

# Clinical and Translational Science

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## Administration:

Dean of the School: Wayne H. Giles  
Director of Graduate Studies: Saria Awadalla  
MS CTS Program Director: Jack Zwanziger

## Program Codes:

20FS5140MS (MS)

The School of Public Health offers work leading to the Master of Science in Clinical and Translational Science. The degree is intended to train clinicians, primarily postdoctoral or postresidency fellows and junior faculty, to become leaders in clinical research. In addition, the school participates with the College of Dentistry in offering the DMD/MS CTS joint degree program; with the College of Medicine in offering the MD/MS CTS joint degree program; with the College of Pharmacy in offering the PharmD/MS CTS joint degree program; and with the National University of Health Sciences in offering a coordinated DC/MS CTS degree program.

## Admission and Degree Requirements

- [MS in Clinical and Translational Science: Coordinated DC/MS in Clinical and Translational Science](#)
- [DMD/MS in Clinical and Translational Science](#)
- [MD/MS in Clinical and Translational Science](#)
- [PharmD/MS in Clinical And Translational Science](#)

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## Health Policy and Administration Courses

### HPA 403. U.S. Health Care System. 3 hours.

Overview of the U.S. healthcare system, including its evolution, utilization patterns, providers - human, institutional and organizational - financing, regulating, evaluating, and reforming.

### HPA 404. Ethical Issues in Healthcare Policy and Management. 3 hours.

Designed to provide students with an overview of some of the most debated and difficult ethical issues that arise in the healthcare industry. Course Information: This will be a blended course. Combined synchronous online delivery and on site classroom delivery. Prerequisite(s): Approval of the department.

### HPA 405. Leadership in Public Health Practice. 3 hours.

Utilizing public health core functions, this course explores leadership style and practice through case studies and techniques which enhance leadership development. Course Information: Same as CHSC 405. Prerequisite(s): Graduate or professional standing; or approval of the department.

### HPA 407. Fundamentals of Emergency Management and Resilience Planning. 4 hours.

Aims to provide a foundational body of knowledge on the ideas that can help homeland security professionals think and act critically and strategically. Course Information: Extensive computer use required. This is an online course. Prerequisite(s): Graduate or professional standing; or consent of the instructor.

### HPA 408. Decision Support Systems for Emergency Management and Resilience Planning. 4 hours.

Focuses on decision support systems to facilitate the analysis and identification of optimum remedial risk management alternatives and resilience planning. Course Information: Extensive computer use required.

### HPA 410. Health Organizational Leadership. 3 hours.

Examines the roles, responsibilities, and impact of leaders of organizations in the health industry. Critical structures and techniques of effective organizational leaders are taught.

### HPA 412. Comparative Health Systems: Global Perspective. 3 hours.

International health care systems will be analyzed from the perspective of their operational, policy and local health delivery systems. A comparative analysis of these global health systems will then be made to the health care system within the US. Prerequisite(s): IPHS 410.

### HPA 415. Introduction to Public Health Policy. 3 hours.

Provides an overview of all aspects of the public health policymaking process at the federal level with understanding, examples, and applications of topics at the state and local levels. Course Information: Credit is not given for HPA 415 if the student has credit in HPA 430. Prerequisite(s): Approval of the Department.

### HPA 417. Quality Management in Health Services. 3 hours.

Surveys development of quality management and theoretical basics and diverse perspectives of quality management and regulation. Presents relevant research and management methodologies.

### HPA 419. Public Health Foundations. 3 hours.

Students will be introduced to key public health concepts, the history of public health and how the core areas of public health can be integrated to promote health at population level. Prerequisite(s): BSTT 400.

### HPA 420. US Health Care System for Public Health Practitioners. 3 hours.

Introduces students to characteristics of the U.S. health care systems; healthcare organizations, financing, and delivery of services. Course Information: Credit is not given for HPA 420 if student has credit in HPA 403. Prerequisite(s): Approval of the Department.

### HPA 425. Healthcare Human Resource Management. 3 hours.

Develops the core human resources competencies needed to effectively manage and lead healthcare delivery organizations. Examines general human resources topics, applied within the healthcare delivery setting.

### HPA 429. Introduction to Health Services Research. 2 hours.

Introduction to health services research using classic studies and current trends which examine access, cost, quality, and organization of health care. Course Information: Prerequisite(s): HPA 400.

**HPA 430. Introduction to Health Policy. 3 hours.**

Explores the multiple influences on public health policy, such as politics and cultural and societal norms, and the impact that policy has had on population health. Course Information: Prerequisite(s): Graduate or professional standing; and approval of the department. Credit will not be given for HPA 430 if student has credit in HPA 415.

**HPA 431. Public Health Law and Ethics. 3 hours.**

Provides a dynamic approach to learning about public health law, the relationship between law and the public's health, and will examine the ethical underpinnings and context of public health practice. Course Information: Prerequisite(s): HPA 415; and approval of the department.

**HPA 432. Public Health Advocacy. 3 hours.**

Designed to provide prospective public health policy professionals strategies for collecting, analyzing, assimilating and delivering pertinent health policy information to policy makers, stakeholders, and other interested parties. Course Information: Credit is not given for HPA 432 if the student has credit for CHSC 430. Prerequisite(s): Approval of the Department. Recommended background: HPA 415.

**HPA 434. Healthcare Law and Ethics. 3 hours.**

Designed to provide a general understanding of the laws and regulations that impact the healthcare industry, the most frequent legal issues which face healthcare executives today and how to recognize legal risks in daily operations. Course Information: Prerequisite(s): Approval of the Department.

**HPA 436. GIS for Environmental and Public Health Professionals. 4 hours.**

Aims to promote a critical understanding of the basic practices and techniques associated with GIS applications in the environmental and public health areas. Course Information: Online course. Co-requisite(s): HPA 480. Recommended background: Computer skills (knowledge of Excel is a minimum) and a strong quantitative background. Class Schedule Information: To be properly registered, students must enroll in one Lecture-Discussion and one Practice.

**HPA 437. Health Policy and Politics. 3 hours.**

Health policy including economic implications is analyzed, applied, and evaluated from a comprehensive understanding of the state of the US healthcare system. Course Information: This is a blended course. Combined synchronous online delivery and on site classroom delivery. Prerequisite(s): Approval of the department.

**HPA 440. Healthcare Data Analytics. 3 hours.**

Introduces administrative healthcare data sources, methods to describe and visualize data, and statistical concepts to analyze healthcare issues, with applications using Excel software. Course Information: Prerequisite(s): Approval of the Department.

**HPA 444. Strategic Planning and Budgeting/Finance. 3 hours.**

Provides a systematic understanding of strategic planning, budgeting, and financial management of public health organizations. Contemporary theories and principles are used to develop, implement, and evaluate organizational strategy. Course Information: Prerequisite(s): IPHS 403; and approval of the department.

**HPA 445. Organizational Leadership in Public Health. 3 hours.**

Examines classic and contemporary leadership theory and practice as applied to the diverse organizational, systems and community settings in which public health leaders function. Course Information: Extensive computer use required. This is an online course. Prerequisite(s): HPA 400.

**HPA 446. Public Health Resource Management: Methods, Ethics and Policy. 3 hours.**

Equips students to analyze, evaluate and address the relationships among budgets, resources, forces of change, and organizational and professional values as they pertain to managerial choices and decisions. Course Information: Extensive computer use required. This is an online course. Prerequisite(s): HPA 400.

**HPA 450. Public Health Informatics Certificate Integrative Paper. 0 hours.**

Student will develop an integrative paper that will synthesize and apply the knowledge acquired from the program to address a public health informatics problem. Course Information: Satisfactory/Unsatisfactory grading only. Extensive computer use required. Prerequisite(s): HPA 465 and HPA 481 and HPA 563 and HPA 564 and HPA 565. Students must register for the integrative paper during the last semester of enrollment in the campus certificate program.

**HPA 451. Health Care Finance I. 3 hours.**

Examines practical aspects of finance in health care and recent developments in financial management of health care organizations, and applications of financial management techniques to specific problems facing health care managers. Course Information: Prerequisite(s): Graduate or professional standing and approval of the department.

**HPA 455. Geographic Information Systems Integrative Project. 2 hours.**

The integrative project aims to demonstrate a comprehensive mastery of the course materials, database theories, and GIS techniques by pursuing a project resembling those encountered by public health. Course Information: Extensive computer use required. Taught Online. Satisfactory/Unsatisfactory grading only. Prerequisite(s): Consent of the instructor.

**HPA 458. Managerial Epidemiology. 3 hours.**

Applies principles and tools of epidemiology, explore distribution and determinants of disease, and synthesize this knowledge with the management of health service organizations, hospitals, health care plans and physicians practices. Course Information: Prerequisite(s): Approval of the department.

**HPA 459. Introduction to Health Inequities in the United States. 3 hours.**

Introduction to the origins, evolution and debates surrounding "disparities" in health. Through readings, discussions and lectures participants will be exposed to debates about health inequities in the US and how they might be eliminated. Course Information: Extensive computer use required. Prerequisite(s): Graduate or professional standing; and consent of the instructor. Students in the Health Disparities Research Certificate will be given first priority for the online section of this course.

**HPA 460. Introduction to the Economics of Health and Healthcare. 3 hours.**

Examines health, the health care sector, and healthy policy issues using economic theoretical frameworks and empirical evidence. Course Information: Credit is not given for HPA 460 if the student has credit in HPA 463. Prerequisite(s): Approval of the Department.

**HPA 461. Information and Decision Support Systems for Healthcare Administration. 3 hours.**

Introduces students to the role of information systems in healthcare and public health practices, the use of information systems for management control; information systems project evaluation, information technology personnel.

**HPA 462. Quantitative Methods in Health Disparities Research. 4 hours.**

Students will learn concepts and quantitative research methods in US health disparities with a focus on local Chicago data. Course Information: Extensive computer use required. Prerequisite(s): At least one graduate level course in biostatistics or equivalent experience and graduate or professional standing or consent of the instructor. Students in the Health Disparities Research Certificate will be given first priority for the online section of this course. Recommended background: Knowledge of a statistical program. Priority will be given to students enrolled in the Health Disparities Research Certificate Program.

**HPA 463. Managerial Health Economics. 3 hours.**

Uses managerial economics to study health care system: demand for medical services; role of health insurance; productivity/cost measurement; labor markets and competition. Course Information: Prerequisite(s): HPA 400 or consent of the instructor.

**HPA 464. Sociocultural Dimensions of Health Disparities Research. 3 hours.**

Addresses a range of measurement issues and additional concepts that are important when conceptualizing, planning, and conducting health disparities research. Course Information: Extensive computer use required. Prerequisite(s): Graduate or professional standing; and consent of the instructor. Students in the Health Disparities Research Campus Certificate will be given first priority for the online section of this course. Recommended background: HPA 459.

**HPA 465. Health Information and Decision Support Systems. 4 hours.**

Introduction to computer assisted management information and decision systems in health organizations: analysis and design of databases; data and information flow; reports; and uses microcomputers. This is an online course.

**HPA 466. Critical Infrastructure Protection and Allocation of Assets Planning. 4 hours.**

Aims to cover complex intergovernmental and public-private sector critical infrastructure protection frameworks; vulnerability/risk analysis and management techniques; assets (resources) allocation planning tools; and crisis management. Course Information: Extensive computer use required. This is an online course. Prerequisite(s): HPA 407; and approval of the department.

**HPA 469. Evidence Based Policy Development and Implementation: Health Disparity Case Studies. 3 hours.**

This case study based course focuses on the development, implementation and evaluation of health policy that aims to reduce health disparities in the US. Emphasizes systematic public policy approaches to address health disparity issues. Course Information: Extensive computer use required. Prerequisite(s): Graduate or professional standing; and consent of the instructor and completion of at least one graduate level course in health disparities. Students in the Health Disparities Research Campus Certificate will be given first priority for the online section of this course. Recommended background: Advanced master's level or concurrent doctoral level work in health policy, policy analysis and health disparity course work offered in the Health Disparities Research Certificate.

**HPA 470. Quantitative Methods for Healthcare Managers. 3 hours.**

Provides an understanding of how to use data analytics and other quantitative methods to facilitate healthcare decision making. Course Information: Prerequisite(s): BSTT 400; and approval of the department.

**HPA 472. Clinical Research Methods I. 4 hours.**

Introduces experimental and quasi-experimental study designs and descriptive statistics. Course Information: Online course. Extensive computer use required. Prerequisite(s): Graduate or professional standing; and approval of the department.

**HPA 473. Clinical Research Methods II. 4 hours.**

Introduces OLS multivariate regression models, its assumptions, interpretation of outputs and departures, and surveys more advanced multivariate regression models. Course Information: Online course. Extensive computer use required. Prerequisite(s): HPA 472; and graduate or professional standing; and approval of the department.

**HPA 475. Contexts for Clinical Research. 3 hours.**

Provides an overview of the healthcare system, epidemiological and research subject protections contexts for clinical research. Course Information: Online course. Extensive computer use required. Prerequisite(s): Graduate or professional standing; and approval of the department.

**HPA 477. Data Collection and Management for Clinical Research. 3 hours.**

Provides basic statistical computing and data management concepts, an overview of qualitative research techniques, and a survey of survey design from sampling strategies to data collection, item and measure development and survey analysis. Course Information: Online course. Extensive computer use required. Prerequisite(s): HPA 472; and graduate or professional standing; and approval of the department.

**HPA 479. Evaluating Clinical Interventions. 3 hours.**

Introduces the major approaches used to evaluate clinical interventions. Course Information: Online course. Extensive computer use required. Prerequisite(s): HPA 472; and graduate or professional standing; and approval of the department.

**HPA 480. Health Related Database Design and Analysis. 4 hours.**

Introduces students to the design and analysis of health related relational and spatial databases. Course Information: Same as EOHS 475. Extensive computer use required. Taught online only. Prerequisite(s): Consent of the instructor. Recommended Background: Strong quantitative background recommended.

**HPA 481. Development of Public Health Surveillance Information Systems. 3 hours.**

Examination of the process and methods of designing and evaluating public health information surveillance systems. Course Information: Extensive computer use required. Prerequisite(s): HPA 465.

**HPA 483. Management of Communication Systems for Public Health Informatics Applications. 4 hours.**

Focuses on the examination and management of current information communication systems and their applications in public health informatics. Course Information: Extensive computer use required. This is an online course. Prerequisite(s): HPA 465.

**HPA 485. Legal and Ethical Issues in Public Health Informatics. 3 hours.**

Examination of the legal and ethical issues involved in the use of health related information in public health. Course Information: Extensive computer use required. This is an online course. Prerequisite(s): HPA 465.

**HPA 486. Survey of Public Health Information Systems. 4 hours.**

Focuses on survey of various public health information systems with respect to their functionalities, planning, design, development, sustainability, interoperability, and management. Course Information: Extensive computer use required. This is an online course. Prerequisite(s): HPA 465; and consent of the instructor.

**HPA 487. Public Health Informatics Methods. 3 hours.**

Course summarizes the three major methodological approaches for accessing and managing health information: Web-based information systems, data mining, and geographic information systems (GIS). Course Information: Extensive computer use required. This is an online course. Prerequisite(s): HPA 465; and consent of the instructor.

**HPA 488. Public Health Information Systems Evaluation and Project Management. 3 hours.**

Introduces students to the fundamental principles of information systems project evaluation and project management, with specific references to public health practice. Course Information: Extensive computer use required. This is an online course. Prerequisite(s): HPA 465; and consent of the instructor.

**HPA 490. Topics in Healthcare Leadership. 1 hour.**

Provides students with a series of explorations of various leadership specialty areas within the delivery of healthcare. The specific demands and skill of each will be covered. Course Information: May be repeated to a maximum of 2 hours. Prerequisite(s): Approval of the Department.

**HPA 491. Professional Development. 1 hour.**

Students will be taught the professional skills and develop the emotional intelligence necessary to work effectively in a team-based business environment.

**HPA 494. Introductory Special Topics in Health Policy and Administration. 1-4 hours.**

Introductory topics in health administration, policy analysis, health care financing, cost-effectiveness evaluation. Topics vary by semesters.

**HPA 495. MHA Preceptorship. 1-3 hours.**

Preceptor-guided field experience in health administration designed to promote critical thinking and problem solving skills, and application of management knowledge and skills in a practice setting. Course Information: Satisfactory/Unsatisfactory grading only. May be repeated to a maximum of 6 hours. Prerequisite(s): Graduate or professional standing and approval of the department.

**HPA 496. MHA Capstone I. 1 or 3 hour.**

Creates a structured process for students to successfully complete their capstone and to produce a high quality, professional analysis of a capstone issue that is delivered in the form of a capstone paper and presentation. Course Information: Prerequisite(s): Graduate or professional standing and approval of the department.

**HPA 497. Integrative Project in Emergency Management. 4 hours.**

Independent investigation that draws upon the professional experience and knowledge synthesis of the student. Students investigate a topic/problem in their field and write an article. Course Information: Satisfactory/Unsatisfactory grading only. Extensive computer use required. This is an online course. Prerequisite(s): Consent of the instructor.

**HPA 498. MHA Capstone II. 1 hour.**

The MHA capstone process, structured over two courses and two semesters, creates and structured pathway for students to successfully complete their capstone ,that is delivered in the form of a capstone paper and presentation. Course Information: HPA 496; and graduate or professional standing; and approval of the department.

**HPA 499. Introduction to Research Design for Public Health Practitioners. 1 hour.**

Introduces students to data collection techniques for qualitative and quantitative research. Data gathering and analysis are central methods for conducting research to inform policy. Course Information: Prerequisite(s): Approval of the Department.

**HPA 505. Strategic Planning and Marketing in Healthcare. 3 hours.**

Introduces the principles, methods and concepts of two primary aspects of strategic management as they relate to healthcare organizations 1) Strategic Planning and 2) Marketing. Course Information: Prerequisite(s): HPA 403 and HPA 451 and HPA 410; and approval of the department.

**HPA 509. Physician Relations: Practice and Leadership. 3 hours.**

Physician Relations is intended to provide an overview of the changing role of physicians in our healthcare system and how to effectively work with them in a leadership capacity. Course Information: Credit is not given for HPA 509 if students are enrolled in Public Health. Prerequisite(s): HPA 403 and HPA 410; and approval of the department.

**HPA 511. Organization Theory Applied to Health Programs. 3 hours.**

Classical and modern organization theories applied to health programs. Includes organization structure and goals, management functions and processes, and managerial controls and evaluation. Course Information: Prerequisite(s): HPA 400 or consent of the instructor.

**HPA 512. Ethics in Clinical Research. 1 hour.**

Survey of key ethical issues involved in conducting research with human subjects, including informed consent, confidentiality, access and equity. Course Information: Same as MHPE 512. Extensive computer use required. Requires completion of an online course in human subjects research, to be supplemented by classroom discussion of the topics raised in that course and others. Prerequisite(s): Approval of the department. Students must be enrolled in the Master of Science in Public Health program.

**HPA 516. Health Personnel Management. 3 hours.**

Health personnel policies and programs, human resources requirements, recruitment, development, performance appraisal, salary and wage administration, and management/labor relations in the health industry. Course Information: Prerequisite(s): HPA 400 and consent of the instructor.

**HPA 521. Empirical Methods for Health Research I. 3 hours.**

Examines empirical methods used in health policy research and focuses on econometric theory and the sensible application of econometric methods to important topics in health and healthcare research. Course Information: Prerequisite(s): Graduate or professional standing; and approval of the department.

**HPA 522. Empirical Methods for Health Research II. 3 hours.**

Graduate level quantitative research methods course. Utilizes social science research methods with an emphasis on experimental and quasi-experimental research designs in the study of methodologically sound public health research investigations. Course Information: Prerequisite(s): HPA 521; and graduate or professional standing; and approval of the department.

**HPA 525. Population Based Healthcare Services Planning. 3 hours.**

Examines the roles that health care delivery organizations can play, and methodologies used, in developing programs specific to the needs of the community they serve. Course Information: Prerequisite(s): HPA 403 and HPA 410 and HPA 495.

**HPA 526. Leadership and Diversity in Clinical Research. 2 hours.**

Graduate level course designed to provide researchers with the leadership and team science skills and knowledge needed to conduct culturally competent and sensitive research and to effectively consider and engage communities in research. Course Information: Taught online. Prerequisite(s): Approval of the department.

**HPA 527. Critical Issues in Long Term Care Policy. 3 hours.**

Examines the policy process and policy implications affecting the organization, financing, delivery, and utilization of long-term care services. Course Information: Same as CHSC 527. Prerequisite(s): Credit or concurrent registration in CHSC 400 and Credit or concurrent registration in CHSC 425; and graduate or professional standing; or consent of the instructor.

**HPA 534. Research Design and Grant Writing. 2 hours.**

Introduction to the skills necessary to plan a research project and write a research grant proposal using a systematic approach. Course Information: Same as MHPE 534. Previously listed as MHPE 431. Prerequisite(s): Graduate or professional standing; and approval of the department.

**HPA 535. Translating Research into Practice. 3 hours.**

Current theory and practical reality related to the adoption and use of new scientific findings in patient care. The influence of research on public policy. Course Information: Same as MHPE 535. Extensive computer use required. Prerequisite(s): Graduate or professional standing; and approval of the department.

**HPA 541. Strategic Management of Healthcare Organizations. 3 hours.**

Introduction to strategic analysis for healthcare organizations. Topics include: Health care competition, entrepreneurship, technology and innovation, multi-constituent environment, and human resources. Course Information: Previously listed as HPA 441. Prerequisite(s): HPA 551; graduate standing and approval of the department.

**HPA 546. EMHA Capstone. 3 hours.**

The EMHA Capstone is the EMHA program's major integrative experience based on a significant project in a healthcare organization. Course Information: Prerequisite(s): Approval of the Department.

**HPA 551. Marketing Health Programs. 3 hours.**

Concepts of marketing as a management tool; application of marketing to health care: the marketing process, marketing resources, and strategies for accomplishing marketing objectives. Course Information: Prerequisite(s): HPA 400 or MKTG 563 or consent of the instructor.

**HPA 552. Healthcare Finance II. 3 hours.**

Builds on the topics introduced in HPA 451. Specific emphasis will be placed on understanding project risk assessment, capital investments, debt, equity and lease financing and developing a long range strategic plan. Course Information: Previously listed as HPA 452. Prerequisite(s): HPA 451 and ACTG 510.

**HPA 556. U.S. Mental Health Policy. 2 hours.**

Public policies which have supported the U.S. mental health service system from 1946 to the present. Theory, development, and evaluation of mental health policy in the US. Course Information: Prerequisite(s): HPA 400 and HPA 430 and either EPID 400 or BSTT 400.

**HPA 563. Web-Based Public Health Information Systems. 4 hours.**

Examination of web based applications in public health practice and factors in the design of web based public health education and database systems. This is an on-line course. Course Information: Prerequisite(s): HPA 465; and consent of the instructor. Unless otherwise permitted, limited to students in the public health informatics track of HPA.

**HPA 564. Geographic Information System Application in Public Health. 3 hours.**

Advanced level GIS course to promote critical understanding of the major practices associated with GIS in the many applications areas found in public health. Course Information: Same as HPA 564. Extensive computer use required. This is an on-line course. Prerequisite(s): HPA 465 or HPA 436 or EOHS 436; and consent of the instructor.

**HPA 565. Datamining Applications in Public Health. 3 hours.**

Presents the key public health information system sources, describes the process of datamining and introduces the student to a sample of datamining techniques. Course Information: Same as EOHS 565. Extensive computer use required. Prerequisite(s): BSTT 400.

**HPA 567. Public Health Policy Analysis. 3 hours.**

Enables students to conduct an in-depth, evidence-based public health policy analysis within an economic and public policy frame. Focus will be on public health policy analyses conducted by government and non-government organizations. Course Information: Previously listed as HPA 467. Credit is not given for HPA 567 if the student has credit in HPA 467. Prerequisite(s): HPA 415; and approval of the department. Recommended background: HPA 460.

**HPA 569. Risk Visualization and Management Techniques in Homeland Security Sciences. 4 hours.**

Focuses on the examination of risk visualization techniques applied for managing and mitigating natural hazards, environmental, and homeland security threats. Course Information: Extensive computer use required. Prerequisite(s): HPA 436; or HPA 408; and approval of the department. Recommended background: A strong quantitative background and knowledge of the ArcGIS platform.

**HPA 573. Principles of Economic Evaluations of Health Care Interventions. 3 hours.**

Principles, models and practical methods for the economic evaluation of health care services with an emphasis on pharmaceutical care. Course Information: Same as PSOP 573. Extensive computer use required. Course offered online, in person, or via distance education. Prerequisite(s): Consent of the instructor.

**HPA 575. Strategic Planning for Disaster Resilience. 4 hours.**

Focuses on formulating disaster resilience strategic plans for entities in the private and public sectors. Course Information: Extensive computer use required. Prerequisite(s): HPA 407; and approval of the department. Recommended background: Basic emergency management and/or continuity planning knowledge.

**HPA 576. Disaster Response and Recovery Operations. 4 hours.**

Focuses on the frameworks and methods for designing, developing, implementing, and evaluating programs and cost effective plans for disaster response and recovery operations in the public and private sectors. Course Information: Extensive computer use required. Prerequisite(s): HPA 407; and approval of the department.

**HPA 581. Advanced Topics in Health Economics. 3 hours.**

Examines the latest literature on a variety of current topics in Health Economics. It will consist of a series of lectures by faculty experts. Different topics will be covered each year to reflect the expertise of participating faculty. Course Information: Prerequisite(s): HPA 460; and approval of the department.

**HPA 590. Grant Writing. 1 hour.**

Students will learn how to write a grant application through the guidance of a mentoring committee. They will formulate a research proposal which will be presented to a panel of researchers who will critique the proposed study.

**HPA 591. Grant Writing for New Investigators. 3 hours.**

Fosters grant writing skills, and helps students learn the mechanics of an NIH grant application, particularly K awards, and how to peer review applications. Course Information: Prerequisite(s): Consent of the instructor. MS in Clinical and Translational Science students are expected to have completed the required coursework for the program and to have made significant progress in their research project.

**HPA 592. Spatial Data Analysis and Visualization. 4 hours.**

Application of spatial analysis techniques to visualize patterns, distributions, relationships of public health related data emphasizing their advantages and limitations. Course Information: Prerequisite(s): Credit or concurrent registration in HPA 564; or consent of the instructor. Recommended background: basic statistics and ordinary least squares regression.

**HPA 593. Social Vulnerability Analysis. 4 hours.**

Study of advanced level social vulnerability analysis techniques and their application for the protection of communities. Course Information: Extensive computer use required. Taught online. Prerequisite(s): Approval of the Department. Recommended background: Introductory GIS and quantitative skills.

**HPA 594. Advanced Special Topics in Health Policy and Administration. 1-4 hours.**

Advanced topics in health administration, policy analysis, health care financing, cost-effectiveness evaluation. Topics vary by semester. Course Information: Prerequisite(s): Consent of the instructor.

## Biostatistics Courses

**BSTT 400. Biostatistics I. 4 hours.**

Descriptive statistics, basic probability concepts, one- and two-sample statistical inference, analysis of variance, and simple linear regression. Introduction to statistical data analysis software. Course Information: Enrollment restricted to public health students and healthcare administration students; other graduate, professional and advanced undergraduate students admitted by consent as space permits. To obtain consent, see the SPH registrar.

**BSTT 401. Biostatistics II. 4 hours.**

Simple and multiple linear regression, stepwise regression, multifactor analysis of variance and covariance, non-parametric methods, logistic regression, analysis of categorical data; extensive use of computer software. Course Information: Prerequisite(s): BSTT 400.

**BSTT 402. Health Policy for Epidemiologists and Biostatisticians. 1 hour.**

Epidemiological data and biostatistics provide the evidence to support the development and justification of policies. Public health policy interventions, factors influencing political and social environments and the evaluation of policy-making. Course Information: Same as EPID 402.

**BSTT 413. Introduction to Data Analysis w/ R. 2 hours.**

An introductory overview of statistical programming using R in the context of describing and analyzing public health data. Course Information: Extensive computer use required. Recommended background: BSTT 400; or IPHS 402.

**BSTT 426. Health Data Analytics Using Python Programming. 3 hours.**

Covers methodologies of online data collection by Python Programming. Topics include: introduction to Python, Information retrieval Techniques, Retrieving and analyzing information from medical data sources, IBM Bluemix. Course Information: Extensive computer use required. Prerequisite(s): No prerequisites except that some very basic understanding of programming in SAS or R or some other programming language is needed along with basic analytical knowledge. Motivation to learn programming concepts is key. Recommended Background: IPHS 402 or EPID 406 or BSTT 494.

**BSTT 494. Introductory Special Topics in Biostatistics. 1-4 hours.**

Special topics in biostatistics. Content varies. Course Information: May be repeated. Students may register in more than one section per term. Prerequisite(s): Consent of the instructor.

**BSTT 505. Logistic Regression and Survival Analysis. 2 hours.**

Interpretation of logistic regression and survival analysis models. Running logistic and proportional hazards regression models and constructing life-tables using SAS. Course Information: Previously listed as BSTT 402. Prerequisite(s): BSTT 400 and BSTT 401.

**BSTT 506. Design of Clinical Trials. 3 hours.**

Rationale for clinical trials, blinding, ethical issues, methods of randomization, crossover trials, power and sample size calculations, data management, protocol deviation, data analysis, interim analysis. Course Information: Previously listed as BSTT 430. Prerequisite(s): BSTT 400 and BSTT 401.

**BSTT 507. Sampling and Estimation Methods Applied to Public Health. 3 hours.**

The purpose of this course is to provide a comprehensive overview of current methods and issues in survey sample design and associated estimation procedures. Course Information: Previously listed as BSTT 440. Credit is not given for BSTT 507 if the student has credit in STAT 431. Restriction applies only to certification for students pursuing the Interdepartmental Graduate Concentration in Survey Methodology. Prerequisite(s): BSTT 401 or BSTT 502 or consent of the instructor.

**BSTT 510. Biostatistics Theory I. 3 hours.**

Part of a two-semester probability-statistical inference sequence with an emphasis on public health- and biostatistics-related aspects of the probabilistic paradigm. Coverage includes probability, and random variables. Course Information: Extensive computer use required. Prerequisite(s): Two semesters of college calculus; and consent of the instructor.

**BSTT 511. Biostatistics Theory II. 4 hours.**

Provides to the students approach to probability and statistical inference and their application to research in public health and health science fields. This course covers the fundamental theories of biostatistical inferential procedures. Course Information: Extensive computer use required. Prerequisite(s): BSTT 510; or consent of the instructor.

**BSTT 521. Applied Multivariate Analysis. 3 hours.**

Analysis of vector of responses; MANOVA, data reduction methods; introduction to cluster analysis, discriminant analysis, and structural equation models. Course Information: Prerequisite(s): BSTT 537 and consent of the instructor.

**BSTT 523. Biostatistics Methods I. 4 hours.**

Foundations for and introduction to statistical inference, including one- and two-sample problems; regression analysis, including multiple regression and indicator variables. Course Information: Previously listed as BSTT 502. Prerequisite(s): College calculus, including multivariable calculus, concurrent registration in BSTT 524, and consent of the instructor.

**BSTT 524. Biostatistics Laboratory. 2 hours.**

Use of spreadsheets for statistical investigations; use of statistical software; matrix theory, including methods relevant in biostatistical analysis. Course Information: Previously listed as BSTT 503. Prerequisite(s): Concurrent registration in BSTT 523 and consent of the instructor.

**BSTT 525. Biostatistics Methods II. 4 hours.**

Analysis of variance and multiple comparisons; model building and diagnostics; generalized linear models; logistic and Poisson regression; introduction to repeated measures and mixed models. Course Information: Previously listed as BSTT 504. Prerequisite(s): Grade of B or better in BSTT 523 and Grade of B or better in BSTT 524, or consent of the instructor.

**BSTT 527. Statistical Learning in Health Analytics. 3 hours.**

Covers multivariate statistical methods such as LASSO, ElasticNet, Decision Trees etc, and machine learning methods Bagging, random Forest, Boosting etc in context of statistical learning in PH applications. Course Information: Extensive computer use required. Prerequisite(s): IPHS 402 and BSTT 505; or BSTT 523 and BSTT 525. Recommended Background: IPHS 402 or EPID 406 or BSTT 494.

**BSTT 528. Machine Learning in Health Analytics. 3 hours.**

Covers several advanced statistical and machine learning methods including graphical models, natural language processing, neural nets, hierarchical modeling, annealing, deep belief networks. Course Information: Extensive computer use required. Prerequisite(s): BSTT 526 and BSTT 527.

**BSTT 529. Health Analytics Investigations. 2 hours.**

This is a main competency measure of MS in Public Health with Health Analytics concentration. Course Information: Satisfactory/Unsatisfactory grading only. Extensive computer use required. Prerequisite(s): BSTT 526 and BSTT 527 and BSTT 528; or consent of the instructor.

**BSTT 535. Categorical Data Analysis. 3 hours.**

Contingency tables and their tests, measures of association, stratified analysis, logistic regression, generalized linear model, Poisson regression, log-linear model, matched data, marginal homogeneity, ordinal data. Course Information: Previously listed as BSTT 511. Prerequisite(s): Grade of B or better in BSTT 525; and STAT 411, or consent of the instructor.

**BSTT 536. Survival Analysis. 3 hours.**

Concepts of lifetime or survival distributions, especially with censored data; nonparametric estimation of the survival function; rank tests; proportional hazards regression models; parametric models. Course Information: Previously listed as BSTT 512. Prerequisite(s): Grade of B or better in BSTT 525 and Grade of B or better in STAT 411, or consent of the instructor.

**BSTT 537. Longitudinal Data Analysis. 4 hours.**

Application and theory of models for longitudinal data analysis for both continuous and categorical response data, including use of statistical software for these methods. Course Information: Previously listed as BSTT 513. Prerequisite(s): Grade of B or better in STAT 411 and Grade of B or better in BSTT 525, or consent of the instructor.

**BSTT 538. Biostatistical Consulting. 2 hours.**

Discussion of techniques required for successful biostatistical consultation; effective communication, problem formulation, data analysis, oral and written reports, supervised consulting experience. Course Information: Previously listed as BSTT 514. Prerequisite(s): Grade of B or better in BSTT 525 and consent of the instructor. Restricted to students enrolled in the biostatistics major.

**BSTT 550. Biostatistical Investigations. 4 hours.**

Analysis of several large data sets that will require integration of numerous biostatistical tools; written summarization and discussion of results. Course Information: Previously listed as BSTT 522. Prerequisite(s): Grade of B or better in BSTT 535 and Grade of B or better in BSTT 536 and Grade of B or better in BSTT 537 and Grade of B or better in BSTT 538 and Grade of B or better or concurrent registration in BSTT 521.

**BSTT 560. Large Sample Theory. 2 hours.**

Deriving and applying large sample statistical theories. The primary focus will be in limit theorems and their applications in biostatistical problems. Course Information: Meets eight weeks of the semester. Previously listed as BSTT 534. Prerequisite(s): Open only to PhD degree students; or consent of the instructor. Adequate training at the level of intermediate mathematical statistics. Masters degree in biostatistics or mathematics.

**BSTT 561. Advanced Statistical Inference. 3 hours.**

An in-depth consideration of some important ideas of statistical inference including large-sample theory, estimation and testing. Specific topics to be covered include asymptotic theory, parameter estimation methods and hypothesis testing. Some computer use in class. Course Information: Previously listed as BSTT 531. Prerequisite(s): Open only to Ph.D. degree students; and consent of the instructor. Recommended background: MS degree in Biostatistics or the equivalent.

**BSTT 562. Linear Models. 4 hours.**

Generalized inverse matrices; distributions for quadratic forms; estimability and testable hypotheses; constrained linear model; applications to regression, ANOVA, ANCOVA models; variance component models. Course Information: Previously listed as BSTT 533. Prerequisite(s): Open only to Ph.D. degree students; or consent of the instructor. Recommended background: MS degree in Biostatistics or the equivalent.

**BSTT 563. Generalized Linear Models. 4 hours.**

Teaches students the components of generalized linear models and their extensions. Course Information: Previously listed as BSTT 541. Prerequisite(s): BSTT 561 and concurrent registration in or prior completion of BSTT 560. Open only to PhD degree students; or consent of the instructor. Adequate training at level of intermediate mathematical statistics. Masters degree in biostatistics, mathematical statistics or mathematics.

**BSTT 564. Missing Data. 4 hours.**

Students will learn the statistical methods used for analyzing data with missing values. Course Information: Previously listed as BSTT 542. Prerequisite(s): BSTT 561 and concurrent registration in or prior completion of BSTT 560. Open only to PhD degree students; or consent of the instructor. Adequate training at level of intermediate mathematical statistics. Masters degree in biostatistics, mathematical statistics or mathematics.

**BSTT 565. Computational Statistics. 4 hours.**

Developing a broad and thorough working knowledge of modern statistical computing and computational statistics on a practical, conceptual, philosophical and mathematical level. Course Information: Previously listed as BSTT 543. Extensive computer use required. Prerequisite(s): Concurrent registration in or prior completion of BSTT 560. Open only to Ph.D. degree students; or consent of the instructor. Adequate training at level of intermediate mathematical statistics. Masters degree in biostatistics, mathematical statistics or mathematics.

**BSTT 566. Bayesian Methods. 4 hours.**

Developing a broad and thorough working knowledge of Bayesian applications on a practical, conceptual, philosophical and mathematical level. Course Information: Previously listed as BSTT 544. Prerequisite(s): Concurrent registration in or prior completion of BSTT 560. Open only to Ph.D. degree students; or consent of the instructor. Adequate training at level of intermediate mathematical statistics. Masters degree in biostatistics, mathematical statistics or mathematics. Class Schedule Information: Extensive computer use required.

**BSTT 567. Advanced Survival Analysis. 4 hours.**

Methods of analysis for multivariate survival data, including transition models and shared frailty models. Theory behind existing methodology is covered as well as implementation. Course Information: Prerequisite(s): Grade of B or better or concurrent registration in BSTT 536; and consent of the instructor. Recommended background: Intended for students in the Biostatistics PhD program.

**BSTT 568. Programming and Simulation in R. 2 hours.**

Applications in R on a practical, conceptual, philosophical and mathematical level. The focus is on simulation and computation, not on data analysis. Course Information: Extensive computer use required. Prerequisite(s): BSTT 400; or both BSTT 523 and BSTT 524; and graduate or professional standing; or consent of the instructor.

**BSTT 594. Special Topics in Biostatistics. 1-4 hours.**

Advanced special topics. Content varies. Course Information: May be repeated. Students may register in more than one section per term. Prerequisite(s): Consent of the instructor.

**BSTT 595. Biostatistics Research Seminar. 1 hour.**

Current developments in theory and application of biostatistics and epidemiology with presentations by faculty and visiting scientists. Course Information: Satisfactory/Unsatisfactory grading only. May be repeated.