EPIDEMIOLOGY OF MICROBIAL DISEASES

EMD 512b, Immunology for Public Health Professionals Richard Bungiro
This course provides an introduction to the organization and function of the mammalian immune system. Topics include immune molecules, cells, and organs; innate and adaptive immunity; the molecular basis of antigen recognition; immune cell development, activation, and interaction; immune regulation, dysregulation, and manipulation; methods for analyzing immune responses; responses to infection; and immunologically relevant issues including vaccination, transplantation, autoimmunity, immunodeficiency, and cancer. By the end of the course students understand the major components of the human immune system, the general timeline of an immune response, how immune cells and molecules react to infections, how the science of immunology has developed over time, and the ways that modern medicine uses that knowledge to manipulate the immune response to save lives and improve health. This course is appropriate for any EPH student with a basic knowledge of biology (which is typically—but not exclusively—acquired from a high school or college general biology course) who wants to expand their knowledge by gaining an understanding of the mammalian immune system. It provides a foundation for and is complementary to numerous other EMD courses in infectious disease, global health and vaccine science.

EMD 517a, Principles of Infectious Diseases I Michael Cappello
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 518b, 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 Michael Cappello
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. o Course cr per term

[EMD 530, Health Care Epidemiology: Improving Health Care Quality through Infection Prevention]
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. 1 Course cr

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. Not open to auditors.

EMD 536b, Outbreak Investigations: Principles and Practice Albert Ko
Epidemiologists are often called in to investigate outbreaks and epidemics, as exemplified by the key role they served during the COVID-19 pandemic. This course teaches students why and how outbreaks are investigated. They learn how to identify the important epidemiological questions during an outbreak and apply epidemiological tools to achieve answers to these questions. The course builds upon and extends the basic principles in the biology, epidemiology, and transmission dynamics of infectious diseases as they apply to outbreaks and pandemics and why they emerge and recede. Furthermore, we explore the many behind-the-scene facets of an outbreak investigation, which include the key actors in an investigation and the public health response, communication, and decision-making making processes. The principles and practice of outbreak investigations are taught through lectures and case studies of real-life examples of outbreaks, including the COVID-19 pandemic. The course is

appropriate for all students enrolled in M.P.H., M.S. or doctoral degree programs in public health. Students should have taken or be concurrently taking a basic course in epidemiology (e.g. EPH 508, Foundations of Epidemiology for Public Health) and a basic course in biostatistics (e.g., EPH 505, Biostatistics in Public Health). Basic fluency in analyzing data with statistical software is recommended.

EMD 537a / EHS 537a, Water, Sanitation, and Global Health Ying Chen
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 the Analysis and Interpretation of Public Health Surveillance Data 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 weakness, 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 546a, Vaccines and Vaccine-Preventable Diseases Inci Yildirim
This course develops in-depth understanding of epidemiological, biological, and applied aspects of commonly used 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, Health Policy and Health Care Systems, 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, Health Policy and Health Care Systems course.

EMD 550a, Epidemiology and Control of Vector Borne Diseases Serap Aksoy and Brian Weiss

This course offers a trans-disciplinary view of vector-borne diseases (VBDs) transmitted by arthropods to humans. Topics covered introduce VBDs of global public health significance, as well as the epidemiology and biological and ecological drivers that lead to VBD transmission. Lectures cover state-of-the-art topics in vector biology research, with particular attention paid to translational implications for vector control strategies designed to reduce disease. Course content is designed to enable students to increasingly understand how a One Health approach is crucial to advance the control of VBDs.

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 563a or b, Laboratory and Field Studies in Infectious Diseases Kaveh Khoshnood

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 epidemiological modeling. Permission of the instructor required.

EMD 565b, Laboratory Methods for Infectious Diseases Chantal Vogels
This course provides students with a foundation in the principles of molecular biology to study the epidemiology of infectious diseases. Recent technological advances have facilitated studies on the epidemiology of (re-)emerging pathogens and development of novel prevention and control strategies, leading to breakthroughs in molecular epidemiology. Emphasis is on understanding the molecular basis of commonly used laboratory techniques in public health, the application of molecular methods to answer questions in infectious disease epidemiology, and the critical evaluation and interpretation of molecular data used to inform policy. Active learning is achieved through a variety of lectures, exercises, discussions, case studies, and a site visit. This course is intended for students with diverse future career trajectories from laboratory, to field, to policy, who want to gain a high level of proficiency in the application of molecular epidemiology to advance public health. This course is appropriate for MPH, MS, and doctoral degree students in public health or related fields. Students should have a basic understanding of molecular biology, microbiology, and/or infectious diseases, but no other prior experience is required.

EMD 566b, Practical Methods in Epidemiological Field Research Brian Wahl
This course provides comprehensive training in designing and conducting epidemiological field research, particularly in global health settings. Students learn to transform research concepts into operational studies through hands-on learning and case-based scenarios. The course bridges the gap between epidemiological theory and field implementation by focusing on the practical challenges and solutions in conducting research in diverse global contexts. Students develop the technical and operational skills essential for successful field studies through applied exercises drawn from real-world examples. The course spans the research lifecycle—from protocol development and community engagement through data system management and dissemination. While primarily focused on quantitative methods, the course also covers essential qualitative approaches. This course is appropriate for M.P.H., M.S., and Ph.D. students who have completed basic epidemiology and biostatistics coursework and are interested in conducting community-based research. Biostatistics in Public Health and Foundations of Epidemiology for Public Health are pre-requisites for this course. Specifically, the study design and sample size calculation components will require an understanding of biostatistics and epidemiology.

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.

EMD 568a, Global Change and Infectious Disease Epidemiology Colin Carlson
This course explores infectious disease epidemiology and public health practice in a world that has been transformed by human influence on the biosphere. The course is divided into three modules, focused on: (1) the role of anthropogenic environmental change in the process of zoonotic and vector-borne disease emergence, including new epidemic and pandemic threats; (2) the effects of climate change on infectious disease dynamics in humans and animals; and (3) levers for intervention to curb environmental drivers of disease risk or reduce their impact on human health and health systems. A primary aim of this course is to expose students to different frameworks for study design and causal inference, including approaches from epidemiology, ecology, econometrics, and anthropology. Suggested prerequisite: Principles of Infectious Diseases I or equivalent survey course on major infectious diseases *or* permission of the instructor. Students would benefit from a working familiarity with major kinds of pathogen life cycles/major categories of global health burden in order to contextualize the material/dive deeper into the ecology and epidemiology of these pathogens.

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 588a or b / SBS 588a or b, Health Justice Practicum Staff
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 emphases 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. Law students should apply via the ordinary clinical bidding process. Students in other schools should submit a CV and a statement of interest to health.justice@yale.edu; the deadline for application should be confirmed with the instructor, typically in August for fall and November for spring. 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 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.