and yet unsafe water poses threats to human health globally, from the poorest to the wealthiest countries. More than two billion people around the world lack access to clean, safe drinking water, hygiene, and sanitation (WASH). This course focuses on the role of water in human health from a public health perspective. The course provides a broad overview of the important relationships between water quality, human health, and the global burden of waterborne diseases. It discusses the basics of water compartments and the health effects from exposures to pathogenic microbes and toxic chemicals in drinking water. It also covers different sanitation solutions to improve water quality and disease prevention and discusses future challenges and the need for intervention strategies in the new millennium.

**EMD 538a, Quantitative Methods for Infectious Disease Epidemiology**  Virginia Pitzer
This course provides an overview of statistical and analytical methods that apply specifically to infectious diseases. The assumption of independent outcomes among individuals that underlies most traditional statistical methods often does not apply to infections that can be transmitted from person to person. Therefore, novel methods are often needed to address the unique challenges posed by infectious disease data. Topics include analysis of outbreak data, estimation of vaccine efficacy, time series methods, and Markov models. The course consists of lectures and computer labs in which students gain experience analyzing example problems using a flexible computer programming language (MATLAB).

**EMD 539b, Introduction to Public Health Surveillance**  Daniel Weinberger
Surveillance is one of the fundamental activities of public health organizations and is critical for understanding disease burden, impacts of interventions, and the detection of unusual events. The first part of the course provides an overview of the types of surveillance systems and their strengths and weaknesses, sources of data for surveillance, and controversies resulting from surveillance activities. The second part focuses on methods used to analyze surveillance data, with a particular focus on practical application. There is a focus throughout on the critical evaluation of surveillance data from different sources.

**EMD 541b, Health in Humanitarian Crises**  Kaveh Khoshnood
This course educates students about humanitarian crises and their impact on population health. It provides foundational knowledge and insights about the humanitarian system and public health interventions to mitigate the impact of humanitarian crises on population health.

[ EMD 542E, Introduction to Public Health Modeling ]
Public health modeling is a powerful systems-based approach to understand and manage the complex forces that drive the health of populations. In this course students gain understanding of the main applications of different modeling approaches and the types of scientific questions that can be answered using modeling methods; acquire knowledge of key modeling concepts and techniques necessary to understand and interpret scientific literature; and develop skills necessary to critically evaluate the role of assumptions and uncertainty in model validity. Open only to students enrolled in the Executive Online M.P.H. Program. 1 Course cr

**EMD 546b, Vaccines and Vaccine-Preventable Diseases**  Saad Omer and Inci Yildirim
This course develops in-depth understanding of epidemiological, biological, and applied aspects of commonly used and developing vaccines and vaccine-preventable diseases (VPDs) of public health importance. The course content is structured to review specific vaccines and VPDs. Where relevant, the course lectures use examples from both developed and developing countries. This course and EPH 510 are designed to complement each other. Students interested in a focus on epidemiological, biological, and applied aspects of vaccines and VPDs should take this course, whereas students interested in learning more about the making, understanding, and consequences of health policy decisions on vaccines should take EPH 510.

**EMD 548b, Observing Earth from Space**  Xuhui Lee
A practical introduction to satellite image analysis of Earth’s surface. Topics include the spectrum of electromagnetic radiation, satellite-borne radiometers, data transmission and storage, computer image analysis, the merging of satellite imagery with GIS and applications to weather and climate, oceanography, surficial geology, ecology and epidemiology, forestry, agriculture, archaeology, and watershed management. Prerequisites: college-level physics or chemistry, two courses in geology and natural science of the environment or equivalents, and computer literacy.

[ EMD 550, Biology of Insect Disease Vectors ]
Insects transmit pathogens that cause many emerging and reemerging human and agriculture-related diseases. Many of these diseases, which are referred to as neglected tropical diseases (NTDs), have a dramatically negative impact on human health in the developing world. Furthermore, they cause indirect devastation by significantly reducing agricultural productivity and nutrient availability, exacerbating poverty and deepening disparities. This course introduces students to the biological interactions that occur between major groups of important disease vectors and the pathogens they transmit. Lectures cover current research trends that relate to the ecology and physiology of insect vectors. Course content focuses on how these aspects of vector biology relate to the development and implementation
of innovative and effective disease-control strategies. Offered every other year. Prerequisite: full year of college/university-level biology, or permission of the instructor(s). 1 Course cr

**EMD 553b, Transmission Dynamic Models for Understanding Infectious Diseases**  Theodore Cohen  
This course is an introduction to the use of transmission dynamic models as tools for studying the complex patterns that arise from the interaction between pathogens and hosts. Topics covered include the structure, parameterization, and analysis of simple mathematical models. Questions addressed include: Why do some pathogens fail to spread effectively in a host community while others increase in prevalence before eventual elimination? Why do some infections oscillate in frequency while others occur at relatively constant levels over long periods of time? How is it possible that an intervention could perversely increase the burden of disease in the community, even as it reduces the overall prevalence of infection? The course consists of lectures and practical exercises in which students gain experience designing and manipulating mathematical models of infectious diseases by hand and with the open-source programming language R. Knowledge of algebra is assumed, and familiarity with basic calculus concepts is helpful. There are no formal prerequisites, but students without any familiarity with infectious diseases are encouraged to contact the instructor before registering. This course is required of students in the Public Health Modeling Concentration.

**EMD 562a or b, Laboratory and Field Studies in Infectious Diseases**  Christian Tschudi  
The student gains hands-on training in laboratory or epidemiologic research techniques. The term is spent working with EMD faculty in a single laboratory or epidemiology research group. Students choosing to work in the laboratory gain experience in molecular biology, basic immunology, parasitology, virology, bacteriology, or vector biology. Students may also choose to work on a non-laboratory-based epidemiology research project. These students gain experience in epidemiologic methods including study design; field data collection including human cases, vectors, and environmental parameters; data analysis; and epidemiologic modeling. Permission of the instructor required.

**EMD 567a, Tackling the Big Three: Malaria, TB, and HIV in Resource-Limited Settings**  Sunil Parikh  
Malaria, tuberculosis, and HIV account for more than five million deaths worldwide each year. This course provides a deep foundation for understanding these pathogens and explores the public health issues that surround these infectious diseases in resource-limited settings. Emphasis is placed on issues in Africa, but contrasts for each disease are provided in the broader developing world. The course is divided into three sections, each focusing in depth on the individual infectious disease as well as discussions of interactions among the three diseases. The sections consist of three to four lectures each on the biology, individual consequences, and community/public health impact of each infectious disease. Discussion of ongoing, field-based research projects involving the diseases is led by relevant faculty (research into practice). The course culminates with a critical discussion of major public health programmatic efforts to tackle these diseases, such as those of PEPFAR, the Bill & Melinda Gates Foundation, the Global Fund, and the Stop TB Partnership. Prerequisite: EMD 518.

**EMD 570b, Ethical Issues in Global Public Health: Practice, Research, and Policy**  Laura Bothwell  
The purpose of this course is to foster sophisticated ethical reasoning so that students may apply and negotiate different ethical principles in relation to major current public health challenges at a global scale. The course examines ethical frameworks across cultures and considers social, regulatory, and historical context of ethical constructs and applications. Public health practitioners, researchers, regulators, and policy makers encounter important ethical imperatives across different settings, including attention to matters of race, gender, and socioeconomic background; consideration of vulnerable populations; human rights; justice; equity; solidarity; respect for persons; navigating individual liberty and population interdependence; transparency; and avoiding conflicts of interest. We explore how these ethical issues come into play in myriad realms of public health research, practice, and policy making. The course is designed to serve any students with an interest in ethics as well as students in the Global Health Concentration, Climate Change and Health Concentration, and Regulatory Affairs Track.

**EMD 580a / HPM 580a, Reforming Health Systems: Using Data to Improve Health in Low- and Middle-Income Countries**  Robert Hecht  
Health systems in low- and middle-income countries are in constant flux in the face of myriad pressures and demands, including those emanating from the current COVID-19 pandemic. Under such conditions, how can senior country officials and their international partners make the best decisions to reform health systems to achieve universal coverage and improve the allocation and use of resources to maximize health gains, including on scale-up of programs to fight infectious diseases and address other health problems? The course provides students with a thorough understanding of health systems, health reforms, and scaling up— their components, performance, and impacts—by teaching the key tools and data sources needed to assess options and make coherent and effective policy and financing choices. Using these frameworks, students analyze case examples of major country reforms and of scaling up of national disease programs (e.g., AIDS treatment, immunization, safe motherhood, mental health services, cardiovascular illness prevention, etc.) and prepare a paper applying what they have learned to real-world health systems challenges. This course is open to all Yale students with interest in the topic. A knowledge of global health, health policy, and health economics and financing is desirable but not required.

**EMD 582b, Political Epidemiology**  Gregg Gonsalves  
Political epidemiology is the study of the impact of welfare regimes, political institutions, and specific policies on health and health equity. This course emphasizes the last among these—the effects of specific policies—on health outcomes in infectious diseases and other areas of human health and development. The course takes an issues- and methods-based approach, looking at how to evaluate the effects of political determinants of health (e.g., immigration, education, fiscal and environmental policies) through experimental and quasi-experimental methods, as well as various techniques associated with policy modeling (e.g., Markov models, systems dynamics,
microsimulation, spatial models). Prerequisites: EPH 505 or a similar introductory course in statistics. S&DS 541, MATH 241, or a similar introductory course in probability is recommended but not required, and a review of probability is offered in the first discussion section.

[ EMD 584, Advanced Global Health Justice Practicum: Fieldwork ]
The course is primarily for students who previously have enrolled in EMD 596/SBS 596; however, new students will be considered. Permission of the instructor required. 1 Course cr

EMD 588a or b / SBS 588a or b, Health Justice Practicum  Ali Miller, Gregg Gonsalves, and Amy Kapczynski
This is an experiential learning course focused on domestic and transnational health justice work. Health justice work focuses on health equity and is committed to addressing the fundamental social causes of disease. It also emphasizes power-building and political economy, instead of viewing health as a technocratic field where issues are resolved through application of expertise alone. Students work on projects supervised by faculty and in collaboration with outside partners. Projects change according to the needs of our partners and are generally determined at the beginning of each term. Credits vary according to the time commitment required by the projects. The course is designed for public health and law students, but other students may enroll where appropriate given project needs. Permission of the instructors required. The class is designed for students who are also taking, or have taken, EMD 596/SBS 596, but exceptions may be made in particular cases. An application must be submitted to health.justice@yale.edu. YSPH students should submit a CV and a statement of interest in policy and legal issues related to health, and any relevant courses or other experiences at the law/policy/health intersection. Instructors will communicate the deadline for application to all students prior to the start of each term. This course meets according to the Law School calendar and may establish special sessions and makeup sessions to accommodate any difference between schedules on the main campus and in the Law School.

EMD 596b / SBS 596b, Health Justice: Theory to Practice  Ali Miller, Gregg Gonsalves, and Amy Kapczynski
This course is an intensive introduction to the social, economic, political, and legal determinants of health, developed through readings and classroom discussion. We use a health justice lens to explore the historical structures and policy choices that have shaped health equity, primarily in the United States but with some attention to global and planetary health as well. We evaluate the role of race, class, and gender in structuring vulnerability, and explore the ability of technical versus power-building approaches to advance health justice and health equity. We also regularly bring guests to class to help us integrate theory and practice, with speakers chosen to help introduce us to real-world campaigns and movements to address the health issues involved in the class readings. The course is designed as a gateway or accompaniment to EMD 588/SBS 588, but students are not required to enroll in the practicum. The course is designed for public health and law students, though students from other disciplines are also encouraged to apply. Permission of the instructors required. An application must be submitted to health.justice@yale.edu. YSPH students should submit a CV and a statement of interest in policy and legal issues related to health, and any relevant courses or other experiences at the law/policy/health intersection. Instructors will communicate the deadline for application to all students prior to the start of each term. This course meets according to the Law School calendar and may establish special sessions and makeup sessions to accommodate any difference between schedules on the main campus and in the Law School.

EMD 600a or b, Independent Study or Directed Readings  Staff
Independent study or directed readings on a specific research topic agreed upon by faculty and student. By arrangement with faculty. For M.S. and Ph.D. students only.

EMD 625b, How to Develop, Write, and Evaluate an NIH Proposal  Christian Tschudi
This pragmatic skills-building course aims to provide a mentored, guided structure for developing a significant research project and leads students through the steps of assembling a grant application following the NIH mechanism: either the predoctoral National Research Service Award (NRSA, F31) or the Exploratory/Developmental Research Grant Award (R21). Students are provided detailed information on each aspect of NIH grants: fundamentals of good grant writing, general preparation of grant application (e.g., specific aims, research strategy, analysis of reviews, and strategies of rebuttal and reapplication), identifying study sections, program officers and scientific review officers (SROs), research strategy, and detailed descriptions of the different types of funding mechanisms. Students develop skills to objectively review an NIH grant proposal and write a scientific critique.

EMD 670a and EMD 671b and EMD 672a, Advanced Research Laboratories  Virginia Pitzer
This course is required of all EMD Ph.D. students and is taken for three terms. The course offers experience in directed research and reading in selected research laboratories. The first two terms must be taken in the first year of the doctoral program, and the third term is normally taken in the summer after the first year. Open only to doctoral students.

[ EMD 680, Advanced Topics in Tropical Parasitic Diseases ]
An introductory topic-based course in modern parasitology. For each topic there is an introductory lecture followed by a journal-club-like discussion session of relevant papers selected from the literature. The course provides an introduction to basic biological concepts of parasitic eukaryotes causing diseases in humans. Topics include strategies used by parasitic eukaryotes to establish infections in the host and approaches to disease control, through either chemotherapy, vaccines, or genomics. In addition, emphasis is placed on evaluating the quality and limitation of scientific publications and developing skills in scientific communication. Prerequisite: permission of the instructor. 1 Course cr