



**MS and PhD Guidelines for  
Graduate Students in Public Health  
2017-2018**

# Master of Science in Public Health

The Master of Science (M.S.) degree program in Public Health (PH) is designed with an emphasis on mastering the skills in individual specialty areas within public health. Programs are currently offered in Biostatistics and Chronic Disease Epidemiology. The length of study leading to the M.S. degree is two years full-time for the Biostatistics track and one year full-time for the Chronic Disease Epidemiology track. Part-time students must complete the degree within five years of matriculation.

The M.S. in PH is offered through the School's affiliation with the Graduate School of Arts and Sciences. The Graduate Studies Executive Committee (GSEC) and the director of graduate studies (DGS) are responsible for overseeing the progress of M.S. students.

## BIOSTATISTICS TRACK (BIS)

The M.S. in Biostatistics is a two-year program. It is designed to train students to meet the growing need in managed care organizations, medical research, and the pharmaceutical industry for graduates with technical skills in data analysis. In contrast to the more general M.P.H. degree, the M.S. degree emphasizes the mastery of biostatistical skills from the beginning of the plan of study. While graduates of this program may apply to the Ph.D. degree program, the M.S. degree is itself quite marketable as a terminal degree.

### *Degree Requirements*

The Biostatistics track requires the completion of fifteen required and elective courses (excluding EPH 600b; the Seminar, BIS 525a and b; and the Summer Internship, BIS 695c).

### *Curriculum*

#### REQUIRED COURSES

<i>Course number</i>	<i>Course title</i>	<i>Course units</i>
†BIS 525a and b	Seminar in Biostatistics and Journal Club	n/a
BIS 540a	Fundamentals of Clinical Trials	1
BIS 623a	Applied Regression Analysis	1
BIS 625a	Categorical Data Analysis	1
BIS 628b	Longitudinal and Multilevel Data Analysis	1
BIS 630b	Applied Survival Analysis	1
BIS 678a	Statistical Consulting	1
BIS 679a	Advanced Statistical Programming in SAS and R	1
BIS 681b	Statistical Consulting Lab	1
†BIS 695c	Summer Internship in Biostatistical Research	n/a
‡CDE 508a	Principles of Epidemiology I	1
†EPH 600a	Research Ethics and Responsibility	n/a
*S&DS 541a	Probability Theory	1
*S&DS 542b	Theory of Statistics	1

\*These courses are offered in the Graduate School of Arts and Sciences.

†These courses do not count toward the thirteen required courses.

‡Students entering the program with an M.P.H. or relevant graduate degree may be exempt.

In addition, students must complete two Biostatistics elective courses chosen from the list below and two Statistics and Data Science electives at the 600 level. Students will also be required to take a Professional Skills Seminar (dates and times announced during the fall term).

Biostatistics electives are to be selected from these courses: BIS 557a, Computational Statistics; BIS 567a, Bayesian Statistics; BIS 643b, Theory of Survival Analysis; BIS 646b, Nonparametric Statistical Methods and Their Applications; BIS 651b, Spatial Statistics in Public Health; and BIS 691b, Theory of Generalized Linear Models. Students demonstrating a mastery of topics covered by the required courses may replace them with more advanced courses but must receive written permission from the DGS prior to enrolling in the substitute courses.

### *Competencies*

Upon receiving an M.S. in the Biostatistics track of Public Health, the student will be able to:

- Describe advanced concepts of probability, random variation, and commonly used statistical probability distributions.
- Develop an efficient design for collecting, recording, and storing data collected in the conduct of public health and medical research.
- Develop sample size and statistical power calculations for basic study designs including those utilized in clinical trials.
- Design efficient computer programs for study management, statistical analysis, as well as presentation using SAS and other programming languages.
- Produce edited data sets suitable for statistical analyses.
- Apply advanced informatics techniques with vital statistics and public health records in the description of public health characteristics and in public health research and evaluation.
- Perform analyses of stated hypotheses using a variety of analytical tools including analysis of variance, multiple regression, nonparametric statistics, logistic regression, multivariate analyses, and methods for analyzing rates and failure-time data.
- Interpret results of advanced statistical analyses and use these results to make relevant inferences from data.
- Produce working tables and statistical summaries describing research in health science.
- Develop written presentations based on intermediate to advanced statistical analyses for both public health professionals and educated lay audiences.
- Develop oral presentations based on intermediate to advanced statistical analyses for both public health professionals and educated lay audiences.

### **CHRONIC DISEASE EPIDEMIOLOGY TRACK (CDE)**

There is a high demand for well-trained graduates in chronic disease epidemiology. This track provides intensive training in epidemiology and research methods for medical and health care professionals, or others seeking the skills necessary to conduct epidemiological research in their professional practice.

Applicants should have a basic understanding of quantitative science and statistics. It is recommended that candidates have strong science backgrounds and demonstrated competency in statistical analysis and logical thinking. Applicants from rigorous programs in the biological or social sciences will be given preference. At a minimum, applicants should have one year of course work in statistics or the equivalent prior to enrolling in this program. Summer courses are available to fulfill this requirement. Full-time applicants are preferred.

### *Degree Requirements*

The CDE track consists of required and elective course work and satisfactory completion of the Capstone experience. A total of ten courses is required (excluding EPH 600b and the Seminar, CDE 525a and b). It is expected that this program will be completed during a single academic year. Students with an M.P.H. or relevant graduate degree may be eligible to substitute advanced courses for some of the required courses. Written permission of the DGS is required prior to enrolling in substitute courses.

### *Curriculum*

#### REQUIRED COURSES

<i>Course number</i>	<i>Course title</i>	<i>Course units</i>
BIS 623a	Applied Regression Analysis	1
BIS 625a	Categorical Data Analysis	1
BIS 630b	Applied Survival Analysis	1
CDE/EMD 508a	Principles of Epidemiology I	1
CDE 516b	Principles of Epidemiology II	1
CDE 523b	Measurement Issues in Chronic Disease Epidemiology	1
†CDE 525a,b	Seminar in Chronic Disease Epidemiology/Social and Behavioral Sciences	n/a
*CDE 617b	Developing a Research Proposal	1
†EPH 600a	Research Ethics and Responsibility	n/a
Suggested electives (three courses are required):		
BIS 540a	Fundamentals of Clinical Trials	1
BIS 561b	Advanced Topics and Case Studies in Multicenter Clinical Trials	1
BIS 643b	Theory of Survival Analysis	1
BIS 645b	Statistical Methods in Human Genetics	1
CDE/EHS 520b	Case-Based Learning for Genetic and Environmental Diseases	1
CDE 532b	Epidemiology of Cancer	1
CDE 533b	Topics in Perinatal Epidemiology	1
CDE 535b	Epidemiology of Heart Disease and Stroke	1
CDE 562a	Nutrition and Chronic Disease	1
CDE 597a	Genetic Concepts in Public Health	1
*CDE 600a or b	Directed Readings	1

CDE 634a	Advanced Applied Analytical Methods in Epidemiology and Public Health	1
CDE 650a	Introduction to Evidence-Based Medicine and Health Care	1
SBS 531a	Health and Aging	1

\*In the capstone course CDE 617b, the student is required to develop a grant application that is deemed reasonably competitive by the instructor. An alternative to this capstone course is an individualized tutorial (CDE 600a or b), in which the student completes a manuscript that is suitable for submission for publication in a relevant journal.

†These courses do not count toward the ten required courses.

### *Competencies*

Upon receiving an M.S. in the Chronic Disease Epidemiology track of Public Health, the student will be able to:

- Explain and apply the terminology and definitions of epidemiology.
- Evaluate the scientific merit and feasibility of epidemiologic study designs.
- Describe the epidemiology of common chronic diseases.
- Synthesize information from a variety of epidemiologic and related studies.
- Design epidemiologic studies at an intermediate level.
- Analyze data and draw appropriate inferences from epidemiologic studies at an intermediate to advanced level, using a variety of analytical tools including multivariate logistic regression, Poisson regression, linear regression, and survival analysis.
- Write an epidemiologic research proposal or a publishable epidemiologic article.
- Identify, interpret, and use routinely collected data on disease occurrence.
- Review, critique, and evaluate epidemiologic reports and research articles at an intermediate level.

# Doctoral Degree

Doctoral training has been part of Yale's mission since early in its history. The University awarded the first Ph.D. in North America in 1861, and the doctoral program in public health began with the establishment of the department in 1915. Six years later, in 1922, Yale conferred the Doctor of Philosophy (Ph.D.) in Public Health on two candidates.

Within the Yale academic community, the Ph.D. is the highest degree awarded by the University. The School of Public Health offers studies toward the Ph.D. degree through its affiliation with the Graduate School of Arts and Sciences. The Graduate School makes the final decisions on accepting students into the program, admission to candidacy, and awarding the degree.

The primary mission of the doctoral program in Public Health (PH) is to provide scholars with the disciplinary background and skills required to contribute to the development of our understanding of better ways of measuring, maintaining, and improving the public's health. The core of such training includes the mastery of research tools in the specialty discipline chosen by the candidate. Public health spans disciplines that use tools available in the laboratory, field research, social sciences, the public policy arena, and mathematics. Students engage in a highly focused area of research reflecting scholarship at the doctoral level but are exposed to a broad view of public health as seen in the diverse research interests of the School's faculty.

## COMPETENCIES FOR THE PH.D. IN PUBLIC HEALTH

Upon receiving a Ph.D. in Public Health, the student will be able to:

- Critically evaluate public health and related literature.
- Discuss and critically evaluate the broad literature of the student's discipline.
- Review in depth the background and research advances in the student's specific research area.
- Apply at an advanced level the research methodology of the student's broader discipline and, in particular, the student's specific research area.
- Present research to colleagues and professionals on a national and international level at professional meetings.
- Design a course in the student's broad discipline.
- Explain the principles of research ethics and apply these principles to specific research projects.
- Design and conduct an advanced, original research project in the student's discipline.
- Generate data to create publishable manuscripts that represent important contributions to the literature.

## ACADEMIC ADVISING

Each student is assigned to an academic adviser at the time of matriculation. The academic adviser is available for help with general academic questions, course selections, choosing a dissertation project, and preparation for the qualifying examinations. A student may request a change of academic adviser by writing to the director of graduate studies (DGS). The request must be agreed upon by both the previous and new academic advisers.

## TEACHING FELLOWSHIPS

Teaching and research experiences are regarded as an integral aspect of the graduate training program. All doctoral students are required to serve as teaching fellows for a minimum of two terms, typically during years two and three. With the permission of the DGS, the total teaching requirement beyond two terms may be reduced for students who are awarded fellowships supported by outside funding or who serve as graduate research assistants in year three. Other exceptions may be granted after two terms of teaching are completed, with the approval of the DGS. During the first term of teaching, students must attend a training session conducted by the Center for Teaching and Learning. First-year students are encouraged to focus their efforts on course work and are not permitted to serve as teaching fellows.

## DEGREE REQUIREMENTS

There are six departments in PH in which doctoral students may choose a specialty. Requirements for each department vary and are outlined below under Departmental Requirements. In addition, all candidates for the Ph.D. degree must conform to the requirements of the Graduate School of Arts and Sciences.

### *Required Course Work*

Generally, the first two years are devoted primarily to course work. Each student must satisfactorily complete a minimum of ten courses or their equivalent and must satisfy the individual departmental requirements (see below for course requirements in each department). All first-year PH doctoral students are required to participate in a course covering both practical and theoretical issues in research ethics (EPH 600b, Research Ethics and Responsibility); this course is in addition to the minimum required courses. Additionally, all first-year students are required to enroll in EPH 608, Frontiers of Public Health. Students entering the Ph.D. program with an M.P.H. may be exempt from this course as determined by the DGS. The Graduate School requires that Ph.D. students achieve a grade of Honors in at least two full-term doctoral-level courses. Additionally students must maintain a High Pass average. (This applies to courses taken after matriculation in the Graduate School and during the nine-month academic year.)

### *Qualifying Examinations*

The required qualifying examinations are usually taken at the end of the second year of study. In order to meet the different departmental needs, each department has developed a qualifying examination format; details are provided in each departmental program description below. The qualifying examinations serve to demonstrate that the candidate has mastered the background and the research tools required for dissertation research. The qualifying examinations are usually scheduled in June, generally within a three-week period.

## Prospectus Guidelines

Before the end of the spring term of the third year, each student must submit a Dissertation Prospectus, i.e., a written summary of the planned nature and scope of the dissertation research, together with a provisional title for the dissertation. It is strongly recommended that students begin working with their thesis adviser on this process early in the third year. Ideally students should submit the names of Dissertation Advisory Committee (DAC) members during the fall term of the third year and then submit the prospectus during the spring term of the third year. Students must have both the DAC members and the prospectus approved by the end of the third year (May).

The DAC consists of at least three members, including the thesis adviser, who must have a Graduate School appointment and will chair the committee. Two members are expected to be Yale School of Public Health faculty, but participation of faculty members from other departments is encouraged. An additional committee member who is a recognized authority in the area of the dissertation may be selected from outside the University; a supporting curriculum vitae must be provided. The student should also submit a one-page specific aims (for the research plan) and a rationale for each committee member. The proposed DAC members must sign the one-page specific aims stating that they have agreed to serve on the committee. The Graduate Studies Executive Committee (GSEC) prefers that students submit this one-page specific aims document for approval prior to developing the prospectus. Once the GSEC approves the student's DAC and specific aims, the student works the DAC to develop the prospectus.

The purpose of the prospectus is to formalize an understanding between the student, the DAC, and the GSEC regarding the scholarship of a proposed dissertation project. The prospectus should:

- Provide a detailed description of the research plan as outlined below, including title, topic, background, significance, study questions, analytic plan, and methods;
- Establish a consensus between the student, the DAC, and the GSEC that the research plan meets the requisite standards of originality, scope, significance, and virtuosity;
- Formalize the DAC's willingness to work with the student to see the proposed research plan to successful completion.

The prospectus should be written in clear, plain English with minimal jargon, abbreviations, or colloquialisms and is limited to a *maximum* of twenty pages (double-spaced). All tables, graphs, figures, diagrams, and charts must be included within the twenty-page limit. References are not part of the page limit. Be succinct and remember that there is no requirement to use all twenty pages. A prospectus found not to comply with these requirements will be returned without review.

The following format should be used (similar to NIH guidelines):

1. Title of proposed dissertation (can be a working title).
2. Specific aims (one page): A self-contained description of the project, which should be informative to other persons working in the same or related fields. State concisely the goals of the proposed research and summarize the expected outcome(s), including the impact that the results of the proposed research will exert on the research field(s) involved.



3. Research strategy: Use the following subsections:
  - a. Significance: This section should place the research project in context and describe the proposed research in a manner intelligible to a nonspecialist. This should include a brief but critical evaluation of the relevant literature and a description of how the proposed research project will advance scientific knowledge and/or technical capability in one or more broad fields.
  - b. Innovation: Explain how the application challenges and seeks to shift current research paradigm(s). Describe any novel theoretical concepts, approaches or methodologies, instrumentation, or interventions to be developed or used, and any advantage(s) over existing methodologies, instrumentation, or interventions.
  - c. Approach: Outline the research project envisioned at this time and sketch out the plan to attain the overall goals of the project. Describe the overall strategy, methodology, and analyses to be used. Include preliminary data, if available. Acknowledge pitfalls and limitations of the research, and if possible suggest alternative strategies.
4. References: Should be included at the end (not counted in the page limit).

The prospectus submitted to the GSEC must be the version approved by the student's DAC and must be submitted together with the Submission of Dissertation Prospectus form.

The GSEC will review the prospectus and may request changes to either the DAC or the prospectus. Once the GSEC has approved the prospectus, it will be submitted to the Graduate School registrar.

Weekly meetings with the chair of the DAC are recommended. Regular face-to-face meetings of the full DAC are invaluable and are expected throughout the student's research toward the thesis. The DAC is expected to meet at least twice each year, and more frequently if necessary. Since dissertation progress reports at the Graduate School are due at the close of the spring term, it is advised that one of the meetings be scheduled in March or April. In doing so, the thesis adviser, student, and DGS will have current information on the student's progress for use in completing the dissertation progress report online. The student schedules the meetings of the DAC. The chairperson of the DAC, i.e., the thesis adviser, produces a summary report outlining progress and plans for the coming year. The document is to be distributed to the other committee members for comments. The student and the DGS are to receive a copy of the document from the DAC chair.

Because the prospectus is required fairly early in the dissertation research, the content of a thesis may change over time, and thus the student should not feel bound by what is submitted. However, major changes to the direction of research described in the prospectus should be discussed with the DAC and approved by the GSEC.

### *Admission to Candidacy*

After all predissertation requirements are successfully completed (course requirements for the chosen department, grades of Honors in at least two full-term doctoral-level courses, an overall High Pass average, pass the qualifying examination, and approval of the dissertation prospectus by the GSEC), the student will be admitted to candidacy

for the Ph.D. degree. These requirements are typically met in three years. Customarily, students who have not been admitted to candidacy will not be permitted to register for the fourth year. Exceptions must be approved in advance by the DGS and the Graduate School associate dean. When students advance to candidacy, the registrar's office automatically submits a petition for the awarding of the M.Phil. degree.

## THE THESIS/DISSERTATION

The Ph.D. thesis in PH should be of publishable quality and represent a substantial contribution to the advancement of knowledge in a field of scholarship. The Graduate School policy in regard to the dissertation is as follows:

The dissertation should demonstrate the student's mastery of relevant resources and methods and should make an original contribution to knowledge in the field. The originality of a dissertation may consist of the discovery of significant new information or principles of organization, the achievement of a new synthesis, the development of new methods or theories, or the application of established methods to new materials. Normally, it is expected that a dissertation will have a single topic, however broadly defined, and that all parts of the dissertation will be interrelated. This does not mean that sections of the dissertation cannot constitute essentially discrete units. Dissertations in the physical and biological sciences, for example, often present the results of several independent but related experiments. Given the diverse nature of the fields in which dissertations are written and the wide variety of topics that are explored, it is impossible to designate an ideal length for the dissertation. Clearly, however, a long dissertation is not necessarily a better one. The value of a dissertation ultimately depends on the quality of its thought and the clarity of its exposition. In consultation with their faculty advisers and the director of graduate studies, students should give serious thought to the scale of proposed dissertation topics. There should be a reasonable expectation that the project can be completed in two to three years.

The dissertation may be presented as a single monograph resulting in a major publication, or as (typically) a minimum of three first-authored scientific papers. One or more of the papers should be published, accepted for publication, or be in submission. The collected paper option does not imply that any combination of papers would be acceptable. For example, three papers related to background material (review papers), or three papers that reported associations of three unrelated exposures, or three papers of the same exposure but reporting different outcomes would not be acceptable. Rather, it is expected that the papers represent a cohesive, coherent, and integrated body of work. For example, one paper might be a systematic review and meta-analysis of the topic, another might develop a new methodological approach, and the third might apply those new methods to an area of current public health interest. In the collected paper option, the final thesis must include introductory and discussion chapters to summarize and integrate the published papers.

The DAC reviews the progress of the dissertation research and decides when the dissertation is ready to be submitted to the readers. This decision is made based on a closed defense of the dissertation. The dissertation defense involves a formal oral presentation

to the DAC and other invited faculty. Upon completion of the closed defense, the chair of the DAC submits its recommendation to the GSEC, and its recommendation of suitable readers.

There will be a minimum of three readers, one of whom is at YSPH. The second reader can be from YSPH or another Yale department. Both Yale readers must hold a Graduate School appointment, and at least one should be a senior faculty member. The third reader must be selected from outside the University. All readers must be recognized authorities in the area of the dissertation. The outside reader must submit a curriculum vitae for review by the GSEC. The outside reader should be an individual who has not coauthored a publication(s) with members of the student's DAC and/or the student within the preceding three years. However, this restriction does not apply to mega-multiauthored publications. Members of the DAC are not eligible to serve as readers. After the completed readers' reports are received by the Graduate School, they are reviewed by the DGS prior to making a School of Public Health recommendation to the Graduate School that the degree be awarded. The DAC may be asked to comment on the readers' reports before recommendations are made to the Graduate School.

### *Oral Presentation of the Doctoral Dissertation*

Doctor of Philosophy (Ph.D.) dissertations in PH must be presented in a public seminar. This presentation is scheduled after the closed defense, after submission of the dissertation to the readers, and preferably prior to the receipt and consideration of the readers' reports. At least one member each of the DAC and GSEC is expected to attend the presentation. It is expected to be presented during the academic term in which the dissertation was submitted and must be widely advertised within YSPH.

## DEPARTMENTAL REQUIREMENTS

The specific requirements with regard to courses, qualifying examinations, and admission to candidacy set by PH departments are described below.

### *Biostatistics*

Biostatistics involves the development and application of sound statistical and mathematical principles to research in the health sciences. Because original theoretical research in biostatistics flows from medical research, it is essential that the foundations of methodological development be firmly grounded in sound principles of statistical inference and a thorough knowledge of the substantive area that provides the source of the medical questions being addressed. Thus, the Department of Biostatistics encourages excellent methodological work that is motivated by sound science that includes but is not limited to active collaborations with other investigators.

Research collaborations for biostatisticians take place both within and across departments in YSPH, as well as with other departments in the School of Medicine and the University at large. Areas of current research include development of general methods that have wide applicability across different areas of health research, as well as more specific techniques for dealing with the underlying processes that give rise to the data of interest. A broad range of health topics addressed by students in this department include

chronic diseases such as cancer, genetic epidemiology, clinical research, and mathematical models for infectious diseases.

Graduates of the doctoral program in Biostatistics are employed in universities throughout the country, as well as in such dedicated research institutions as the National Institutes of Health. In addition, graduates have pursued careers in the pharmaceutical industry, in which they are actively involved in the evaluation of new therapeutic strategies.

#### REQUIRED COURSE WORK

Students in the department of Biostatistics prepare for their qualifying examination by taking the courses listed below. Course waivers must be recommended by the academic adviser and approved by the DGS.

<i>Course number</i>	<i>Course title</i>	<i>Course units</i>
BIS 525a and b	Seminar in Biostatistics and Journal Club	n/a
BIS 557a	Computational Statistics	1
BIS 567a	Bayesian Statistics	1
BIS 610b	Applied Area Readings for Qualifying Exams	1
BIS 628b	Longitudinal and Multilevel Data Analysis	1
BIS 643b	Theory of Survival Analysis	1
BIS 646b	Nonparametric Statistical Methods and Their Applications	1
BIS 678a	Statistical Consulting	1
BIS 681b	Statistical Consulting Lab	1
BIS 691b	Theory of Generalized Linear Models	1
BIS 695c	Summer Internship in Biostatistical Research	n/a
†CDE 508a	Principles of Epidemiology I	1
EPH 600a	Research Ethics and Responsibilities	n/a
†EPH 608b	Frontiers of Public Health	1
*S&DS 610a	Statistical Inference	1
*S&DS 612a	Linear Models	1

\*These courses are offered in the Graduate School of Arts and Sciences.

†Students entering the program with an M.P.H. degree may be exempt.

In consultation with their academic adviser, students choose a minimum of four additional electives that will best prepare them for dissertation work. Students funded by specific fellowships may be subject to additional requirements and should discuss this with their adviser.

#### QUALIFYING EXAMINATION

The qualifying examination has two parts, the first being a written examination that demonstrates competence with the use of statistical principles to develop methods of application. The second involves the critical review of the statistical literature, report writing, and oral defense of a specific biomedical topic agreed upon by the candidate and the BIS faculty adviser that will be evaluated by a committee approved by the BIS faculty.

## RESEARCH EXPERIENCE

In a number of courses, especially Statistical Consulting (BIS 678a), students gain actual experience with various aspects of research including preparation of a research grant, questionnaire design, preparation of a database for analysis, and analysis and interpretation of real data. In addition, doctoral students can gain research experience by working with faculty members on ongoing research studies prior to initiating dissertation research, which includes but is not limited to BIS 695c. During the summer following the first year of course work, candidates are required to take a research rotation that is approved by the department and communicated to the DGS.

## THE DISSERTATION

The department strives for doctoral dissertations that have a strong methodological component motivated by an important health question. Hence, the dissertation should include a methodological advance or a substantial modification of an existing method motivated by a set of data collected to address an important health question. The dissertation must also include the application of the proposed methodology to real data. A fairly routine application of widely available statistical methodology is not acceptable as a dissertation topic. Candidates are expected not only to show a thorough knowledge of the posed health question, but also to demonstrate quantitative skills necessary for the creation and application of novel statistical tools.

### *Chronic Disease Epidemiology*

Epidemiology is the study of disease in populations. Such populations may be groups of people in certain geographic areas, people with a common disease, or people with some suspected risk factor. The Department of Chronic Disease Epidemiology (CDE) has traditionally focused on either chronic or noninfectious diseases, although in recent years the artificiality of this distinction has become obvious and the view has been broadened. A recent thesis, for example concerned the perinatal transmission of HIV/AIDS, and others have examined the viral etiology of cancer.

The department is perhaps best known for its doctoral programs in the epidemiology of aging, cancer, perinatal diseases, genomics, HIV/AIDS, and psychosocial disorders. However, students in the department often work on projects with other departments within YSPH, other departments in the School of Medicine, and other schools within the University. Thus there are numerous opportunities for creating an experientially rich doctoral program.

Graduates from the department's doctoral program are found on the faculties of universities throughout the world, at the highest levels of federal and international research programs, and in leadership positions in numerous private and public foundations and institutions.

## REQUIRED COURSE WORK

Students in the CDE department are expected to complete a minimum of fifteen courses (not including CDE 610b, EPH 600a, and EPH 608b) from the following courses or their equivalents. Students supported by training grants may be subject to additional requirements and should discuss whether there are training-specific requirements with the principal investigator of the grant.

**Epidemiology concentration**

<i>Course number</i>	<i>Course title</i>	<i>Course units</i>
CDE/EHS 502b	Physiology for Public Health	1
CDE/EMD 508a	Principles of Epidemiology I	1
CDE 516b	Principles of Epidemiology II	1
CDE 523b	Measurement Issues in Chronic Disease Epidemiology	1
CDE 534b	Applied Analytic Methods in Epidemiology	1
CDE 610b	Applied Area Readings for Qualifying Exams	1
CDE 617b	Developing a Research Proposal	1
CDE 619a	Advanced Epidemiologic Research Methods	1
CDE 634a	Advanced Applied Analytic Methods in Epidemiology and Public Health	1
CDE 650a	Introduction to Evidence-Based Medicine and Health Care	1
EPH 600a	Research Ethics and Responsibilities	n/a
†EPH 608b	Frontiers of Public Health	1

In consultation with their dissertation adviser, students choose three 600-level course units in Biostatistics (S&DS 563, Multivariate Statistical Methods for Social Sciences, may serve as one of these three courses), as well as three additional electives that will best prepare them for their dissertation research.

†Students entering the program with an M.P.H. degree may be exempt.

**QUALIFYING EXAMINATION**

The qualifying examinations in CDE entail a three-part system emphasizing biostatistics, epidemiologic methods, and the student's chosen specialty area.

The examination covering epidemiological methods includes both an in-class and a take-home portion. One faculty member is responsible for coordinating this examination, and the examination content is developed by the overall faculty. The specialty area examination is usually prepared in a tutorial with one or more faculty members in the term prior to the exam.

**RESEARCH EXPERIENCE**

In a number of courses, students gain actual experience with various aspects of research including preparation of a research grant, questionnaire design, preparation of a database for analysis, and analysis and interpretation of real data. In addition, doctoral students can gain research experience by working with faculty members on ongoing research studies prior to initiating dissertation research.

**THE DISSERTATION**

For the doctoral dissertation, some candidates will design and develop their own research protocol, collect the data, and conduct appropriate analyses. However, epidemiologic studies are often large, time-consuming, and expensive enterprises that often cannot be realistically completed within the time frame expected for a doctoral dissertation. Consequently, some dissertations often result from “piggy-backing” the dissertation research

onto a larger study being conducted by a faculty member. If a student has previously documented experience with data collection, the doctoral dissertation may emphasize the statistical analysis of a data set in such a way as to address a new hypothesis. However the thesis is constructed, the department requires that the research makes a significant contribution to new knowledge in the field of epidemiology.

### *Environmental Health Sciences*

The Environmental Health Sciences (EHS) doctoral program focuses on how environmental agents—physical, chemical, and biological—affect human health, considered within the general framework of epidemiology and public health. Students are skilled in research, assessment, and evaluation of the impact of environmental stressors; they identify potentially adverse environmental agents, assess their exposures, determine their impact on health, and estimate the consequent risk. The Ph.D. emphasizes the preparation of students for scholarly careers in research and teaching.

The EHS doctoral program offers two concentrations: (1) Environmental Epidemiology & Exposure Science and (2) Environmental & Molecular Toxicology.

#### REQUIRED COURSE WORK

##### **Environmental Epidemiology & Exposure Science concentration**

<i>Course number</i>	<i>Course title</i>	<i>Course units</i>
BIS 505a	Introduction to Statistical Thinking I	1
BIS 505b	Introduction to Statistical Thinking II	1
CDE/EMD 508a	Principles of Epidemiology I	1
*EHS 503b	Public Health Toxicology	1
EHS 507a	Environmental Epidemiology	1
EHS 508b	Environmental and Occupational Exposure Science	1
*EHS 525a,b	Seminar and Journal Club in Environmental Health	n/a
EHS 600a	Research Ethics and Responsibilities	n/a
‡EHS 620a,b	Research Rotations	2
†EPH 608b	Frontiers of Public Health	1

\*Additional readings are assigned for Ph.D. students.

†Students entering the doctoral program with an M.P.H. degree are exempt from EPH 608b and may request waiver of other courses taken during the M.P.H.

‡Students give presentations at the end of the research rotation and are graded based on rotation work and presentation.

Recommended electives (four minimum), generally taken in the second year:

BIS 511a	GIS Applications in Epidemiology and Public Health	1
BIS 623a	Applied Regression Analysis	1
BIS 625a	Categorical Data Analysis	1
BIS 628b	Longitudinal and Multilevel Data Analysis	1
CDE 617b	Developing a Research Proposal	1
EHS/CDE 502b	Physiology for Public Health	1
EHS 511b	Principles of Risk Assessment	1
EHS 545b	Molecular Epidemiology	1
EHS 547a	Climate Change and Public Health	1

EHS 562b	Systems Technologies, Big Data, and Biomarkers	1
EHS 580b	Environmental Hormones and Human Health	1

### **Environmental & Molecular Toxicology concentration**

<i>Course number</i>	<i>Course title</i>	<i>Course units</i>
BIS 505a	Introduction to Statistical Thinking I	1
BIS 505b	Introduction to Statistical Thinking II	1
CDE/EMD 508a	Principles of Epidemiology I	1
*EHS 503b	Public Health Toxicology	1
*EHS 525a,b	Seminar and Journal Club in Environmental Health	n/a
EHS 545b	Molecular Epidemiology	1
EHS 600a	Research Ethics and Responsibilities	n/a
‡EHS 620a,b	Research Rotations	2
†EPH 608b	Frontiers of Public Health	1

\*Additional readings are assigned for Ph.D. students.

†Students entering the doctoral program with an M.P.H. degree are exempt from EPH 608b and may request waiver of other courses taken during the M.P.H.

‡Students give presentations at the end of the research rotation and are graded based on rotation work and presentation.

Recommended electives (five minimum), generally taken in the second year:

CDE 617b	Developing a Research Proposal	1
EHS 508b	Environmental and Occupational Exposure Science	1
EHS 537a	Water, Sanitation, and Global Health	1
EHS/CDE 502b	Physiology for Public Health	1
EHS 511b	Principles of Risk Assessment	1
EHS 547a	Climate Change and Public Health	1
EHS 562b	Systems Technologies, Big Data, and Biomarkers	1

### **QUALIFYING EXAMINATION**

A qualifying examination that will serve as the formal test prior to admission to candidacy for the Ph.D. program will be administered after completion of thirteen course units and generally before the end of the second year. Accordingly, the student should complete this examination within two years after entering the program. The student's DAC will administer this qualifying examination. The exam consists of an evaluation of a written prospectus and an oral presentation and defense of the research proposal. The proposal will be on the student's thesis project, written in NRSA format. Within two weeks of completing the written segment, the student will present and defend the thesis proposal to the dissertation advisory committee. The possible outcomes are (a) pass unconditionally, (b) pass conditionally, with further study suggested (or required) in one or more areas, or (c) fail, with or without the option to retake the examination after the areas of concern have been identified and the student has had time to prepare. If a student receives an unconditional pass, the committee should note whether it is an unconditional pass with distinction.

Once the student has passed the qualifying examination without conditions, and the GSEC has approved the prospectus, the student will be admitted to candidacy.



RESEARCH REQUIREMENTS

Two research rotations during the first academic year in EHS laboratories able to accommodate students are required of each student, one in the fall term and one in the second term. In consultation with the student’s academic adviser, an additional rotation may be offered during the summer between the first and second years. Research rotations will be available for both “dry” (i.e., statistical analysis) and “wet” (i.e., bench) laboratory research groups. The student will meet with the EHS graduate faculty member at the beginning of the rotation for an explanation of the goals and expectations of a student in the laboratory. The student will become familiar with the research models, approaches, and methods utilized by the research group through interactions with other laboratory/ research personnel and from laboratory manuscripts. The student is expected to spend at least fifteen hours per week working in the laboratory or research group and to present a rotation seminar at the end of the rotation period.

In years three and beyond, students are expected to present at least twice a year to their DAC and annually to the rest of the Ph.D. students and faculty in a departmental retreat or during an EHS Doctoral Research-in-Progress seminar.

*Epidemiology of Microbial Diseases*

The goals for doctoral students in the department of Epidemiology of Microbial Diseases (EMD) are to obtain a current theoretical and practical base of epidemiological and microbiological principles, to master research methods, and to apply these skills to investigations of the biology of infectious organisms of public health importance, their transmission, and the epidemiology of the diseases they cause. The approach is multidisciplinary and includes in-depth ecological, pathogenic, clinical, cellular, immunological, and molecular aspects of infectious diseases, their causative agents, vertebrate hosts, and vectors.

REQUIRED COURSE WORK

Courses in biostatistics, epidemiology, and microbiology are strongly recommended. The specific courses taken depend on the background of individual students and their stated research interests. An individual program that includes courses, seminars, and research rotations is developed by the student and the student’s academic adviser. All students are required to complete three distinct research rotations. These are done in the fall and spring terms and in the summer between the first and second years. Students will be asked to prepare a brief presentation at the end of each rotation. These research rotations (EMD 670) are graded and account for three of the required ten courses. In addition, students are required to complete course work in epidemiology (EMD 508a or CDE 516b) and in breadth of public health (EPH 608b, *Frontiers of Public Health*). Both courses may be waived if the student enters the program with an M.P.H. degree.

The following courses are suggested courses that are appropriate for Ph.D. students in EMD. However, other courses in YSPH or in other departments may also be appropriate.

<i>Course number</i>	<i>Course title</i>	<i>Course units</i>
*CBIO 602a	Molecular Cell Biology	1
CDE/EMD 508a	Principles of Epidemiology I	1
CDE 516b	Principles of Epidemiology II	1

EMD 538a	Quantitative Methods for Infectious Disease Epidemiology	1
EMD 539b	Introduction to Public Health Surveillance	1
EMD/CDE 543a	Global Aspects of Food and Nutrition	1
EMD 548b	Observing Earth from Space	1
EMD 550b/682b	Biology of Insect Disease Vectors	1
EMD 553b	Transmission Dynamic Models for Understanding Infectious Diseases	1
EMD 567a	Tackling the Big Three: Malaria, TB, and HIV in Resource-Limited Settings	1
EMD 680b	Advanced Topics in Tropical Parasitic Diseases	1
EPH 600a	Research Ethics and Responsibilities	n/a
†F&ES 500a	Landscape Ecology	1
HPM 570a	Cost-Effectiveness Analysis and Decision-Making	1
*PATH 650b	Cellular and Molecular Biology of Cancer	1

\*These courses are offered in the School of Medicine.

†This course is offered in the School of Forestry & Environmental Studies.

### QUALIFYING EXAMINATION

EMD has adopted an oral and written qualifying examination format. The qualifying examination serves as an opportunity for the faculty to evaluate students before their admission to candidacy for the Ph.D. degree. It also serves as a valuable learning experience, where a student has a chance to read critically and in-depth with various faculty members on both the thesis topic and two other topics of interest to the student. The other two topics should ideally be in areas which will expand the dissertation topic to subject matters not covered in the courses. The second component includes writing a research proposal on the proposed dissertation topic. The oral examination takes the form of questions from members of the committee based on the readings and an oral defense of the research proposal.

Detailed information regarding the EMD qualifying examination is available from the EMD representative to the GSEC or the coordinator of graduate student affairs.

### RESEARCH REQUIREMENTS

Three research training modules are required of all students, and each term involves a different investigator. These are offered as formal courses, and there will be a brief presentation to the department at the end of each rotation. Each term is graded and recorded on the student's transcript. Investigators act as tutors and monitor the progress of the work, although students are given a certain amount of independence in their work. Rotations are defined broadly, including experiments in the more traditional wet laboratory setting, as well as work in the field and on the computer.

### *Health Policy and Management*

The doctoral program in the Health Policy and Management (HPM) Department emphasizes application of theory and methods to important policy and management topics. It is designed to educate students to apply knowledge derived from public health, social

sciences (political science, organizational behavior, and microeconomics), and other areas to crucial public health topics. The program educates students to conduct research on the forefront of health services research; management of health care organizations; policy analysis; and health economic issues. Students are prepared for academic, research, and policy careers in both the public and the private sectors in public health.

The program requires individuals to develop expertise in one of three disciplines and then to apply this discipline to a more specialized area; the latter becomes their area of distinction.

**AREAS OF DISCIPLINARY CONCENTRATION**

Disciplinary background and methods are important to meaningful application of theory and methods to key public health topics. Students in HPM will specialize in one of the following disciplines: Economics; Organizational Theory and Management; or Political and Policy Analysis.

**MENTORING AND ADVISING**

A hallmark of our program is the low student-to-faculty ratio and the high student and faculty interaction. Students work closely with their adviser and with a number of faculty with common interests, either a specific topic or a policy area. The adviser or set of advisers conducts independent readings with the student in preparation for the dissertation. In addition, students will typically work on research with faculty from both inside the department and from around the University throughout the student's time in the program; these faculty provide an informal network for supplementary mentoring. The student's DAC works closely with the student and has informal as well as formal meetings.

**COURSE WORK**

Students will complete the following course work or the equivalent of the topic areas covered in these courses. This course listing represents a suggested general program of study, but the specifics of course requirements are adapted to the particular interests and professional aspirations of each student. The standard number of courses taken is eighteen (excluding EPH 600a and EPH 608b), with the option of obtaining credits for previous courses. With the approval of the academic adviser and DGS, alternative courses that better suit the needs of the student may satisfy the course work requirement. The departmental representative to the GSEC, in conjunction with the student's adviser, is responsible for determining if core course requirements have been satisfied by previous course work or alternative courses. If so, the student should apply for a course waiver through the Graduate School. HPM students can only waive up to two of the eighteen courses.

**Methods and Statistics** (minimum of 4 courses)

<i>Course number</i>	<i>Course title</i>	<i>Course units</i>
BIS 623a	Applied Regression Analysis	1
BIS 625a	Categorical Data Analysis	1
BIS 628b	Longitudinal and Multilevel Data Analysis	1
CDE 580b	Qualitative Research Methods in Public Health	1
*ECON 556a	Topics in Empirical Economics and Public Policy	1
*ECON 558a	Econometrics	1

HPM 583b	Methods in Health Services Research	1
*PLSC 500a	Statistics	1
*PLSC 503b	Quantitative Methods	1
*PLSC 504a	Advanced Quantitative Methods	1
*SOCY 580a	Introduction to Methods in Quantitative Sociology	1
*SOCY 581b	Intermediate Methods in Quantitative Sociology	1
*SOCY 582a	Statistics III: Advanced Quantitative Analysis for Social Scientists	1
*S&DS 660	Multivariate Statistical Methods for the Social Sciences	1
*S&DS 665	Data Mining and Machine Learning	1

**Health Policy and Management** (minimum of 4 courses, all with Ph.D. readings)

HPM 510a	Introduction to Health Policy and Health Systems	1
HPM 514b	Health Politics, Governance, and Policy	1
HPM 560b	Health Economics and U.S. Health Policy	1
HPM 561b	Managing Health Care Organizations	1
HPM 570a	Cost-Effectiveness Analysis and Decision-Making	1
HPM 573b	Advanced Topics in Modeling Health Care Decisions	1
HPM 587a	Advanced Health Economics	1
HPM 590b	Addiction, Economics, and Public Policy	1
HPM 597b	Capstone Course in Health Policy	1
†HPM 617a and b	Colloquium in Health Services Research	n/a

**Area of depth** (minimum of 4 courses, all with Ph.D. readings)

See below for courses by area 4

**Individualized readings** (required)

HPM 610b	Applied Area Readings	1
----------	-----------------------	---

**Additional courses**

‡CDE 508a	Principles of Epidemiology I	1
EPH 600a	Research Ethics and Responsibilities	n/a
‡EPH 608b	Frontiers of Public Health	1

\*These courses are offered in the Graduate School of Arts and Sciences

†HPM 617 is required of all Ph.D. students but does not count toward the total number of required courses.

‡Students entering the program with an M.P.H. degree may be exempt.

**DISCIPLINARY CONCENTRATION COURSE WORK**

**Required courses in Economics**

*ECON 545a	Microeconomics	1
*†ECON 558a	Econometrics	1

†ECON 558a may count as methods/statistics course or disciplinary concentration course, but not both.

In addition, students take two field courses in a concentration area in which they plan to develop expertise. Sets of courses across topics can be selected to meet research interests. Concentration areas are:

*Behavioral Economics*

*MGMT 758b	Foundations of Behavioral Economics	1
*PSYC 553a	Behavioral Decision-Making I: Choice	1
*PSYC 554a	Behavioral Decision-Making II: Judgment	1

*Industrial Organization*

*ECON 600a	Industrial Organization I	1
*ECON 601b	Industrial Organization II	1

*Labor Economics*

*ECON 630a	Labor Economics	1
*ECON 631b	Labor Economics	1
*ECON 776b	Economics of Population	1

*Public Finance*

*ECON 556a	Topics in Empirical Economics and Public Policy	1
*ECON 680a	Public Finance I	1
*ECON 681b	Public Finance II	1

**Required courses in Organizational Theory and Management**

HPM 600	Directed Readings: Organizational Behavior and Theory in Health Care	1
*MGMT 731	Organizations and Management II: Organizations and the Environment	1
*MGMT 733	Theory Construction	1
*MGMT 736b	Organizations and Management I: Inside Organizations	1

**Required courses in Political and Policy Analysis**

Four courses are required, selected in consultation with the adviser. Suggested courses are:

*PLSC 617b	Deliberative Democracy and Beyond	1
*PLSC 766a	Politics and Markets	1
*PLSC 800a	Introduction to American Politics	1
*PLSC 801a	Political Preferences and American Political Behavior	1
*PLSC 802b	Collective Action and Choice	1
*PLSC 803b	American Politics III: Institutions	1
*PSYC 647b	Social Science and Institutional Design: The Empirical Evaluation of Legal Policies and Practices	1
*SOCY 557b	Political Sociology	1

\*These courses are offered in the Graduate School of Arts and Sciences.

## QUALIFYING EXAMS

Students take qualifying exams in each of these three areas: (1) health policy and management, (2) empirical analysis and/or statistics, and (3) the student's area of concentration. Typically these are taken in the summer after two years of course work.

## RESEARCH REQUIREMENTS

All students are expected to develop their research skills through working with HPM faculty on research. Typically, students will work on a variety of projects with multiple faculty members, beginning during their initial year in the program. Students are expected to attend the departmental research seminar for faculty and are also expected to attend the doctoral research seminar.

## DISSERTATION

Students' doctoral dissertations should have a strong disciplinary base, often with an interdisciplinary approach, applying theory and rigorous methods to a significant public health policy or management topic.

## *Social and Behavioral Sciences*

The Social and Behavioral Sciences (SBS) Department aims to understand and improve health equity, both domestically and globally. SBS provides instruction in the theory and methods of the social and behavioral sciences that emphasize individual, interpersonal, community, and structural influences on health, illness, and recovery. The primary emphases are focused on (1) understanding the psychosocial, behavioral, community, and societal influences on health in the general population, with a focus on those who are disadvantaged; and (2) creating multilevel interventions that eliminate barriers to health, from infancy to old age. The SBS curriculum takes an interdisciplinary approach and focuses on integrating methods from epidemiology and the social sciences, training scientists with a broad skill set that allows them to answer a host of complex research questions. The department has numerous research strengths including in HIV/AIDS, aging health, community-engaged health research, maternal child health, mental health, health equity and disparities, and stigma prevention and health.

## REQUIRED COURSE WORK

Students in the SBS department are expected to complete a minimum of fifteen courses (not including EPH 600a) from the following courses or their equivalents. Students supported by training grants may be subject to additional requirements and should discuss whether there are training-specific requirements with the principal investigator of the grant.

<i>Course number</i>	<i>Course title</i>	<i>Course units</i>
CDE/EMD 508a	Principles of Epidemiology I	1
CDE 516b	Principles of Epidemiology II	1
CDE 534b	Applied Analytic Methods in Epidemiology	1
CDE 617b	Developing a Research Proposal	1
EPH 600a	Research Ethics and Responsibilities	n/a

†EPH 608b	Frontiers of Public Health	1
SBS 580b	Qualitative Methods	1
SBS 610b	Applied Area Readings for Qualifying Exams	1
SBS 676b	Questionnaire Development	1
SBS 699a or b	Advanced Topics in Social and Behavioral Sciences	1

In consultation with their dissertation adviser, students choose three advanced-level (600 or above) statistics courses from Biostatistics, Psychology, Political Science, Sociology, or Statistics and Data Science (S&DS 563, Multivariate Statistical Methods for Social Sciences, may serve as one of these three courses), as well as three additional electives that will best prepare them for their dissertation research.

†Students entering the program with an M.P.H. degree may be exempt.

### QUALIFYING EXAMINATION

The qualifying examinations in SBS entail a two-part system. The first part will consist of completing a systematic review or meta-analysis as part of SBS 610b related to the student’s main area of interest, overseen by the student’s dissertation adviser. The second part consists of an oral exam on the content, theory, and methods outlined in the systematic review/meta-analysis completed in the written part of the qualifying exam. The qualifying exam committee will consist of three faculty who will grade both the written and oral components as Pass/Fail, and cannot include the candidate’s dissertation adviser.

### RESEARCH EXPERIENCE

Students are strongly encouraged to get involved in research by working with faculty members on ongoing research studies throughout their doctoral work. Further, students will gain research experience during their course work by working on real data. Ideally students should publish one to two papers a year during the doctoral program to develop their research portfolio and to be competitive for academic positions after completion of their doctoral degree.

### THE DISSERTATION

SBS uses a three-paper model, where students complete three research papers (of publication quality) on a related topic that demonstrates mastery of content, theory, and methods. In addition, the dissertation will have an introductory chapter that ties the three papers together and a conclusion chapter that summarizes main findings and their research and public health implications. The research papers can involve original data collection, secondary data analysis (using faculty data or national data sets), or some combination of the two.

### M.D./PH.D. PROGRAM REQUIREMENTS

All M.D./Ph.D. students must meet with the director of graduate studies in Public Health if they are considering affiliating with PH. Students in this program are expected to meet the guidelines listed below in the time frame outlined. The DGS must approve any variations to these requirements.

### *Teaching*

One term of teaching will be required. If students teach beyond this requirement, they can be compensated. If a student has served as a teaching assistant elsewhere on campus, this experience may be counted toward the requirement. DGS approval is required to waive the teaching requirement on the basis of previous Yale teaching experience.

### *Rotations/Internships*

Students should do two rotations/internships with potential advisers in YSPH. These short-term research projects will be with a specific principal investigator and can be (1) in a lab, (2) field work, or (3) analysis of an existing dataset. The purpose of these rotations/internships is to learn lab technique and/or to allow the student time to determine if the PI's research interests are compatible with the student's research interests. These rotations/internships are usually done during the summer between the first and second year of medical school course work. In some cases students may need to defer this until the summer after the second year after taking certain courses and/or completing readings so that they possess the background necessary for a successful rotation/internship.

### *Required Course Work*

M.D./Ph.D. students are generally expected to take the same courses as traditional Ph.D. students. Departmental requirements may vary; therefore, students should confer with the DGS and/or their Ph.D. adviser.

### *Timeline for Qualifying Exam*

Students generally will take medical school courses in years one and two. Students can take PH doctoral courses in years one and two before they affiliate if scheduling allows. Once affiliated with the PH program, students will complete all course requirements for the department. This generally takes a minimum of two terms but can take up to four terms after affiliating with PH. The qualifying exam is commonly completed after the fourth term of affiliation with the Ph.D. program in PH but can sometimes be done earlier with approval of the Ph.D. adviser and DGS.

### *Prospectus Timeline*

Following completion of the qualifying exam, students should focus on the prospectus, which must be approved by the PH Graduate Studies Executive Committee (GSEC) before the end of the student's sixth term as an affiliated Ph.D. student in PH.

### *Admission to Candidacy*

To be admitted to candidacy, students must: (1) satisfactorily complete the course requirements for their department as outlined above, achieve grades of Honors in at least two full-term doctoral-level courses, and achieve an overall High Pass average; (2) obtain an average grade of High Pass on the qualifying exam; and (3) have the dissertation prospectus approved by the GSEC. All Ph.D. students must be admitted to candidacy before the start of the fourth year in the Ph.D. program (i.e., before the start of the seventh term).



# Course Descriptions

Courses designated “a” meet in the fall term only.

Courses designated “b” meet in the spring term only.

Courses designated “a and b” are yearlong courses.

Courses designated “c” meet in the summer term.

Bracketed courses are not offered in the current academic year.

## BIOSTATISTICS

**BIS 505a, Introduction to Statistical Thinking I** This course provides an introduction to the use of statistics in epidemiology and public health. Topics include descriptive statistics, probability distributions, parameter estimation, hypothesis testing, and simple linear regression, as well as an introduction to sample size and power calculations for a variety of commonly used study designs. Statistical analysis using the Statistical Analysis Systems (SAS) software and development of communication skills relative to the presentation of these analyses are introduced. E. Claus

**BIS 505b, Introduction to Statistical Thinking II** This continuation of BIS 505a covers multiple regression, analysis of variance, nonparametric tests, survival analysis, poisson regression, and logistic regression. The course concludes with a review of commonly used statistical methods. As in the first term, the Statistical Analysis Systems (SAS) software package is used for statistical analysis. Prerequisite: BIS 505a. D. Zelerman

**[BIS 511b, GIS Applications in Epidemiology and Public Health** The study of epidemiology often seeks to determine associations between exposure risk and disease that are spatially dependent. Geographic information systems (GIS) are modern computer-based tools for the capture, storage, analysis, and display of spatial information. GIS technologies are just beginning to be used for public health planning and decision-making. Public health applications of GIS provide cost-effective methods for evaluation interventions and modeling future trends, and also provide a visual tool for data exploration. This class teaches the technical and design aspects of implementing a GIS project in public health and provides students with basic tools for using GIS. Examples are given to introduce a variety of applications in the field of epidemiology. Not offered in 2017–2018]

**BIS 515c, Accelerated Biostatistics** This intensive seven-week summer course provides a comprehensive introduction to the use of statistics in the fields of epidemiology, public health, and clinical research. Students gain experience conducting and interpreting a broad range of statistical analyses. Topics include descriptive statistics, rules of probability, probability distributions, parameter estimation, hypothesis testing, sample size estimation, analysis of variance, nonparametric tests, and linear regression. Through computer laboratory sessions, students become familiar with the SAS statistical software package. Course is worth 2 course units. Enrollment limited to students in the Advanced Professional M.P.H. and Accelerated M.B.A./M.P.H. programs. Auditors are not allowed. M. Ciarleglio

**BIS 525a and b, Seminar in Biostatistics and Journal Club** The BIS departmental seminar fosters engagement with innovative statistical researchers outside Yale and exposes students to new ideas in statistical research that they may not encounter in their traditional course work. Topics discussed in seminar talks vary, but a major theme is statistical-methodological innovation in the service of public health. Although no credit or grade is awarded, satisfactory performance will be noted on the student's transcript. M. Kane, J. Warren

[**BIS 538b, Survey Sampling: Methods and Management** This course reviews the major sampling plans: simple stratified, systematic, and cluster random sampling. The uses of weighted data and ratio estimation are discussed. The course emphasizes application of methodology, including use of SAS and discussion of other software packages such as R and Stata. Prerequisite: BIS 505b or equivalent. Not offered in 2017–2018]

**BIS 540a, Fundamentals of Clinical Trials** This course addresses issues related to the design, conduct, analysis, and interpretation of clinical trials. Topics include protocol development, examination and selection of appropriate experimental design, methods of randomization, sample size determination, appropriate methods of data analysis including time-to-event (possibly censored) data, non-inferiority studies, and interim monitoring and ethical issues. Prerequisites: BIS 505a or equivalent and second-year status. R. Makuch

**BIS 557a, Computational Statistics** This is a course in the theory and practice of statistical computing. The goal of the course is to develop analytical and computational skills that will enable students to solve computational challenges in their own research. The course covers basic mathematical and statistical techniques that statisticians use when analyzing data and models for which there is no ready-made software. Every component of the course covers theoretical concepts, implementation details, and applications to real data or common statistical models that students will encounter in practice. This course is not an introduction to programming, nor is it a survey of software packages for doing statistics; the course covers fundamentals of using the R language, but students are expected to be already familiar with basic concepts in programming. F. Crawford

**BIS 561b, Advanced Topics and Case Studies in Multicenter Clinical Trials** This course addresses advanced issues related to the design, conduct, monitoring, and analysis of multicenter randomized clinical trials. Topics include organizational, regulatory, and human rights issues; an overview of design strategies; advanced topics in sample size estimation and monitoring; data management and quality assurance procedures; cost-effectiveness and quality of life; and case studies of vaccine trials, factorial trials, primary and secondary prevention trials, large simple trials, strategy trials, and cost-effectiveness. The case studies include many of the classical and landmark clinical trials, such as the polio vaccine field trial, Physicians Health Study, and the trials of coronary artery surgery. Prerequisite: BIS 505a. P. Peduzzi

**BIS 567a, Bayesian Statistics** Bayesian inference is a method of statistical inference in which prior beliefs for model parameters can be incorporated into an analysis and updated once data are observed. This course is designed to provide an introduction to basic aspects of Bayesian data analysis including conceptual and computational methods.

Broad major topics include Bayes's theorem, prior distributions, posterior distributions, predictive distributions, and Markov chain Monte Carlo sampling methods. We begin by motivating the use of Bayesian methods, discussing prior distribution choices in common single parameter models, and summarizing posterior distributions in these settings. Next, we introduce computational methods needed to study multi-parameter models. R software will most often be used. We then apply these methods to more complex modeling settings including linear, generalized linear, and hierarchical models. Discussion of model comparisons and adequacy is also presented. J. Warren

**BIS 575b, Introduction to Regulatory Affairs** This course provides students with an introduction to regulatory affairs science, as these issues apply to the regulation of food, pharmaceuticals, and medical and diagnostic devices. The course covers a broad range of specialties that focus on issues including legal underpinnings of the regulatory process, compliance, phases of clinical testing and regulatory milestones, clinical trials design and monitoring, quality assurance, post-marketing study design in response to regulatory and other needs, and post-marketing risk management. The complexities of this process require awareness of leadership and change management skills. Topics to be discussed include: (1) the nature and scope of the International Conference on Harmonization, and its guidelines for regulatory affairs in the global environment; (2) drug development, the FDA, and principles of regulatory affairs in this environment; (3) the practice of global regulatory affairs from an industry perspective; (4) description/structure/issues of current special importance to the U.S. FDA; (5) historical background and FDA jurisdiction of food and drug law; (6) the drug development process including specification of the important milestone meetings with the FDA; (7) risk analysis and approaches to its evaluation; (8) use of Bayesian statistics in medical device evaluation, a new approach; (9) use of data monitoring committees and other statistical methods for regulatory compliance; (10) developments in leadership and change management; and (11) food quality assurance including risk analysis/compliance/enforcement. Through course participation, students also have opportunities to meet informally with faculty and outside speakers to explore additional regulatory issues of current interest. R. Makuch

**BIS 600a,b, Independent Study or Directed Readings** Independent study or directed readings on a specific research topic agreed upon by faculty and student. By arrangement with faculty.

**BIS 610b, Applied Area Readings for Qualifying Exams** Required of BIS Ph.D. students, in preparation for qualifying exams. Readings arranged with specific faculty in related research area. By arrangement with faculty.

**BIS 623a, Applied Regression Analysis** This course covers linear regression, estimation, and testing hypotheses in multivariate regression, regression diagnostics, analysis of variance, and adjusting for covariates. Emphasis is on the application of methods. The R programming environment is used throughout the course. Prerequisite: BIS 505b or equivalent. M. Kane

**BIS 625a, Categorical Data Analysis** This course presents methods for analyzing categorical data in public health, epidemiology, and medicine. Topics include discrete distributions, log-linear models, and logistic regression. Emphasis is placed on the application

of the methods and the interpretation of results by applying the techniques to a variety of data sets. Prerequisite: BIS 505b or equivalent. Z. Wang

**[BIS 626a, Gerontologic Biostatistics: Statistical Methods for Clinical Research with Older Study Participants]** This course addresses the statistical issues that arise in the design, conduct, analysis, and interpretation of clinical research with older study participants and of basic aging research. Special attention is given to the conceptual understanding of the challenges involved in aging research and to the practical application of methods for meeting those challenges. Topics include issues such as multicomponent intervention clinical trials, triggered sampling observational designs, and transition modeling. All topics are illustrated with case studies from the Yale Program on Aging. Prerequisites: BIS 505a and b. Not offered in 2017–2018]

**BIS 628b, Longitudinal and Multilevel Data Analysis** This course covers methods for analyzing data in which repeated measures have been obtained for individuals over time. Different methods are discussed to handle both continuous and discrete longitudinal response data. Both subject-specific and population averaged approaches are covered (with particular reference to capturing the heterogeneity between different individuals). Some of the approaches covered include linear, nonlinear, and generalized mixed effects models, as well as generalized estimating equations. The course also covers exploratory methods, approaches for handling missing data, and possibly transition models and advanced topics such as multivariate longitudinal responses, nonparametric longitudinal responses, the joint consideration of longitudinal and survival data, and the joint consideration of longitudinal and spatial data. Emphasis is placed on applying the methods, understanding underlying assumptions, and interpreting results. Both SAS and S-Plus software are used throughout the course. Prerequisites: BIS 623a and 625a. H. Lin

**BIS 630b, Applied Survival Analysis** This course demonstrates statistical methods for analyzing and interpreting time-to-failure data. The techniques described include the construction and analysis of failure rates, survival curves, significance tests for comparing survival curves, parametric models, and semiparametric models for the analysis of time-to-failure data including the proportional hazards model. Skills for using statistical software to perform the analyses are developed. In addition, study design is covered, including sample size and power calculations. Prerequisites: BIS 505a and b; and BIS 623a or 625a. Knowledge of single variable calculus is expected. M. Ciarleglio

**[BIS 639b, Descriptive Analysis of Public Health Data]** The analysis of publically available health data provides insight into ways of exploring disease etiology, especially when considering temporal and spatial trends in disease rates and corresponding changes that are related to putative etiologic agents. Age-period-cohort models have been an effective analytical strategy for exploring disease trends and generating hypotheses for putative risk factors to be explored using analytical studies. This course introduces methodology for extracting disease rates from public sources and using them to analyze temporal-spatial trends for disease. It also uses survey data on exposure to putative risk factors and results from analytical studies to quantify the extent that known etiology can account for disease trends. This information is also used to assess the impact of public health policy on disease control. Prerequisites: BIS 505a and b; and BIS 623a or 625a. Not offered in 2017–2018]

**[BIS 643b, Theory of Survival Analysis]** This course presents the statistical theory underlying survival analysis. It covers different models of censoring and the three major approaches to analyzing this type of data: parametric, nonparametric, and semiparametric methods. The application of this theory through some exemplary data sets is also presented. Prerequisites: S&DS 541a and 542b. Offered every other year. Not offered in 2017–2018]

**BIS 645b/CB&B 647b/GENE 645b, Statistical Methods in Human Genetics** Probability modeling and statistical methodology for the analysis of human genetics data are presented. Topics include population genetics, single locus and polygenic inheritance, linkage analysis, genome-wide association studies, quantitative trait locus analysis, rare variant analysis, and genetic risk predictions. Prerequisites: BIS 505a and b, or equivalent; and permission of the instructor. Offered every other year. H. Zhao

**BIS 646b, Nonparametric Statistical Methods and Their Applications** Nonparametric statistical procedures including recursive partitioning techniques, splines, bootstrap, and other sample reuse methods are introduced. Some of the supporting theory for these methods is proven rigorously, but some is described heuristically. Advantages and disadvantages of these methods are illustrated by medical and epidemiological studies. Students may be required to compare these methods with parametric methods when analyzing data sets. Familiarity with basic statistical theory and computer languages is assumed. Prerequisites: S&DS 541a and 542b. H. Zhang

**[BIS 648a, Statistical Methods for Sequence Data Analysis]** The availability of massive amounts of sequencing data has generated both great promises and significant challenges for biological and biomedical researchers. This course focuses on the statistical and computational issues arising from the analysis of these data. Topics to be covered include data pre-processing, allele calling, RNA-seq analysis, ChIP-seq analysis, and metagenomics data analysis. The course combines methodology expositions with real data examples to illustrate the discussed methods. Not offered in 2017–2018]

**BIS 650a,b, Master's Thesis Research** The master's thesis is not required of M.S. or M.P.H. students matriculating in 2017. The thesis is the culmination of the student's educational experience in Biostatistics. Students work with faculty advisers in designing their project and writing the thesis. Detailed guidelines for the thesis are outlined in Appendix II. H. Zhao

**[BIS 651b, Spatial Statistics in Public Health]** Statistical methods for the analysis of spatial data that arise from health studies are developed in order to account for spatially correlated outcomes. Techniques to be discussed include methodology for continuous responses such as inverse distance weighting and Kriging. Bayesian models for smoothing disease risk maps are derived. Environmental exposure models are developed. In addition, spatial/temporal models are discussed that allow the analysis of both sources of correlation. Techniques are illustrated using data from ongoing studies. Prerequisites: S&DS 541a and 542b. Not offered in 2017–2018]

**BIS 678a, Statistical Consulting** This class offers the chance for students to gain experience and practical knowledge working as a biostatistician in a real-world setting. Students collaborate with an investigator, designing and implementing statistical approaches to

further clinical research efforts under the supervision of an instructor. This class prepares students for further, unsupervised collaborations in their careers as biostatisticians with an emphasis on developing effective oral and written communication skills. Prerequisites: BIS 623a and 625a; open to second-year Biostatistics doctoral and M.S. students, or by permission of the instructors. P. Peduzzi, J. Dziura, D. Esserman

**BIS 679a, Advanced Statistical Programming in SAS and R** This class offers students the chance to build on basic SAS and R programming skills. Half of the term is spent working with SAS learning how to create arrays, format data, merge and subset data from multiple sources, transpose data, and write and work with macros. The second half of the term is spent working with R learning how to work with data, program functions, write simulation code using loops, and bootstrap. Prerequisites: BIS 505a and basic knowledge of both SAS and R. D. Esserman

**BIS 681b, Statistical Consulting Lab** This class offers the opportunity for students to gain experience and practical knowledge by working as a practicing biostatistician in a “real-world” setting, a statistical consulting lab supervised by instructors in the Biostatistics Department. The course is primarily aimed at having graduate students in Biostatistics provide statistical consultation to other graduate students at the Yale School of Public Health and Yale School of Medicine who are working on their thesis/research projects: i.e., students helping students. Prerequisites: BIS 623a, BIS 625a, and BIS 678a; open to second-year Biostatistics doctoral and M.S. students, or by permission of the instructors. P. Peduzzi, J. Dziura, D. Esserman

**BIS 691b, Theory of Generalized Linear Models** This course considers a class of statistical models that generalize the linear model through the link functions of response mean. Major varieties of GLMs including models for Gaussian, Gamma, binomial, un/ordered polynomial, and Poisson responses are discussed. Goodness of fit of the models and overdispersion are considered. Extensions to correlated responses are examined through the approaches of quasi-likelihood and generalized estimating equation. The course covers both theoretical and applied aspects of data analytic issues arising from practice. Prerequisites: S&DS 542b, BIS 623a, and some knowledge of matrix calculation. Offered every other year. S. Ma

[**BIS 692b/CB&B 645b/S&DS 645b, Statistical Methods in Genetics and Bioinformatics** Introduction to problems, algorithms, and data analysis approaches in computational biology and bioinformatics; stochastic modeling and statistical methods applied to problems such as mapping disease-associated genes, analyzing gene expression microarray data, sequence alignment, and SNP analysis. Statistical methods include maximum likelihood, EM, Bayesian inference, Markov chain Monte Carlo, and some methods of classification and clustering; models include hidden Markov models, Bayesian networks, and the coalescent. The limitations of current models, and the future opportunities for model building, are critically addressed. Prerequisite: S&DS 538a, 542b, or 661a. Prior knowledge of biology is not required, but some interest in the subject and a willingness to carry out calculations using R is assumed. Not offered in 2017–2018]

**BIS 695c, Summer Internship in Biostatistical Research** The purpose of this course is to provide students with the opportunity of gaining practical experience in the analysis

and the development of biostatistical methods as part of a health sciences research team including medicine, public health, pharmaceutical industry, or health care delivery. This experience provides a basis for developing a dissertation thesis proposal that has practical significance for addressing important scientific questions. Students work with a biostatistics faculty mentor to select a suitable placement for the summer intern, and a one-page description of the plans will be submitted to the instructor at least three weeks prior to starting the program, for approval within two weeks. The internship must be full-time: 35–40 hours per week for 10–12 weeks during the summer. Upon completion of the internship, a written report of the work must be submitted to the instructor no later than October 1. Prerequisite: completion of one year of the Ph.D. or M.S. program or permission of the instructor. H. Zhao

## CHRONIC DISEASE EPIDEMIOLOGY

**CDE 502b/EHS 502b, Physiology for Public Health** The objective of this course is to build a comprehensive working knowledge base for each of the primary physiologic systems that respond to acute and chronic environmental stressors, as well as chronic disease states. This course follows the general framework: (1) Examine the structural and functional characteristics of given physiological system; (2) Explore how both structure and function (within and between physiological systems) work to promote health; (3) Explore how necessary features of each system (or integrated systems) are points of vulnerability that can lead to dysfunction and disease. In addition, this course offers the opportunity to examine each physiological system with respect to influences key to public health interest, e.g., age, race/ethnicity, environmental exposures, chronic disease, microbial disease, and lifestyle, including the protection afforded by healthy lifestyle factors. C. Yeckel

**CDE 508a/EMD 508a, Principles of Epidemiology I** This course presents an introduction to epidemiologic definitions, concepts, and methods. Topics include history of epidemiology, descriptive epidemiology, measurement of disease occurrence and association, study design (ecologic, cross-sectional, case-control studies, cohort, and intervention), surveillance, measurement validity and screening, random variation and precision, bias, confounding, effect modification, and causality. The course also teaches skills for quantitative problem solving and for understanding epidemiologic concepts in the published literature. H. Risch

**CDE 515c, Accelerated Epidemiology** This intensive seven-week summer course provides a comprehensive overview of epidemiologic concepts and methods. Topics include measurements of disease frequency and association, study design (including randomized and non-randomized controlled trials, cohort studies, case-control studies, cross-sectional studies, and ecologic studies), screening principles, reliability and validity, bias, confounding, and effect modification. After completing this course, students are able to calculate and interpret epidemiologic parameters, identify the strengths and weaknesses of various study designs, and apply the principles and methods of epidemiology to the design and analysis of new studies. Not open to students in the traditional two-year M.P.H. program. M. Desai

**CDE 516b, Principles of Epidemiology II** This is an intermediate-level course on epidemiologic principles and methods. The course covers bias, introduction to multivariable analysis for confounder control and assessment of effect modification, indirect standardization, matching, residual confounding, survival analysis, randomized controlled trials including cluster-randomized trials, multiplicity and subgroup analysis, sample size and power, meta-analysis, screening, genetic association studies, use of biomarkers in epidemiology, and epidemic investigation. Through lectures, class discussion, readings from the peer-reviewed literature in both chronic and infectious disease epidemiology, and homework assignments, students learn to (1) evaluate the scientific merit and feasibility of epidemiologic study designs; (2) review, critique, and evaluate epidemiologic reports and research articles; (3) perform epidemiologic calculations; and (4) draw appropriate inferences from epidemiologic data, all at the intermediate level. Prerequisites: CDE/EMD 508a and BIS 505a. F. Shebl

**CDE 520b/EHS 520b, Case-Based Learning for Genetic and Environmental Diseases** This course is a gateway to several updated as well as landmark public health stories with insights, analysis, and exclusives, including topics such as epigenetics, development of disease prevention, and personalized medicines. Ethical, political, and economic issues involved in the proper handling of genetic information are also discussed. Lectures are delivered using multimedia methods, including illustrations, cartoons, videos, and smart reads. Students take away the latest developments in tackling the causes of both early- and late-onset diseases; a roundup of key challenges; and skills in the appropriate design of a study, analysis, and interpretation that will be crucial for tackling the disease of their own interest in the future. Active participation in quizzes, writing, sharing personal research and opinions, and presentations are the criteria for the final grade. No prerequisites. J. Hoh

**CDE 523b, Measurement Issues in Chronic Disease Epidemiology** This course addresses the measurement issues in chronic disease epidemiology from a practical perspective. Through lectures, class discussion, readings from the peer-reviewed literature, and homework assignments, students review and critique questionnaires and instruments commonly used to assess exposures and disease outcomes in chronic disease epidemiology research. Topics include measuring exposure to etiologic factors such as diet, alcohol, physical activity, psychological stress, and environmental exposures. The latter part of the course focuses on the measurement of outcomes for some of the major chronic diseases. Prerequisite: CDE/EMD 508a. J. Lichtman

**CDE 525a and b, Seminar in Chronic Disease Epidemiology** This seminar is conducted once a month and focuses on speakers and topics of particular relevance to CDE students. Students are introduced to research activities of the department's faculty members, with regular presentations by invited researchers and community leaders. The seminar is required of first-year CDE students. Although no credit or grade is awarded, satisfactory performance will be noted on the student's transcript. N. Hawley

**CDE 532b, Epidemiology of Cancer** This course applies epidemiologic methods to the study of cancer etiology and prevention. Introductory sessions cover cancer biology, carcinogenesis, cancer incidence, and mortality rates in the United States, and international variation in cancer rates. The course then focuses on risk factors for cancer (including



tobacco, alcohol, hormonal factors, diet, radiation, and obesity/physical activity) and on major cancer sites (including colon, breast, and prostate). Emphasis is placed on critical reading of the literature. Prerequisite: CDE/EMD 508a. B. Cartmel

**CDE 533b, Topics in Perinatal Epidemiology** This course focuses on reproduction, pregnancy, and delivery. Students obtain a foundation in reproductive biology with practical applications to epidemiologic research. Current and landmark studies in perinatal epidemiology are critically reviewed from a methodological perspective. Topics studied may include issues such as infertility, miscarriage, fetal growth retardation, pregnancy complications, preterm labor and delivery, aspects of prenatal care, congenital malformations, SIDS, and infant mortality. Students actively participate in a seminar format and develop an understanding of what evidence is needed to establish causal relationships in this specialty. Implications of research findings for public health policy, individual decision-making, and future studies are considered. A.M. Jukic

**CDE 534b, Applied Analytic Methods in Epidemiology** This computer lab-based course provides students with a comprehensive overview of data management and data analysis techniques. The SAS statistical software program is used. Students learn how to create and manipulate data sets and variables using SAS; identify appropriate statistical tests and modeling approaches to evaluate epidemiologic associations; and perform a broad array of univariate, bivariate, and multivariate analyses using SAS and interpret the results. Prerequisites: BIS 505a and CDE/EMD 508a; or, for Advanced Professional M.P.H. students, successful completion of BIS 515c and CDE 515c. M. Desai

**CDE 535b, Epidemiology of Heart Disease and Stroke** Heart disease and stroke are among the leading causes of death and disability among industrialized nations. This course introduces students to the major categories of cerebrovascular and cardiovascular disease. Students are challenged to think about how individual diseases contribute to the epidemic of vascular disease in the United States. In this course, students learn basic principles about the rates of disease, risk factors, clinical trial results, and outcomes of heart disease and stroke. Through the analysis of actual studies, students apply basic epidemiology to critically evaluate current literature and topics in this field. Sessions include a clinical overview of a specific disease or risk factor, as well as highly interactive discussion of a specific epidemiologic topic or principle. Students are encouraged to develop their own solutions to current gaps in the epidemiologic literature. J. Lichtman

**CDE 543a/EMD 543a/GLBL 567a, Global Aspects of Food and Nutrition** The course presents a core topic in global health and development that is at the intersection of science, society, and policy. The course familiarizes students with leading approaches to analyzing the causes of malnutrition in countries around the world and to designing and evaluating nutrition interventions. It covers micronutrient and macronutrient deficiencies; approaches to reducing malnutrition; the cultural, economic, environmental, agricultural, and policy context within which malnutrition exists; and the relationships between common infections and nutritional status. D. Humphries

**CDE 545a, Health Disparities by Race and Social Class: Application to Chronic Disease Epidemiology** One of four overarching goals of Healthy People 2020 is to “achieve health equity, eliminate disparities, and improve the health of all groups.” This course

explores disparities in the chronic diseases that contribute disproportionately to ill health, resource utilization, reduced quality of life, and mortality. Taking a life course perspective as we explore disparities across the spectrum of chronic diseases, we focus on differences in health between diverse racial/ethnic and/or socioeconomic groups, primarily in the United States. The primary focus of this course is on understanding the determinants and consequences of health disparities, learning to critically evaluate health disparities research, and thinking creatively about elimination strategies. B. Jones

**CDE 551b, Global Noncommunicable Disease** This course focuses on the contemporary burden of noncommunicable diseases (NCDs), with a particular focus on the health impact of NCDs in low- and middle-income countries. The first part of the course briefly covers the etiology and global distribution of four key NCDs: cardiovascular disease, cancer, chronic respiratory disease, and diabetes. We then discuss the shared behavioral, metabolic, and physiologic risk factors for these diseases and explore how NCDs are associated with economic development, globalization, and the demographic and health transitions. The second half of the course focuses concretely on approaches to NCD intervention, from individual-level approaches to coordinated global action. The last five lectures are by guest speakers offering insight into the successes and challenges of their own intervention attempts. N. Hawley

**CDE 562a, Nutrition and Chronic Disease** This course provides students with a scientific basis for understanding the role of nutrition and specific nutrients in the etiology, prevention, and management of chronic diseases. Nutrition and cancer are particularly emphasized. Other topics addressed include cardiovascular diseases, osteoporosis, obesity, diabetes mellitus, and aging. Implications for federal nutrition policy (dietary guidelines, dietary supplement regulations, food labeling, etc.) are discussed. Prerequisites: biology, biochemistry, and physiology helpful. L. Ferrucci

**CDE 572a, Obesity Prevention and Lifestyle Interventions** This course reviews the methods and evaluation of obesity prevention and lifestyle interventions conducted in multiple settings (e.g., individual, family, and community settings, as well as policy-level interventions). Topics include physical activity, nutrition, and weight-loss interventions in various populations (children, adults, those who are healthy, and those with chronic diseases). The course combines didactic presentations, discussion, and a comprehensive review of a particular lifestyle intervention by students. This course is intended to increase the student's skills in evaluating and conducting obesity prevention and lifestyle interventions. M. Irwin

**CDE 597a, Genetic Concepts in Public Health** This course is geared toward public health students with an interest in genetics, but no previous genetics course work. The course spends a significant amount of time dedicated to introductory genetic principles from the central dogma of DNA-RNA-protein to how the human genome is organized. The course continues with discussions specifically related to disease gene mapping and finally covers topics including gene-environment interactions, genetic screening, and ethics. The course also incorporates three lectures with hands-on computer exercises in both linkage and association analysis. Students gain a basic understanding of genetic concepts and how these are applied in a public health setting. The course prepares interested students

for more advanced course work in genetic epidemiology, statistical genetics, or human genetics. A. DeWan

**CDE 600a,b, Independent Study or Directed Readings** Independent study or directed readings on a specific research topic agreed upon by faculty and student. By arrangement with faculty.

**CDE 610b, Applied Area Readings for Qualifying Exams** Required of CDE Ph.D. students, in preparation for qualifying exams. Readings arranged with specific faculty in related research area. By arrangement with faculty.

**CDE 617b, Developing a Research Proposal** Each student develops a research grant proposal independently. This includes the development of a research question, specific aims, study hypotheses, reviewing and summarizing relevant scientific literature, choosing a study design, and developing a data collection and analysis strategy. Students meet with the instructor and submit drafts of sections of the grant proposal throughout the course and make interim presentations to the class on their progress. During the final weeks of the course, each grant proposal is reviewed for feedback. Students then revise their proposal based on the reviewers' comments and resubmit the revised proposal to the instructor for a final grade. Prerequisite: BIS 505a, BIS 505b (can be taken concurrently), CDE 516b (can be taken concurrently), doctoral status, or permission of the instructor. Auditors are not allowed. X. Ma

**CDE 619a, Advanced Epidemiologic Research Methods** This advanced course focuses on quantitative issues and techniques relevant to the design and analysis of observational epidemiologic studies. Starting with formal definitions of the commonly used epidemiologic parameters, and assuming a working knowledge of ANOVA and linear regression, the course covers analyses based on various related types of regression, e.g., logistic, Poisson, Cox, etc. The GLIM and PECAN computer programs are described and used throughout. Students analyze and discuss data sets of generally increasing complexity. Prerequisite: BIS 505a, 505b, doctoral status, or permission of the instructor. H. Risch

**CDE 634a, Advanced Applied Analytic Methods in Epidemiology and Public Health** The goal of this course is to provide students with the knowledge and necessary skills to carry out advanced analytic methods in epidemiology and public health. Through lectures and readings, students are introduced to various advanced modeling techniques that are commonly used in epidemiology and public health. In addition, students are taught how to use, manipulate, and understand the provided programming codes using the relevant software. Students have the chance to practice through laboratory times and multiple exercises. Students are trained on interpreting the results of the relevant method, describing the method, and presenting the results. The analytic techniques covered include propensity score analysis, principal component analysis, factor analysis, cluster analysis, nested-case control analysis, case-cohort analysis, structural equation modeling, mediation, and quantile regression. F. Shebl

**CDE 650a, Introduction to Evidence-Based Medicine and Health Care** Evidence-based medicine and health care use best current evidence in addressing clinical or public health questions. This course introduces principles of evidence-based practice in formulating

clinical or public health questions, systematically searching for evidence, and applying it to the question. Types of questions include examining the comparative effectiveness of clinical and public health interventions, etiology, diagnostic testing, and prognosis. Particular consideration is given to the meta-analytic methodology of synthesizing evidence in a systematic review. Also addressed is the role of evidence in informing economic analysis of health care programs and clinical practice guidelines. Using a problem-based approach, students contribute actively to the classes and small-group sessions. Students complete a systematic review in their own field of interest using Cochrane Collaboration methodology. Prerequisite: CDE 516b or permission of the instructor. S. Wang

**CDE 670a,b, Advanced Field Methods in Public Health** The course offers direct experience in field methods in chronic disease epidemiology for doctoral students and advanced M.P.H. students. Students are expected to actively participate as part of a research team (8–10 hours per week) doing field research in some aspect of chronic disease epidemiology. It is expected that their progress will be directly supervised by the principal investigator of the research project. This course can be taken for one or two terms and may be taken for credit. Prerequisite: arrangement with a faculty member must be made in advance of registration. J. Lichtman

## ENVIRONMENTAL HEALTH SCIENCES

**EHS 502b/CDE 502b, Physiology for Public Health** The objective of this course is to build a comprehensive working knowledge base for each of the primary physiologic systems that respond to acute and chronic environmental stressors, as well as chronic disease states. This course follows the general framework: (1) Examine the structural and functional characteristics of given physiological system; (2) Explore how both structure and function (within and between physiological systems) work to promote health; (3) Explore how necessary features of each system (or integrated systems) are points of vulnerability that can lead to dysfunction and disease. In addition, this course offers the opportunity to examine each physiological system with respect to influences key to public health interest, e.g., age, race/ethnicity, environmental exposures, chronic disease, microbial disease, and lifestyle, including the protection afforded by healthy lifestyle factors. C. Yeckel

**EHS 503b/F&ES 896b, Public Health Toxicology** This course is designed to serve as a foundation for understanding public health toxicology in the twenty-first century. Although it includes the basic principles of toxicology such as dose response and mechanisms of toxicity and cellular defense, this course introduces new concepts of toxicology such as lifetime exposures, low-level exposure to mixtures, high-throughput screening and computational toxicology, and green chemistry in order to understand fundamental interactions between chemicals and biological systems and possible health outcomes. Through the use of case studies and up-to-date published research, the course provides insights into prevention of mortality and morbidity resulting from environmental exposure to toxic substances, the next-generation risk assessment and regulatory toxicology, and the causes underlying the variability in susceptibility of people to chemicals. V. Vasilou

**[EHS 505a, Occupational Exposure Assessment and Control** This course offers an introduction to methods used to protect the health and safety of workers. Topics include exposure assessment for identifying and evaluating chemical and physical hazards; ergonomics; health and safety standards; personal protective devices; management programs to control hazards; injury and illness record-keeping; and worker's compensation programs. Case studies complement traditional lectures. Not offered in 2017–2018]

**EHS 507a, Environmental Epidemiology** This focuses on application of epidemiology principles and methods to the study of environmental exposures and adverse health outcomes. The major focus on environmental exposures includes both physical and chemical exposures, i.e., environmental chemicals and pesticides, air pollution, radiation, etc. Emphasis is placed on designing population-based studies to investigate environmental issues and human health, critically reviewing literatures and interpreting environmental epidemiologic research data, identifying challenges involved in studying environmental exposures and human health, and analyzing data of environmental exposures and human health. Gene-environment interactions, an essential component when studying environmental hazards in relation to human health, are also addressed and discussed. Prerequisites: CDE/EMD 508a and BIS 505a, or permission of the instructor. Y. Zhang

**EHS 508b/F&ES 897b, Environmental and Occupational Exposure Science** This course examines the fundamental and practical aspects of assessing exposures to environmental agents, broadly defined, in the residential, ambient, and workplace environments. The course provides the knowledge and skills to design and conduct exposure assessments, and has a particular focus on applications to environmental epidemiology and risk assessment. Indirect and direct methods of assessing exposures, such as questionnaires, environmental sampling, biological monitoring, and spatial modeling, are reviewed; and case studies and hands-on projects are presented. N. Deziel

**[EHS 510a, Principles of Environmental Health** Environmental Health focuses on human health effects of exposure to chemical, physical, and biological agents in the community, workplace, and home. This course teaches the principles and tools related to recognizing, assessing, understanding, and mitigating the impacts of environmental agents. Topics include air and water pollution, foodborne illness, climate change, energy use, occupational health, children's health, environmental justice, and pesticide use. Not offered in 2017–2018]

**EHS 511b/F&ES 893b, Principles of Risk Assessment** This course introduces students to the nomenclature, concepts, and basic skills of quantitative risk assessment (QRA). The goal is to provide an understanding necessary to read and critically evaluate and perform QRA. Emphasis is on the intellectual and conceptual basis of risk assessment, particularly its dependence on toxicology, epidemiology, and exposure assessment. Quantitation of exposure and dose response provides practical skills and theoretical background, although not detailed in mathematical and model derivations. Specific cases consider the use of risk assessment for setting occupational exposure limits, establishing community exposure limits, and quantifying the hazards of environmental exposures to chemicals in air, drinking water, consumer products, and the built environment. G. Ginsberg

**EHS 520b/CDE 520b, Case-Based Learning for Genetic and Environmental Diseases**

This course is a gateway to several updated as well as landmark public health stories with insights, analysis, and exclusives, including topics such as epigenetics, development of disease prevention, and personalized medicines. Ethical, political, and economic issues involved in the proper handling of genetic information are also discussed. Lectures are delivered using multimedia methods, including illustrations, cartoons, videos, and smart reads. Students take away the latest developments in tackling the causes of both early- and late-onset diseases; a roundup of key challenges; and skills in the appropriate design of a study, analysis, and interpretation that will be crucial for tackling the disease of their own interest in the future. Active participation in quizzes, writing, sharing personal research and opinions, and presentations are the criteria for the final grade. No prerequisites. J. Hoh

**EHS 525a and b, Seminar and Journal Club in Environmental Health** Students are introduced to a wide variety of research topics, policy topics, and applications in environmental health science. The course consists of seminar presentations and journal club meetings that alternate weekly. The seminar series includes biweekly presentations by EHS faculty and outside experts, followed by a discussion period. The journal club series includes student presentations and discussion on one or two scientific literatures related to the seminar topic of the following week. This course is designed to promote critical thinking regarding current topics in environmental health science as well as to help students develop topics for their theses. Although no credit or grade is awarded, satisfactory performance will be noted on the student's transcript. Y. Chen

**EHS 537a/EMD 537a/GLBL 569a, Water, Sanitation, and Global Health** 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. Y. Chen, E. Wunder

**EHS 545b, Molecular Epidemiology** Many diseases are the outcome of a complex inter-relationship between multiple genetic, epigenetic, and environmental factors. This course covers basic concepts of human genetics as well as recent discoveries in the field of epigenetics, which are fundamental to understanding how individuals differ in their susceptibility to environmental agents and how these susceptibilities change over time. Current knowledge of molecular approaches to identifying specific genetic variations and epigenetic alterations associated with human diseases are introduced, and their roles in gene-environment interactions and disease development are discussed. The course includes formal lectures, article discussions, and laboratory components, which provide hands-on experiences of some commonly used molecular techniques for detecting genetic and epigenetic changes. Y. Zhu

**EHS 547a, Climate Change and Public Health** This course takes an interdisciplinary approach to examining relationships between climate change and public health. After placing climate change in the context of the Anthropocene and planetary health and exploring the fundamentals of climate change science, the course covers impacts of climate change on public health, including heat waves; occupational heat stress; air pollution; wildfires; aeroallergens; vector-borne, foodborne, and waterborne diseases; water scarcity; food security; migration; violent conflict; natural disasters; and health benefits of climate change mitigation. The course integrates climate justice issues and adaptation strategies into the discussion of specific topics. The course is reading-intensive and makes ample use of case studies, with a focus on critical reading of the literature and identifying research gaps and needs. Prerequisites: CDE/EMD 508a or HLTH 240b or equivalent, and BIS 505a or equivalent. R. Dubrow

**EHS 562b, Applications in Systems Biology in Public Health** Systems biology tools such as genomics, proteomics, and metabolomics are being increasingly integrated into epidemiology and public health studies. These multilayered investigations offer a deeper understanding of the complexity of disease etiology, allowing the identification of contributors to disease as well as their interactions, avenues for prevention, early diagnosis, and therapeutics. This course focuses on understanding the different types of systems biology tools that can be used within epidemiology, including those listed, as well as newer approaches such as exposome and microbiome analysis. Lectures concentrate on understanding terminology, experimental design, methodologies, and the types of data generated, enabling students to read and critique research in this field. The course also critically discusses the use of and challenges associated with biomarkers generated from these tools. Case studies show the application of these tools in epidemiology and translational research. C. Johnson

**EHS 573b, Epidemiological Issues in Occupational and Environmental Medicine** This course explores issues around the detection and characterization of health outcomes from environmental and occupational exposures. Case studies include infectious disease outbreaks, cancer clusters in the general environment and within industrial settings, groundwater contaminations and birth defects, lung diseases and cancers following the World Trade Center attacks, health sequelae in military populations, radon exposures and lung cancers in miners and in the general population, exposures among marginalized populations. The course is taught in discussion format by occupational and environmental medicine faculty. There is a take-home final examination. M. Russi, M. Slade

**EHS 575a, Introduction to Occupational and Environmental Medicine** This course presents a broad overview of the fundamental concepts of occupational and environmental medicine (OEM), including the major workplace and environmental hazards and stressors (chemical, physical, biological, psychosocial), the settings in which they occur, major related illnesses and injuries, and preventive strategies. The key role of exposure assessment, industrial hygiene, ergonomics, epidemiology, toxicology, and regulatory and ethical factors in the recognition and prevention of work and environment-related health effects is incorporated throughout the course. The course includes lectures, workplace site visits, and article discussions. There are no prerequisites. C. Redlich, M. Stowe

**[EHS 585a/F&ES 898a, The Environment and Human Health** This course provides an overview of the critical relationships between the environment and human health. The class explores the interaction between health and different parts of the environmental system including water, indoor and outdoor air, environmental justice, and occupational health. Other topics include exposure assessment, case studies of environmental health disasters, links between climate change and health, and integration of scientific evidence on environmental health. Students learn about current key topics in environmental health and how to critique and understand scientific studies. The course incorporates lectures and discussion. Enrollment limited to twenty-five. Not offered in 2017–2018]

**EHS 600a,b, Independent Study or Directed Readings** Independent study or directed readings on a specific research topic agreed upon by faculty and student. By arrangement with faculty.

**EHS 610b, Applied Area Readings for Qualifying Exams** Required of EHS Ph.D. students, in preparation for qualifying exams. Readings arranged with specific faculty in related research area. By arrangement with faculty.

**EHS 620a and b, Research Rotation** This course is required of all EHS Ph.D. students during their first academic year. The research rotations are in EHS laboratories that are able to accommodate students. Research rotations are available for both “dry” (i.e., statistical analysis) and “wet” (i.e., bench) laboratory research groups. The student meets with the EHS graduate faculty member at the beginning of the rotation for an explanation of the goals and expectations of a student in the laboratory. The student becomes familiar with the research models, approaches, and methods utilized by the research group through interactions with other laboratory/research personnel and from laboratory manuscripts. The student is expected to spend at least fifteen hours per week working in the laboratory or research group and to present a rotation seminar at the end of the rotation period. V. Vasiliou

## EPIDEMIOLOGY AND PUBLIC HEALTH

**EPH 100a, Professional Skills Seminar** The Professional Skills Seminar is intended to prepare M.P.H. students for leadership positions as public health professionals. Material covered includes public speaking, presentation skills, professional writing, negotiation and conflict resolution, and networking and social media. Attendance at all sessions is required (elective for Advanced Professional M.P.H. and Accelerated M.B.A./M.P.H. students), and some homework is a part of the program. Although no credit or grade is awarded, satisfactory performance will be noted on the student’s transcript. F. Spencer, K. Shay

**EPH 500b, Public Health Practicum** This course is one of the options available to students to fulfill the practice requirement for the M.P.H. degree. The course design combines experiential learning and guided classroom discussion. Students are assigned to a field placement in an appropriate setting that affords the opportunity to apply public health concepts and competencies learned in the classroom through a practice experience that is relevant to the student’s areas of specialization. Emphasis is placed on situating



students in community-based organizations and other public health service settings such as local or state health departments, where they can work on authentic public health problems and issues. This course provides a means for students to gain exposure to the mission and activities of diverse public health organizations and thus may help to inform their decisions about professional work pursuits upon completion of the M.P.H. degree. Open only to second-year M.P.H. students, Advanced Professional M.P.H. students, and Accelerated M.B.A./M.P.H. students. E. O’Keefe, D. Frankel-Gramelis

**EPH 506a,b, Continuous Study** This course is for M.P.H. students who have completed all required course work but are in “thesis pending” status. Students in this category must be registered for continuous study each term of the regular academic year until all remaining requirements have been completed (except in the case of approved Leave of Absence). Students are permitted to register for continuous study for a maximum of two terms. No credit or grade is awarded.

**EPH 515a, Ethics and Public Health: An Introduction** This four-session seminar introduces students to the ethical implications of public health programs, policies, and research initiatives; their historical roots; and the regulations and guidelines governing human subjects research in the United States and internationally. Case studies are used to demonstrate selected ethical challenges in public health policy, practice, and research. In addition, students learn the functions and procedures of Yale’s Human Research Protection Program and complete its Web-based training on human subjects research. M.P.H. students are required to take the course during the first year of the program. K. Khoshnood

**EPH 520c, Summer Internship** The Internship is a degree requirement that is completed in the summer between the first and second academic years. Students work with their faculty advisers, the Career Management Center, and the Office of Public Health Practice to identify suitable public health placements such as medical care facilities, community agencies, public health departments, research projects, laboratories, and other sites engaged in public health activities. The internship experience sometimes serves as a basis for the M.P.H. thesis. The internship is displayed on the transcript with a grade of “S” (Satisfactory) upon completion. A course unit is *not* given for the summer internship.

All students, with the exception of those in the Advanced Professional M.P.H. Program and the Accelerated M.B.A./M.P.H. Program, *must* complete an approved Summer Internship. The Summer Internship may be used to complete the practice requirement for the M.P.H. degree with prior approval from the Office of Public Health Practice.

**EPH 525b, Thesis** The thesis (2 course units) is typically a yearlong project that is completed in the second academic year and is the culmination of the student’s educational experience at YSPH. It is frequently a report of a small research project performed independently by the student. Students work with faculty advisers in designing their project and in writing the thesis. Detailed guidelines for the thesis are outlined in Appendix II.

The thesis is not a requirement for students in the Biostatistics, Health Care Management, Health Policy, or Advanced Professional M.P.H. programs (except for those in the Occupational and Environmental Medicine track).

**EPH 542b, Practice-Based Community Health Research** This course is one of the options available to students to fulfill the practice requirement for the M.P.H. degree. The course develops students' skills in planning and implementing practice-based community health research projects. The course content is based on an ecological framework, principles of community and public health ethics, and a teaching strategy of significant learning experiences and team-based learning. Given the current emphasis on using evidence-based practices in public health, this course helps students develop skills in turning practice activities and data into evidence. Teams of four to six students work on a community-driven research project at a local agency based on proposals submitted by a range of community organizations. Through this exercise and related assignments throughout the term, students develop skills in planning and implementing practice-based research projects, including developing project timelines, logic models, and program impact theories. D. Humphries

**EPH 555b, Practicum in Climate Change, Sustainability, and Public Health** This course is one of the options available to students to fulfill the practice requirement for the M.P.H. degree. In this course, interdisciplinary student teams carry out applied research or practice projects in the area of climate change, sustainability, and public health. Each team works with a sponsoring organization (e.g., unit within Yale, local health department, state agency, community organization, other nongovernmental organization). As a prerequisite for enrollment, the course requires participation in the fall-term Climate Change, Sustainability, and Public Health Leadership Training Workshop, a partnership among the Climate Change and Health Initiative, the Global Health Leadership Institute, and the Office of Sustainability. In October, students apply to join a team, and in November the selected students participate in this weekend workshop, which provides training on leadership, strategic problem solving, and policy/applied research implementation. Teams use these skills to further conceptualize and plan their projects, which they then implement in this spring-term course. R. Dubrow

**EPH 581a,b, Seminar for Modeling in Public Health** This yearlong, monthly seminar is targeted most specifically to students in the Public Health Modeling concentration but open to all interested members of the Yale community. The seminar features talks by faculty from across Yale University doing modeling-related research, as well as invited speakers from other universities and public health agencies. The objectives of the course are to offer students the opportunity to witness the scope and range of questions in public health policy and practice that may be addressed, understood, and informed using model-based approaches; appreciate the breadth of public health modeling research being conducted around the University and beyond; explore possible collaborations/relationships with other scholars and professionals; review, critique, and evaluate model-based public health research in a structured environment; and form their own opinions regarding the applicability, relevance, and responsible use of modeling methods. This no-credit seminar is required of students in the Public Health Modeling concentration, who must register for the seminar during at least two terms of enrollment. For each class, one or two readings are circulated/posted on the course website prior to the talk. Students are encouraged to read the articles and articulate questions for the speaker. V. Pitzer, F. Crawford

**EPH 591a, Global Health Seminar** This weekly seminar exposes students in the health professions to key issues in global health research and practice. The course features faculty from across the health professional schools and other global health experts from around the world. Its collaborative nature provides a rich environment for interdisciplinary dialogue. The goal of the course is for students to attain a good understanding of key issues upon which they may base future research, service, and clinical pursuits in the field of global health. Although no course credit is awarded, satisfactory performance is noted on the student's transcript. M. Skonieczny

**EPH 600a, Research Ethics and Responsibility** This course seeks to introduce major concepts in the ethical conduct of research and some of the personal and professional issues that researchers encounter in their work. Sessions are run in a seminar/discussion format. Prerequisite: doctoral student or postdoctoral status only. C. Tschudi

**EPH 608b, Frontiers of Public Health** This course is designed for Ph.D. and Advanced Professional M.P.H. students. It explores the major public health achievements in the last century in order to provide students with a conceptual interdisciplinary framework by which effective interventions are developed and implemented. Discussions examine the advances across disciplines of biomedical research, epidemiology and biostatistics, environmental and behavioral sciences, and health policy and management services that led to these major public health achievements. The course examines global and national trends in the burden of disease and underlying determinants of disease, which pose new challenges; and it covers new approaches that are on the forefront of addressing current and future public health needs. A. Ko

## EPIDEMIOLOGY OF MICROBIAL DISEASES

**EMD 508a/CDE 508a, Principles of Epidemiology I** This course presents an introduction to epidemiologic definitions, concepts, and methods. Topics include history of epidemiology, descriptive epidemiology, measurement of disease occurrence and association, study design (ecologic, cross-sectional, case-control studies, cohort, and intervention), surveillance, measurement validity and screening, random variation and precision, bias, confounding, effect modification, and causality. The course also teaches skills for quantitative problem solving and for understanding epidemiologic concepts in the published literature. H. Risch

**EMD 512a, 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. P. Krause

**EMD 518a, Principles of Infectious Diseases I** 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. M. Pettigrew

**EMD 518b, Principles of Infectious Diseases II** 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 518a and introduces new topics such as infectious causes of chronic diseases; and vector-borne, zoonotic, and emerging pathogens. J. Childs

**EMD 525a and b, Seminar in Epidemiology of Microbial Diseases** 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. Attendance is required of first-year EMD students. Although no credit or grade is awarded, satisfactory performance will be noted on the student's transcript. D. Weinberger

**EMD 530b, 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. L. Dembry, D. Banach

[**EMD 533a, Implementation Science** 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 offered in 2017–2018]

**EMD 536b, Investigation of Disease Outbreaks** This course provides students with the basic skills and perspectives necessary to investigate acute disease outbreaks. The emphasis is on the use of epidemiology to investigate outbreaks of infectious diseases,

although the methods are not limited and can be applied to outbreaks of noninfectious diseases as well. Through this course, it is hoped that students will gain a better appreciation of epidemiology as the science of public health and of the use of epidemiology to guide public health interventions and the development of public health policy. Offered every other year. M. Cartter

**EMD 537a/EHS 537a/GLBL 569a, Water, Sanitation, and Global Health** 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. Y. Chen, E. Wunder

**EMD 538a, Quantitative Methods for Infectious Disease Epidemiology** 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). V. Pitzer

**EMD 539b, Introduction to Public Health Surveillance** 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 of the course 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. D. Weinberger

**EMD 540b, Responding to Violent Conflict: Epidemiologic Methods and Public Health Interventions** In this course we discuss how epidemiological methods are applied to understand specific health consequences of violent conflicts, including infectious diseases, mental health, maternal/child health, and chronic health problems. In addition, we critically examine interventions employed to mitigate these negative consequences and assess the evidentiary basis for their efficacy with the goal of understanding what makes some interventions more successful than others. Throughout the course, we consider inevitable ethical challenges of conducting research in fragile settings and with vulnerable

populations who often lack basic services and are suffering human rights violations.  
K. Khoshnood

**EMD 543a/CDE 543a/GLBL 567a, Global Aspects of Food and Nutrition** The course presents a core topic in global health and development that is at the intersection of science, society, and policy. The course familiarizes students with leading approaches to analyzing the causes of malnutrition in countries around the world and to designing and evaluating nutrition interventions. It covers micronutrient and macronutrient deficiencies; approaches to reducing malnutrition; the cultural, economic, environmental, agricultural, and policy context within which malnutrition exists; and the relationships between common infections and nutritional status. D. Humphries

**EMD 548b/ARCG 762b/F&ES 726b/G&G 562b, Observing Earth from Space** 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. X. Lee

[**EMD 550b/682b/E&EB 650b/F&ES 891b, Biology of Insect Disease Vectors** Insects transmit pathogens that cause many emerging and re-emerging 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. Prerequisite: full year of college/university-level biology, or permission of the instructor(s). Offered every other year. Not offered in 2017–2018]

[**EMD 553b, Transmission Dynamic Models for Understanding Infectious Diseases** 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. Not offered in 2017–2018]

**EMD 563a or b, Laboratory and Field Studies in Infectious Diseases** 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. Prerequisite: permission of the instructor. M. Pettigrew

**EMD 566b/HPM 566b, Critical Issues in Global Health** The course focuses on critical challenges to the health of the poor in low- and middle-income countries and pays particular attention to how these health gaps can be addressed in low-cost and highly effective ways. The course covers the architecture, politics, and governance of global health; key trends in approaches to meeting the health needs of the poor in low- and middle-income countries; and how science and technology can be harnessed for this purpose. It examines the burden of disease and the determinants of this burden; covers the leading causes of illnesses, disability, and preventable death from communicable and noncommunicable diseases, with special attention to women and children; and focuses particular attention on key health systems issues and recent efforts to overcome them, especially in low-income settings. K. Khoshnood

**EMD 567a, Tackling the Big Three: Malaria, TB, and HIV in Resource-Limited Settings** 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 will be 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 518a. S. Parikh

**EMD 580a/HPM 580a, Reforming Health Systems: Using Data to Improve Health in Low- and Middle-Income Countries** Health systems in low- and middle-income countries are in constant flux in the face of myriad pressures and demands. Under such conditions, how can senior country officials and their donor partners make the best decisions to reform health systems to achieve Universal Health Coverage and to improve the allocation of resources to maximize health gains? The course rounds out and reinforces the Yale M.P.H. experience in the Global Health concentration by providing students

with a thorough understanding of health systems and health reforms – their components, dynamics, performance, and impacts – and by imparting the key tools and data sources needed to conceptualize and assess options related to health system reform and resource allocation, and to make coherent and effective policy and financing recommendations. Using these analytical frameworks and techniques, students analyze 6–8 case examples of major country reforms and prepare two short policy papers applying what they have learned to real-world health systems challenges. This course is the capstone for the Global Health Concentration. R. Hecht

**EMD 596b/LAW 30168/SBS 596b, Global Health and Justice Practicum** This course fuses didactic and experiential learning on critical topics at the intersection of public health, rights, and justice in the twenty-first century. Students have the opportunity to explore analytic and practical frameworks that engage a diverse range of legal frameworks and processes that act as key mediators of health, including producing or responding to health disparities in the United States and worldwide. Readings and project approaches draw from legal, public health, historical, anthropological, and other fields to introduce students to the multiple lenses through which health issues can be tackled, and to build their competence to work with colleagues in other disciplines around such interventions. Because of the substantial time commitment involved, with both classroom and experiential learning, the Global Health and Justice Practicum is worth 2 course units. Enrollment limited to twelve. A. Kapczynski, A. Miller, G. Gonsalves

**EMD 670a and b, Advanced Research Laboratories** 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. C. Tschudi

**EMD 680b/MBIO 680b, 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. C. Tschudi

**[EMD 695a,b/E&EB 961a/960b, Studies in Evolutionary Medicine I and II** This two-term course begins in January. Students learn the major principles of evolutionary biology and apply them to issues in medical research and practice by presenting and discussing original papers from the current research literature. Such issues include lactose and alcohol tolerance; the hygiene hypothesis and autoimmune disease; human genetic variation in drug response and pathogen resistance; spontaneous abortions, immune genes, and mate choice; parental conflicts over reproductive investment mediated by genetic imprinting; life history trade-offs and the evolution of aging; the evolution of virulence and drug resistance in pathogens; the evolutionary genetics of humans and their pathogens; the ecology and evolution of disease; the evolutionary origin of diseases; and the



emergence of new diseases. Students develop a research proposal based on one of their own questions in spring term, spend the summer on a research project related to their research proposal, and write a paper based on the results of their research in fall term. Credit and grades are awarded for each term. Only students who have engaged in summer research projects may enroll in the fall term. Admission is by competitive application only. Forms are available on the E&EB department website. Not offered in 2017–2018]

## HEALTH POLICY AND MANAGEMENT

**HPM 502a/MGT 502a, Foundations of Accounting and Valuation** Distinguishing value creation from redistribution is a key problem faced by any economy. Modern accounting practices are focused on this problem, and knowledge of them is extremely useful. Further, value creation activities in a modern society can become complex and abstract, and accounting practices have developed accordingly. While worthy of a lifetime of study, the purpose of this course is to enable the student to gain a foundation upon which a deep understanding of accounting can be built. One cannot have a sensible discussion of accounting as assessing value without having some idea of what value means and how to think about it. Therefore, this course begins by exploring the basic determinants of value and the techniques used to assess it: discounting cash flow and risk/return analysis. These techniques are based on the timing and statistical properties of cash flow. With this introduction, the course then turns to the more fundamental processes of generating cash flow by creating value through the production and delivery of goods or services and then converting that value into cash flows. The basic financial statements, balance sheets, income statements, and cash flow statements as well as the accounting mechanics with which they are built are introduced in this context. S. Garstka

**HPM 510a, Introduction to Health Policy and Health Systems** This course provides an introduction to the making, understanding, and consequences of health policy. The design and performance of the health care system are assessed, with particular attention to the complex and often contested manner in which health care is organized, financed, and delivered in the United States. The course also considers the fundamental concerns – such as cost, access, and quality – that shape the development of health policy and health systems in all countries, and it looks to the health systems of other countries in order to understand the advantages and disadvantages of alternative approaches. An overview of the important actors in the health care and political systems is provided, and students are introduced to methods for understanding the behavior of these policy makers and stakeholders. Health issues are placed in the context of broader social goals and values. J. Schwartz

**HPM 514b, Health Politics, Governance, and Policy** This course is designed to familiarize students with the various processes by which governmental health policy is made in the United States, and with current policy debates. One focus of the course is to understand the politics underlying the successes and failures of health policy making during the course of the twentieth century. This includes a discussion of the relevant governmental institutions, political actors, the major national programs that have been established, and how political actors use resources and set their strategies. M. Schlesinger

**HPM 542b, Health of Women and Children** The focus of this course is women's and children's health and health care in the United States. Emerging health issues and related health policy are presented and discussed in terms of epidemiology, including racial/ethnic disparities and effects of poverty; utilization and financing of children's health care; and existing programs and public policies that facilitate access to care. Data sources and data needs are identified. Topics may include history of MCH programs and policy, Medicaid and SCHIP, low birth weight and infant mortality, maternal mortality, reproductive health, breast and cervical cancer screening, pediatric oral health, pediatric asthma, childhood obesity, adolescent health care and teen pregnancy, children with special health care needs, childhood injuries and injury prevention. Students are expected to critically evaluate the public health implications of selected conditions and the effect of public policy on availability, accessibility, acceptability of services, and accountability in health care for women and children. M. A. Lee

[**HPM 545b, Health Disparities** This course explores our nation's striking inequities in morbidity, mortality, and injury (including by race, ethnicity, socioeconomic and immigration status, gender, and geography), with particular focus on the social determinants of the inequities. Through readings drawn from multiple disciplines, the course examines such topics as the impacts on health of poverty and inequality in income, wealth, and education; overt and implicit discrimination; residential segregation and poverty concentration and associated differential exposures to environmental hazards and health-promoting resources; differential access to, and quality of, health care; and the role of law as a determinant of health inequity. A variety of interventions to address health inequities are reviewed and critiqued, as are some of the ways law and policy are being used as a tool to promote health equity. Not offered in 2017–2018]

[**HPM 546a, Ethical Issues in Public Health** This course is a study of ethical and social dimensions of public health policy and practice both within the United States and globally. Public health always has a normative as well as a scientific aspect. Social legitimacy and public trust are always essential to effective public health. Ideals of human rights, individual liberty, social justice and equality, community, solidarity, and the common good are central to public health policy and practice. At the same time, however, existing structures of power, coercion, discrimination, and stigma also shape those policies and practices.

Important frameworks of ethical and political theory are explained and compared, including utilitarianism, rights theory, theories of social and global justice, and democratic and elitist theories of governance. These frameworks are then applied to selected public health issues. Topics include global health justice, the ethical implications of studies of the social determinants of health, the cultural framing of health and illness, ethical issues in infectious disease control, and ethical conflicts arising in health promotion and behavior modification interventions in cases such as smoking and obesity. Environmental health and the global health effects of climate change are also explored. Not offered in 2017–2018]

**HPM 555b, Health Policy or Health Care Management Practicum** This course is one of the options available to HPM students to fulfill the practice requirement for the M.P.H. degree. The practicum is a project-based learning experience. Students work 8–10 hours

per week. The Health Policy Practicum allows students to work on current state and/or local health policy issues while placed with state and/or local legislative or executive agency policy makers, or with senior staff at a nonprofit health policy or advocacy group. The Health Management Practicum allows students to focus on current issues confronting a hospital department while working under the guidance of a departmental administrator. Students are required to attend the first week of class to enroll. Prerequisite: permission of the instructor. S. Busch (HCM), R. Stahl (HCM), S. Geballe (HP)

**HPM 560b, Health Economics and U.S. Health Policy** This course introduces students to the organization and operation of the American health care system. The course examines systems of health care delivery and finance and recent trends in their organization, including the growth of managed care. The course seeks to provide students with an understanding of the existing structure of the system and with conceptual frameworks. Z. Cooper

[**HPM 561b/MGT 630b, Managing Health Care Organizations** This course is designed to integrate previous course work in management and in public health to further students' understanding of organizational, managerial, and strategic issues facing health care organizations (HCOs) and the health care workforce. The course provides students with a foundation for developing, implementing, and analyzing efforts to improve HCOs' performance. A major objective of the course is to sharpen the leadership, problem solving, and presentation skills of those who aim to hold operational and strategic positions in health care organizations. Through case studies, readings, in-class exercises, and class discussions, students learn analytic frameworks, concepts, tools, and skills necessary for leading and managing organizational learning, quality improvement, innovation, and overall performance in health care organizations. Not offered in 2017–2018]

**HPM 566b/EMD 566b, Critical Issues in Global Health** The course focuses on critical challenges to the health of the poor in low- and middle-income countries and pays particular attention to how these health gaps can be addressed in low-cost and highly effective ways. The course covers the architecture, politics, and governance of global health; key trends in approaches to meeting the health needs of the poor in low- and middle-income countries; and how science and technology can be harnessed for this purpose. It examines the burden of disease and the determinants of this burden; covers the leading causes of illnesses, disability, and preventable death from communicable and noncommunicable diseases, with special attention to women and children; and focuses particular attention on key health systems issues and recent efforts to overcome them, especially in low-income settings. K. Khoshnood

**HPM 570a, Cost-Effectiveness Analysis and Decision-Making** This course introduces students to the methods of decision analysis and cost-effectiveness analysis in health-related technology assessment, resource allocation, and clinical decision-making. The course aims to develop technical competence in the methods used; practical skills in applying these tools to case-based studies of medical decisions and public health choices; and an appreciation of the uses and limitations of these methods at the levels of national policy, health care organizations, and individual patient care. S. Resch

**HPM 573b, Advanced Topics in Modeling Health Care Decisions** This course develops students' technical competencies in managerial decision-making using spreadsheet simulation models. The course aims to enhance skills in developing, implementing, and analyzing spreadsheet models to inform decisions concerning health care resource allocation, technology assessment, and clinical decision-making. Students also acquire skills in conducting, presenting, and critically evaluating modeling studies in health care. The course consists of lectures, in-class labs, practical exercises, and a final project through which students gain experience in developing and evaluating simulation models to guide health care decisions. R. Yaesoubi

[**HPM 575b/GLBL 821b, Making Policy Choices to Improve Health in Low Income Settings** Using data and customized analytical techniques, students explore ways to formulate and assess policy and program options that address the most pressing health/nutrition/population (HNP) challenges in developing countries. The course examines a series of eight to ten new analytical frameworks and techniques that have been developed and applied over the past five years to major HNP challenges in Africa, Asia, and Latin America, with important impacts on the ground. Students contribute to shaping the agenda for further development of innovative methods for global health policy research and advisory services, and pursue their own mini-project on an HNP issue of their choosing. Prerequisite: introductory economics or permission of the instructor. Not offered in 2017–2018]

**HPM 576b, Comparative Health Care Systems** This course examines the basic structure of health care systems across countries, with a focus on how system design can impact the provision of care. Health care systems evolve within distinct cultures; consequently, these systems vary substantially in the ways they finance, organize, and deliver care. In spite of these differences, the aims of health care systems worldwide are often quite similar: chiefly, to facilitate access to high-quality care that improves health at a reasonable cost. Over the course of the term we identify themes in how countries organize their health care systems, examine the strengths and weaknesses of various approaches to the payment and delivery of health care, and explore specific examples of ongoing efforts to reform health systems. Recurring concepts include the role of public and private systems in financing and delivering health care, the impact of the local environment on the structure of health care systems, and the effect of health system design on patient and provider behavior. C. Ndumele

**HPM 580a/EMD 580a, Reforming Health Systems: Using Data to Improve Health in Low- and Middle-Income Countries** Health systems in low- and middle-income countries are in constant flux in the face of myriad pressures and demands. Under such conditions, how can senior country officials and their donor partners make the best decisions to reform health systems to achieve Universal Health Coverage and to improve the allocation of resources to maximize health gains? The course rounds out and reinforces the Yale M.P.H. experience in the Global Health concentration by providing students with a thorough understanding of health systems and health reforms – their components, dynamics, performance, and impacts – and by imparting the key tools and data sources needed to conceptualize and assess options related to health system reform and resource allocation, and to make coherent and effective policy and financing recommendations.

Using these analytical frameworks and techniques, students analyze 6–8 case examples of major country reforms and prepare two short policy papers applying what they have learned to real-world health systems challenges. This course is the capstone for the Global Health Concentration. R. Hecht

**HPM 583b, Methods in Health Services Research** This course introduces students to both quantitative and qualitative methods for research in health services. Topics include research objectives and hypotheses formulation, study design, sampling techniques, measurement, data analysis, results presentation, and discussion. Students synthesize these skills in the final paper. Prerequisite: BIS 505a. X. Chen

**HPM 586a, Microeconomics for Health Policy and Health Management** This course introduces students to microeconomics, with an emphasis on topics of particular relevance to the health care sector. Attention is paid to issues of equity and distribution, uncertainty and attitudes toward risk, and alternatives to price competition. This course is designed for students with minimal previous exposure to economics. A. Friedman

**HPM 587a, Advanced Health Economics** This course applies the principles learned in *Microeconomics for Health Policy and Health Management (HPM 586)* to the health of individuals, to health care institutions and markets, as well as to health care policy. The economic aspects of health behaviors, hospital markets, cost-benefit analysis, regulation, and the market for physician services are covered. Prerequisite: microeconomics or permission of the instructor. S. Busch

**HPM 588a, Public Health Law** This course focuses on the law of population health, examining the legal powers and duties of federal, state, and local governments to promote and protect the health of their communities, as well as the constraints placed on those powers to protect individual rights. A course designed specifically for students with no legal training, it introduces students to the multiple ways the law can be used as a tool to advance public health, including through direct and indirect regulation to alter the information and built environments; through governments' power to tax and spend to fund public health programs and services, and in ways that can influence individual and corporate behavior; and through the courts. Students gain basic proficiency in finding, reading, and interpreting primary legal sources, in applying the law to public health problems, and in identifying ways to most effectively influence legislative, administrative, and judicial lawmaking processes to promote and protect (and also thwart efforts to impede) public health. Prerequisite: HPM 514b or permission of the instructor. S. Geballe

**[HPM 589a, Leadership and Public Health** This course examines in depth several key conceptual frameworks related to leadership, with application to a variety of public health and medical topics. The class focuses on four interrelated challenges: (1) working across boundaries defined by roles, power, and race; (2) managing common resources to maximize social welfare; (3) anticipating and responding to change at social, organizational, and individual levels; and (4) understanding paradoxes in leadership in a complex world. Assignments include active participation and attendance in class sessions; a midterm reflection paper; a group experience resulting in a short paper; and a final paper that uses concepts developed in the class and readings to analyze the leadership landscape associated with a public health or medical problem chosen by the student, and to determine

whether the leadership is addressing the problem effectively and why. Not offered in 2017–2018]

**[HPM 590b/ECON 461b, Addiction, Economics, and Public Policy** Smoking, alcoholism, and use of illicit drugs are addictions that are increasingly studied by economists. Overeating resulting in obesity can also be viewed as an addiction. This class studies economic and policy issues relating to these four addictions. Specifically, the class covers (1) models of substance use including rational addiction and behavioral economics, (2) alternative views on whether, why, and how to intervene in personal decisions, (3) facts and findings from the literature on each addiction, and (4) policies related to each. Policy issues include supply and demand sides of illicit drugs; how to prevent drug-related crime; taxes on alcohol, cigarettes, and soda; treatment effectiveness; legal interventions such as the case against the tobacco companies; the role of public information and private marketing; and paying people for good habits. Prerequisite: microeconomics. Not offered in 2017–2018]

**[HPM 592a/GLBL 322a/HLTH 450a/PLSC 121a, Strategic Thinking in Global Health** This course defines and applies a set of core principles regarding development and implementation of grand strategy and problem solving in global health. Students come to understand and apply principles of grand strategy and strategic problem solving, which are taught at both a conceptual and a practical level as applied to common problems in global health. Students develop expertise in political and policy analysis as well as organizational theory and leadership skills that are central to addressing global health issues in low- and middle-income countries. Not offered in 2017–2018]

**HPM 595a/LAW 20616, Food and Drug Administration Law** The Food and Drug Administration (FDA) is the premier consumer protection agency in the United States, with control over the availability and public discourse about potentially lifesaving therapeutics, foods, supplements, and related consumer products. Its authority has been built in response to public health crises and is constantly under scrutiny from all sides of the political spectrum. The class reviews the history of the FDA's regulation over the health care products market, the noteworthy legislation that has shaped its oversight in this area, Supreme Court and other cases that have impacted its authority, and an introduction to key current controversies related to the FDA that affect health care delivery. (This course does not cover food law.) The enduring theme is how the FDA balances its vital public safety role against countervailing forces of personal autonomy and the rights or interests of consumers, patients, physicians, and corporations. Each class is organized around interactive discussion introducing students to the material, including hypothetical cases that require students to apply the day's lessons and themes in determining legal and policy solutions. Students with high-quality papers will be given specific guidance in submitting them for publication in the peer-reviewed medical/public health/policy literature. Paper of 2,500–4,000 words is required. Enrollment limited to twenty. A.S. Kesselheim

**HPM 597b, Capstone Course in Health Policy** This course is designed as the capstone educational experience for students concentrating in health policy. It integrates previous course work in health policy and public health and facilitates students' transition from the

academic setting into the world of professional policy analysis. Students practice different approaches to policy formulation, policy analysis, and policy implementation. As part of their course assignments, students use various strategies to frame policy debates to promote desired outcomes. There is extensive work on improving oral and written presentation skills pertinent to current, applied policy dilemmas. Prerequisite: HPM 510a or equivalent. M. Schlesinger

**HPM 600a,b, Independent Study or Directed Readings** Independent study or directed readings on a specific research topic agreed upon by faculty and student. By arrangement with faculty.

**HPM 601b/F&ES 862b/PSYC 601b, The Science of Science Communication** The simple dissemination of valid scientific knowledge does not guarantee it will be recognized by non-experts to whom it is of consequence. The science of science communication is an emerging, multidisciplinary field that investigates the processes that enable ordinary citizens to form beliefs consistent with the best available scientific evidence, the conditions that impede the formation of such beliefs, and the strategies that can be employed to avoid or ameliorate such conditions. This course surveys, and makes a modest attempt to systematize, the growing body of work in this area. Special attention is paid to identifying the distinctive communication dynamics of the diverse contexts in which non-experts engage scientific information, including electoral politics, governmental policy making, and personal health decision-making. D. Kahan

**HPM 610b, Applied Area Readings** Required of HPM Ph.D. students, in preparation for qualifying exams. Readings arranged with specific faculty in related research area. By arrangement with faculty.

**HPM 611a/MGT 611a/ENAS 649a, Policy Modeling** How can one evaluate the effectiveness of HIV prevention programs? How many drug treatment slots are required to provide treatment on demand? Does capital punishment deter homicide? And what do the above questions have in common? The answer to the last query is simple: these problems and more are considered in Policy Modeling. Building on earlier course work in quantitative analysis and statistics, the course provides an operational framework for exploring the costs and benefits of public policy decisions. The techniques employed include “back of the envelope” probabilistic models, Markov processes, queuing theory, and linear/integer programming. With an eye toward making better decisions, these techniques are applied to a number of important policy problems. In addition to lectures, assigned articles and texts, and short problem sets, students are responsible for completing a take-home midterm exam and a number of cases. In some instances, it will be possible to take a real problem from formulation to solution, and compare your own analysis to what actually happened. Prerequisite: a demonstrated proficiency in quantitative methods. E. Kaplan

**HPM 617a,b, Colloquium in Health Services Research** This seminar focuses on the analysis of current issues in health policy and on state-of-the-art methodological issues in health services research. The format includes guest speakers and presentations of ongoing research projects by YSPH and other faculty and graduate students. Students

participate in critical discussions of the issues that arise in both types of sessions. Prerequisite: doctoral status or permission of the instructor. Z. Cooper

**HPM 620a/b, Readings in Health Services Research** In-depth readings, discussion, and analysis of topics specific to health policy research. Optional for Ph.D. students choosing this area of depth. By arrangement with faculty.

**HPM 630b, Advanced Readings in Health Services Research** In-depth readings, discussion, and analysis of topics specific to health services research. Optional for Ph.D. students choosing this area of depth. By arrangement with faculty.

**HPM 697a, Health Policy Leadership Seminar** This seminar introduces students to innovative health policy leaders with experience in federal, state, and local government, nonprofit policy/advocacy organizations, business, and/or health policy-oriented foundations. The speakers cover a range of current health policy issues and also reflect on their own career paths. The seminar, required of Health Policy students, meets once a month. Although no credit or grade is awarded, satisfactory performance will be noted on the student's transcript. S. Geballe

**HPM 698b/MGT 698b, Health Care Policy, Finance, and Economics** This course teaches students the critical skills in analyzing and working within the health care industry. The first part of the course focuses on the economic and financial drivers of the domestic health care system, including private and public financing and delivery models. In the latter part of the course, students learn about current issues of importance to this \$3 trillion industry. The course is part didactic/part seminar in style, with team projects and presentations as a major component of the grade. Open to M.P.H. students in Health Care Management, SOM students, and others with permission of the instructor. H. Forman

**HPM 699a,b/MGT 699a,b, Colloquium in Health Care Leadership** This seminar series, meeting on the medical school campus, introduces the students to leading figures in health care: public sector, private sector, and third sector executives and leaders discuss their career paths and current insights into the evolution and revolution in health care delivery and services. The course provides credit in the spring term for a full year of attendance. Only students who have been attending fall sessions can enroll in the spring. H. Forman

## SOCIAL AND BEHAVIORAL SCIENCES

**SBS 505a/PSYC 657a, Social and Behavioral Foundations of Health** This course provides students with an introduction to social and behavioral science issues that influence patterns of health and health care delivery. The focus is on the integration of biomedical, social, psychological, and behavioral factors that must be taken into consideration when public health initiatives are developed and implemented. The course emphasizes the integration of research from the social and behavioral sciences with epidemiology and biomedical sciences. M. White



**SBS 505c, Accelerated Social and Behavioral Foundations of Health** This intensive seven-week summer course provides students with an introduction to social and behavioral science issues that influence patterns of health and health care delivery. The focus is on the individual, interpersonal, community, and societal influences that must be taken into consideration when public health initiatives are developed and implemented. This course emphasizes the integration of research from the social and behavioral sciences with epidemiology and biomedical sciences. Not open to students in the traditional two-year M.P.H. program. T. Kershaw

**SBS 525a and b, Seminar in Social and Behavioral Sciences** This seminar is conducted once a month and focuses on speakers and topics of particular relevance to SBS students. Students are introduced to research activities of the department's faculty members, with regular presentations by invited researchers and community leaders. The seminar is required of first-year SBS students. Although no credit or grade is awarded, satisfactory performance will be noted on the student's transcript. D. Keene

**SBS 531a/PSYC 664a, Health and Aging** This course explores the ways psychosocial and biological factors influence aging health. Topics include interventions to improve mental and physical health; effects of ageism on health; racial and gender health disparities in later life; and how health policy can best adapt to the growing aging population. Students have the opportunity to engage in discussions and to develop a research proposal on a topic of interest. B. Levy

**SBS 537b, Social and Interpersonal Influences on Health** Social relationships, such as friends, family, romantic partners, neighbors, and coworkers, are an important part of our lives. They are the targets of our behaviors, for example, when we help, love, fight, and discriminate against others. They are the basis of our feelings of status and self-esteem and why we experience the majority of our emotions. Importantly, social relationships have strong influences on our mental and physical health. The purpose of this class is to learn about different ways of conceiving of our social environment, and learning how these social factors can contribute to our mental and physical health. We critically review the literature that examines the associations between social factors and mental and physical health. We address several social concepts, and in each case discuss how they "get under the skin" to influence health. This course is recommended for those with a background in social and behavioral sciences or a keen interest in social and interpersonal influences on health. J. Monin

**SBS 541b, Community Health Program Evaluation** This course develops students' skills in designing program evaluations for public health programs, including nongovernmental and governmental agencies in the United States and abroad. Students learn about different types of summative and formative evaluation models and tools for assessment. The course content is based on an ecological framework, principles of public health ethics, a philosophy of problem-based learning, and critiques of evaluation case studies. Students write evaluation plans for a specific existing public health program. Students may also work as a team with a local community health agency reviewing their evaluation plans and providing guidance on developing a program evaluation plan for one of the agency's public health programs. K. Duffany

**SBS 568b, Public Health Communication** This course is an introduction to the theory, design, and implementation of public health communication. All students work as groups on specific projects for various nonprofit and governmental agencies in the New Haven area, helping the organizations solve their real-world communication needs. To the extent possible, students choose the groups and projects they wish to work with. In class, students learn the theories of public health communication as well as specific production techniques such as podcasts, videos, posters, slogans, press releases, and social media. The class time is a highly interactive seminar. The goal is to enhance students' abilities in both communication of science-based public health information in nontechnical language to the general public and response to crises such as disease outbreaks. R. Bazell

**SBS 573a, Social and Cultural Factors in Mental Health and Illness** This course provides an introduction to mental health and illness with a focus on the complex interplay between risk and protective factors and social and cultural influences on mental health status. We examine the role of social and cultural factors in the etiology, course, and treatment of substance misuse; depressive, anxiety, and psychotic disorders; and some of the severe behavioral disorders of childhood. The social consequences of mental illness such as stigma, isolation, and barriers to care are explored, and their impact on access to care and recovery considered. The effectiveness of the current system of services and the role of public health and public health professionals in mental health promotion are discussed. M. Smith

**SBS 574b, Developing a Health Promotion and Disease Prevention Intervention** The primary objective of the course is to gain experience in intervention research by developing a health promotion and disease prevention intervention. Students choose a health problem (e.g., physical inactivity, smoking, HIV risk) and develop an intervention focused on favorably changing the determinants and behaviors that influence the health problem. The course emphasizes transferring concepts from the abstract to the concrete. Students develop an intervention manual consisting of actual intervention materials and methods that specifically outline how the intervention will be designed, conducted, evaluated, and disseminated. T. Kershaw

**SBS 580b, Qualitative Research Methods in Public Health** This is a course about doing qualitative social research in public health. The course, which has both theoretical and practical components, introduces students to various epistemological, philosophical, and ethical considerations that are involved with qualitative research methods and the practice of social science research more generally. Additionally, students gain hands-on experience with some of the strategies and techniques that are needed to conduct qualitative research. D. Keene

**SBS 581a, Stigma and Health** This course engages students in conceptualizing stigma as a fundamental cause of adverse health. After reviewing conceptual models of stigma, students examine the multiple mechanisms—both structural and individual—through which stigma compromises the health of a large proportion of U.S. and global populations. Given the relevance of identity and stress to the study of stigma and health, the empirical platform of the course is complemented by considering the relevance of

conceptual models of identity, intersectionality, and minority stress. The course reviews social/behavioral and epidemiological methods for studying stigma. Students compare individual- and structural-level interventions to reduce both stigma at its source and its downstream impact on individual health. Class content is organized around themes that cut across all stigmatized conditions and identities. However, students devote course assignments to individual stigmas of their choice. Therefore, students can expect to explain stigma as a predicament that affects nearly all individuals at some point in the life course while developing expertise in one or two stigmas that are particularly relevant to their interests. J. Pachankis

**[SBS 582a, Regulatory and Scientific Issues Relating to Tobacco Use** This course provides students with an understanding of nicotine dependence and tobacco addiction and related research methods. Specific topics include animal models of nicotine dependence; genetics of tobacco addiction; imaging methods for tobacco addiction; measurement of tobacco addiction, including self-report, biomarkers; the effects of various ingredients (additives, flavors) on palatability, inhalability, and addictiveness; interventions for addiction reduction; smoking initiation and progression in adolescents; the role of public health policy in addiction reduction; and training in research methods. Not offered in 2017–2018]

**SBS 585a/GLBL 529a/LAW 20568, Sexuality, Gender, Health, and Human Rights** The course explores the application of human rights perspectives and practices to issues in regard to sexuality and health. It addresses the necessity—and complexity—of adding nuanced rights perspectives to programming and advocacy on sexual health. Through reading, interactive discussion, paper presentation, and occasional outside speakers, students learn the tools and implications of applying rights to a range of sexuality and health-related topics. The overall goal is twofold: to engage students in the world of global sexual health and rights policy making as a field of social justice and public health action; and to introduce them to conceptual tools that can inform advocacy and policy formation and evaluation. A. Miller

**SBS 594a, Maternal-Child Public Health Nutrition** This course examines how nutrition knowledge gets translated into evidence-informed maternal-child food and nutrition programs and policies. Using multisectorial and interdisciplinary case-study examples, the course highlights (1) socioeconomic, cultural, public health, and biomedical forces that determine maternal-child nutrition well-being; and (2) how this understanding can help shape effective programs and policies capable of improving food and nutrition security of women and children. Topics include maternal-child nutrition programs, food assistance and conditional cash-transfer programs, and the Dietary Guidelines for Americans. Prerequisites: CDE 508a and BIS 505a, or permission of the instructor. R. Pérez-Escamilla

**SBS 596b/EMD 596b/LAW 30168, Global Health and Justice Practicum** This course fuses didactic and experiential learning on critical topics at the intersection of public health, rights, and justice in the twenty-first century. Students have the opportunity to explore analytic and practical frameworks that engage a diverse range of legal frameworks and processes that act as key mediators of health, including producing or responding to

health disparities in the United States and worldwide. Readings and project approaches draw from legal, public health, historical, anthropological, and other fields to introduce students to the multiple lenses through which health issues can be tackled, and to build their competence to work with colleagues in other disciplines around such interventions. Because of the substantial time commitment involved, with both classroom and experiential learning, the Global Health and Justice Practicum is worth 2 course units. Enrollment limited to twelve. A. Kapczynski, A. Miller, G. Gonsalves

**SBS 600a,b, Independent Study or Directed Readings** Independent study or directed readings on a specific research topic agreed upon by faculty and student. By arrangement with faculty.

**SBS 610b, Applied Area Readings for Qualifying Exams** Required of CDE Ph.D. students, in preparation for qualifying exams. Readings arranged with specific faculty in related research area. By arrangement with faculty.

**SBS 670a,b, Advanced Field Methods in Public Health** The course offers direct experience in field methods in social and behavioral sciences for doctoral students and advanced M.P.H. students. Students are expected to actively participate as part of a research team (8–10 hours per week) doing field research in some aspect of social and behavioral sciences. It is expected that their progress will be directly supervised by the principal investigator of the research project. This course can be taken for one or two terms and may be taken for credit. Prerequisite: arrangement with a faculty member must be made in advance of registration. T. Kershaw

**SBS 676b, Questionnaire Development** This course is designed to direct students through the process of questionnaire selection and development for use in health research. Questionnaires and surveys are used extensively in medical, epidemiological, and public health research. The specific questionnaire utilized has great potential to affect research conclusions. Students learn to critically evaluate existing measures and how to construct questionnaires for use in health research. Topics include constructs and operational definitions, writing and evaluating questionnaire items, item scaling, domain sampling, item wording and readability, test bias, and item weighting and scoring. Students learn how to evaluate psychometric indicators (e.g., internal consistency, reliability, and validity coefficients). Students are required to construct a questionnaire and are guided through all phases of questionnaire development, including item generation, scaling decisions, survey design, pilot testing, data collection, reliability analysis, and calculation of validity coefficients. The practical learning goal is to generate a publication-level questionnaire to evaluate a unique exposure history or health-related construct. By course end, students are able to critically evaluate existing measures and have the skills necessary to develop psychometrically valid tools for research. Prerequisites: CDE/EMD 508a and BIS 505b (may be taken concurrently). M. White

[**SBS 699a or b, Advanced Topics in Social and Behavioral Sciences** Not offered in 2017–2018]