The Committee on Clinical & Translational Science (CCTS) is a freestanding academic unit housed within the Biological Sciences Division. Our mission is to enhance multidisciplinary training in clinical and translational science at the University of Chicago. We seek to offer high-quality curriculum and mentorship to a new generation of researchers who will synthesize social and biological science to significantly advance medical science and practice.

With joint input from CHeSS and the Institute for Translational Medicine, the CCTS mobilizes faculty from across the University of Chicago to enhance course offerings at the university in clinical and translational science. We organize these courses into coherent areas of concentration designed to provide graduate-level trainees, postdoctoral fellows, and junior faculty with state-of-the-art skills in the field. For more information contact Kelsey Bogue, committee administrator at kbogue@bsd.uchicago.edu. You can also visit our website at chess.uchicago.edu. (http://chess.uchicago.edu/CCTS/)

Current Areas of Concentration include:
- Comparative Effectiveness Research
- Translational Informatics
- Health Services Research
- Quality & Safety
- Clinical Research
- Community-Based Research
- Global Health
- Pharmacogenomics

In the "courses" tab there is a list of graduate courses that have been offered over the past two years. Refer to the CCTS section of the CHeSS website for current course offerings and prerequisites for each course:

http://chess.uchicago.edu (http://chess.uchicago.edu/CCTS/)

CLINICAL AND TRANSLATIONAL SCIENCE COURSES

CCTS 31300. Infectious Disease Epidemiology; Networks and Modeling. 100 Units.
Instructor(s): M. David, J. Schneider Terms Offered: Spring 2015
Prerequisite(s): PBHS 30700 or PBHS 30900 or introductory epidemiology or consent of instructor.

CCTS 33000. Scientists Advancing the Forefront. 000 Units.
In this survey course, leading basic and translational biomedical scientists will review cutting-edge themes that constitute the forefront of medical research. Learners will emerge with a broad understanding of:
Instructor(s): Erika Claud, Ronald Cohen Terms Offered: Spring Winter. Students who register in fall and spring will earn 50 credit units in spring.
Prerequisite(s): Course open to MS1 students
Note(s): Students should email Kelsey Bogue at kbogue@bsd.uchicago.edu to request permission to enroll.
Equivalent Course(s): MEDC 33000, MOLM 33000

CCTS 38300. Health Economics and Public Policy. 100 Units.
This course analyzes the economics of health and medical care in the United States with particular attention to the role of government. The first part of the course examines the demand for health and medical and the structure and the consequences of public and private insurance. The second part of the course examines the supply of medical care, including professional training, specialization and compensation, hospital competition, and finance and the determinants and consequences of technological change in medicine. The course concludes with an examination of recent proposals and initiatives for health care reform.
Instructor(s): Meltzer, D Terms Offered: Spring
Equivalent Course(s): MEDC 33000, MOLM 33000

CCTS 40004. Advanced Clinical Pharmacology I. 50 Units.
This course provides an introductory introduction to fundamental principles of the practice of clinical pharmacology relevant to drug development and personalized therapeutics. Topics include: pharmacokinetics, drug metabolism, protein binding, absorption and renal and hepatic elimination, pharmacodynamics, introduction to modeling methods, evaluation of adverse events, and pre-clinical and clinical elements of drug development.
Instructor(s): N. Pinto, M. Sharma Terms Offered: Autumn
Prerequisite(s): MEDC 30777, equivalent Intro to Pharmacology course, or instructor approval.

CCTS 40300. Signal Transduction and Disease. 100 Units.
Topics include receptor ligands, membrane receptor tyrosine kinases and phosphatases, G proteins, proto-oncogenes, signaling pathways, cytoplasmic protein kinases and phosphatases, transcription factors, receptor-nucleus signaling, development and cancer, genetic dissection of signaling pathways, cell growth and cell proliferation, interplay of cell cycle regulators, cell cycle progression and apoptosis, and sensing of hypoxia and mechanical stimuli. The role of signaling in disease is a theme throughout the course.
Instructor(s): N. Dulin Terms Offered: Winter
Equivalent Course(s): CCTS 21005, MEDC 31005

CCTS 40400. Health Disparities in Breast Cancer. 100 Units.
Across the globe, breast cancer is the most common women’s cancer. In the last two decades, there have been significant advances in breast cancer detection and treatment that have resulted in improved survival rates. Yet, not all populations have benefited equally from these improvements, and there continues to be a disproportionate burden of breast cancer felt by different populations. In the U.S., for example, white women have the highest incidence of breast cancer but African-American women have the highest breast cancer mortality overall. The socioeconomic, environmental, biological, and cultural factors that collectively contribute to these disparities are being identified with a growing emphasis on health disparities research efforts. In this 10-week discussion-based course students will meet twice weekly and cover major aspects of breast cancer disparities.
Instructor(s): E. Dolan, S. Conzen Terms Offered: Winter
Prerequisite(s): BIOS 25108
Equivalent Course(s): GNSE 30408, HLTH 20400, GNSE 20408, CCTS 20400, BIOS 25327

CCTS 40500. Machine Learning & Advanced Analytics for Biomedicine. 100 Units.
The age of ubiquitous data is rapidly transforming scientific research, and advanced analytics powered by sophisticated learning algorithms is uncovering new insights in complex open problems in biology and biomedicine. The goal of this course is to provide an introductory overview of the key concepts in machine learning, outlining the potential applications in biomedicine. Beginning from basic statistical concepts, we will discuss concepts and implementations of standard and state of the art classification and prediction algorithms, and go on to discuss more advanced topics in unsupervised learning, deep learning architectures, and stochastic time series analysis. We will also cover emerging ideas in data-driven causal inference, and demonstrate applications in uncovering etiological insights from large clinical databases of electronic health records, and publicly available sequence and omics datasets. The acquisition of hands-on skills will be emphasized over machine learning theory. On successfully completing the course, students will have acquired enough knowledge of the underlying machinery to intuit and implement solutions to non-trivial data science problems arising in biology and medicine.
Instructor(s): Ishanu Chattopadhyay Terms Offered: Winter. Not offered every year
Equivalent Course(s): BIOS 29208, CCTS 20500

CCTS 41005. The Making of the ’Good Physician’: Virtue Ethics and the Development of Moral Character in Medicine. 100.00 Units.
This multi-disciplinary course draws insights from medicine, sociology, moral psychology, philosophy, ethics and theology to explore answers to the unique challenges that medicine faces in the context of late modernity: How does one become a ‘good physician’ in an era of growing moral pluralism and health care complexity? Students will engage relevant literature from across these disciplines to address issues regarding the legitimate goals of medicine, medical professionalism, the doctor-patient relationship, vocation and calling, the role of religion in medicine, and character development in medical education. The course will first introduce the challenges that moral pluralism in contemporary society presents to the profession of medicine along with the subsequent calls for a renewed pursuit of clinical excellence in today’s complex health care system. It will then survey the resurgence of a philosophical discipline (virtue ethics) that has begun to shape contemporary debate regarding what types of ‘excellences’ are needed for a good medical practice dominated by medical science and technology.
Instructor(s): John Yoon Terms Offered: Autumn Spring Winter
Prerequisite(s): Rudimentary knowledge of probability theory, and basic exposure to scripting languages such as python/R is required. This course does not qualify in the Biological Sciences major.
Equivalent Course(s): BIOS 29208, CCTS 20500

CCTS 41006. Discourse of Islamic Bioethics. 50 Units.
This course is a mentored and directed reading course that introduces students to critical concepts in Islamic theology and law that undergird normative ethical frameworks within Islam and exposes the student to exemplar works from the wide range of Islamic bioethics literature. The first part of the course will focus on the theoretical aspects of the Islamic moral and ethical tradition and cover scholarly contestations regarding Islamic
moral theology as they relate to an Islamic bioethics. The latter half of course will focus on the practical aspects of the emerging field by considering research methods for the field and selected literature reviews of Islamic responses to pressing bioethical issues. Read more about the course at ches.uchicago.edu/CCTS
Instructor(s): Aasim Padela Terms Offered: Summer. Not offered every year
Prerequisite(s): None

CCTS 41008. Health Systems in Low- and Middle-Income Countries. 100 Units.
Strengthening health systems is imperative to achieving lasting improvements in health. This course provides students with a comprehensive overview of health systems in low- and middle-income countries. We will learn key frameworks and tools to analyze, assess and influence health systems in these contexts. The course is organized around core components of health systems, including service delivery, human resources for health, health financing, supply chain systems, governance, community engagement and information systems. Each class draws upon contemporary case studies from a variety of low- and middle-income countries to illustrate challenges, controversies and opportunities in these contexts. We will examine historical, social and political contexts, and key international, national and local stakeholders that influence health systems presently. We will consider the impact of external shocks, such as conflict, natural disasters, and economic and political crises, on the structure and functioning of health systems. Finally, recognizing the convergence between global and local, we will situate current challenges in the U.S. health system in a global context.
Instructor(s): Veena Sriram Terms Offered: Autumn. Not offered every year.
Prerequisite(s): Open to graduate students and third- and fourth-year undergraduate students. First- and second-year undergraduates interested in taking the course may write to the course instructor for permission.
Equivalent Course(s): HLTH 21008, CCTS 21008

CCTS 42003. Global Health Sciences III: Biological and Social Determinants of Health. 100 Units.
Global health is an interdisciplinary and empirical field, requiring holistic and innovative approaches to navigate an ever-changing environment in the pursuit of health equity. This course will emphasize specific health challenges facing vulnerable populations in low resource settings including in the United States and the large scale social, political, and economic forces that contribute to them through topical events and case studies. Students will study the importance of science and technology, key institutions and stakeholders; environmental impacts on health; ethical considerations in research and interventions; maternal and child health; health and human rights; international legal frameworks and global health diplomacy. Students will gain skills in technical writing as they construct position statements and policy briefs on global health issues of interest. Career opportunities in global health will be explored throughout the course.
Instructor(s): C. Olopade, O. Olopade Terms Offered: Spring Winter. This course is offered every Spring quarter on campus and every Winter quarter in Paris.
Prerequisite(s): This course does not meet the requirements for the Biological Sciences major.
Equivalent Course(s): HLTH 21008, CCTS 21008

CCTS 43007. Clinical and Health Services Research: Methods and Applications. 100 Units.
This course will introduce the interdisciplinary field of clinically-oriented health services research with a focus on policy-related implications. Through exposure to theoretical foundations, methodologies, and applications, students without significant investigative experience will learn about the design and conduct of research studies. We will cover the integration of research within the stages of translational medicine, and how science conducted across the translational medicine spectrum informs policy through purveyors of clinical services (e.g. physicians, hospitals), government, insurers, and professional societies. We will use the examples of postmenopausal hormone replacement therapy and autologous bone marrow transplantation to illustrate pitfalls in the progression from basic science research to clinical trials leading to diffusion in clinical medicine that can complicate the creation of logical, evidence-based practice guidelines, reimbursement, and clinical practice.
Instructor(s): Greg Ruhnke Terms Offered: Spring
Equivalent Course(s): BIOS 29814, CCTS 22003

CCTS 43200. Infectious Disease Epidemiology; Networks and Modeling. 100 Units.
This intermediate-level epidemiology course directed by two infectious disease epidemiologist-physicians will provide an up to date perspective on forgotten, contemporary and emerging infections. The course lectures and readings will provide a rigorous examination of the interactions among pathogens, hosts and the environment that produce disease in diverse populations. In addition to the demographic characteristics and the behaviors of individuals that are associated with a high risk of infection, we will examine complex aspects of the environment as they pertain to disease transmission. These include poverty, globalization, social networks, public health, and racial and ethnic disparities. Methodologic approaches to infectious disease epidemiology that will be covered include traditional study designs, molecular epidemiology, social network analysis, modeling, and network science. Local and global approaches will be applied to case studies from the United States, Asia, and Africa.
Instructor(s): Aasim Padela Terms Offered: TBD. Not offered in 2019-20.
Prerequisite(s): Biology majors: Three quarters of a Biological Sciences Fundamentals sequence. HSTD 30700 or HSTD 30910 or introductory epidemiology or consent of instructor
Equivalent Course(s): PBHS 31300, BIOS 25419, MEDC 31300

CCTS 45000. Introduction to Biostatistics. 100 Units.
This course will provide an introduction to the basic concepts of statistics as applied to the bio-medical and public health sciences. Emphasis is on the use and interpretation of statistical tools for data analysis. Topics
include (i) descriptive statistics; (ii) probability and sampling; (iii) the methods of statistical inference; and (iv) an introduction to linear and logistics regression.

Instructor(s): J. Cursio
Terms Offered: Summer
Prerequisite(s): 2 quarters of pre-calculus

CCTS 45100. Clinical Epidemiology. 100 Units.
Clinical epidemiology is the “application of epidemiologic principles and methods to problems encountered in clinical medicine.” This course introduces the basic principles of epidemiologic study design, analysis and interpretation, with a particular focus on clinical applications. The course includes lectures and discussions based on critical appraisal of significant research articles. The course is primarily intended for, but not restricted to, students with prior clinical training. Public Health Sciences 30700 and 30900 may not both be taken for credit, either will fulfill the basic epidemiology requirement for the MSCP in Public Health Sciences and either will serve as the epidemiology prerequisite for Public Health Sciences 31001.

Instructor(s): B. Chiu, D. Lauderdale
Terms Offered: Summer
Prerequisite(s): Introductory statistics recommended, may be taken concurrently.
Equivalent Course(s): PBHS 30700

CCTS 45200. Fundamentals of Health Services Research: Theory, Methods and Applications. 100 Units.
This course is designed to provide an introduction to the fundamentals of health services research. The basic concepts of health services research will be taught with emphasis on both their social scientific foundations and the methods needed for their practical application to empirically relevant research. Theoretical foundations will draw on principles from economics, sociology, psychology, and the other social sciences. Methodological topics to be covered will include techniques for data collection and analysis, including outcomes measurement, survey methods, large data set research, population-based study design, community based participatory research, research based in clinical settings, qualitative methods, cost-effectiveness analysis, and tools of economic and sociological analysis. The theoretical and empirical techniques taught will emphasize those relevant to the examination of health care costs, quality, and access. Major applications will include: measurement and improvement of health care quality, analysis of health disparities, analysis of health care technology, and analysis of health care systems and markets.

Instructor(s): D. Meltzer, M. H. Chin
Terms Offered: Summer
Equivalent Course(s): PBHS 47900

CCTS 45400. Advanced PCOR Methods: Cost Effectiveness and Modeling. 50 Units.
This course is the first module of a two module sequence in Advanced Patient Centered Outcomes Research (PCOR). This module includes an overview of cost effectiveness analysis, modeling (both markov and probabilistic sensitivity analysis), and discrete events and agent based simulation. Students will gain hands on experience with software such as Treeage, Simio, and Net logo. The second course will be taught in Winter Quarter and will cover topics in evidence generation and synthesis. Students and postdocs must contact Kelsey Bogue at kbogue@bsd.uchicago.edu with a CV and unofficial transcript (if current UChicago student) for approval to attend the course. Appropriate prerequisites include SSAD 45600 and PPHA 38300, or other introductory courses in cost effectiveness analysis or statistical modeling.

CCTS 46001. Fundamentals of Quality Improvement and Patient Safety (QI & PS 101) 25 Units.
Quality Improvement & Patient Safety was designed for faculty and staff at University of Chicago Medicine with the support of the Center for Clinical and Translational Science (CCTS). The course provides an overview of concepts and methodologies for improving the quality and safety of care. Participants will design quality improvement projects using skills learned in class. In addition, UCMC leaders will speak on key topics throughout the course. Participants will become familiar with tools for improving quality of care and service delivery, such as the Model for Improvement and Lean Performance Improvement. Participants will design an actual quality improvement project and complete a personal improvement project using skills learned in the class. Participants will understand the factors impacting the delivery of safe and high quality care in health care organizations such as teamwork, good communication and organization culture. Participants will understand System Thinking and other key concepts in patient safety such as Human Factors and Reliability. Participants will understand the key role of QI in today’s health care environment as a mechanism for improving organizational effectiveness and the patient experience. The course is comprised of seven classes total. Faculty, staff, and students/trainees at the University of Chicago Medical Center are welcome to audit the course and should contact Kelsey Bogue at kbogue@bsd.uchicago.edu to register.

Instructor(s): A. Davis, L. Botwinick
Terms Offered: Autumn

CCTS 47000. Bioinformatics Analysis of High-Throughput Genomics Data. 100 Units.
Biomedical researchers all around the world are starting to exploit the power of high-throughput genomics technologies to address an increasingly diverse range of biological problems. The primary bottleneck in using big genomics data including Next Generation Sequencing (NGS), is the bioinformatics; high-throughput genomics data analysis is not trivial and requires access to dedicated High Performing Computing (HPC) infrastructures, to address the CPU intensive and memory demanding analysis tasks. The focus of this course is training researchers on the use of computational technologies and the latest bioinformatics analysis tools, required to deal with big genomics data. This training will cover a complete range of technologies and applications from
the basics of computational thinking to the large-scale data analysis on Linux and HPC infrastructures. Topics include microarray data analysis using R, the implementation of open source based NGS analysis workflows for RNA-seq data, genomics visualization tools (e.g., IGV, UCSC, circos, etc.) and tools that can perform the most common everyday tasks for bioinformaticians of "omics" data. The course will cover in-depth practical theory and hands-on training.

Instructor(s): Sam Volchenboum, Jorge Andrade, Riyue Bao, Kyle Terms Offered: Autumn
Equivalent Course(s): CCTS 27000

**CCTS 47001. Advanced Community Based Participatory Research (CBPR) Training Program I. 000 Units.** The goal of health-related research is to improve the lives of people in the community studied. In traditional research, the community is not actively involved in designing the projects. Community-based participatory research is a partnership approach to research that equitably involves community members, organizational representatives, and academic researchers in all aspects of the research process. The Advanced CBPR Training Program is designed to help meet the growing need and demand for educational resources that help build the knowledge and skills needed to develop and sustain effective CBPR partnerships. The Program consists of six sessions that are offered on various Fridays throughout the year.

Instructor(s): D. Miller, D. Burnet Terms Offered: Autumn. Students must register for two-course sequence in order to receive course credit; CCTS 47001 and CCTS 47002 in Winter Quarter. Students must also register online. Contact CCTS administrator Kelsey Bogue at kbogue@bsd.uchicago.edu for more details.

**CCTS 47002. Advanced Community Based Participatory Research (CBPR) Training Program II. 25 Units.** The goal of health-related research is to improve the lives of people in the community studied. In traditional research, the community is not actively involved in designing the projects. Community-based participatory research is a partnership approach to research that equitably involves community members, organizational representatives, and academic researchers in all aspects of the research process. The Advanced CBPR Training Program is designed to help meet the growing need and demand for educational resources that help build the knowledge and skills needed to develop and sustain effective CBPR partnerships. The Program consists of six sessions that are offered on various Fridays throughout the year.

Instructor(s): D. Miller, D. Burnet Terms Offered: Winter. Students must register for two-course sequence in order to receive course credit; CCTS 47001 and CCTS 47002 in Winter Quarter. Students must also register online. Contact CCTS administrator Kelsey Bogue at kbogue@bsd.uchicago.edu for more details.

**CCTS 47005. Methods in Health and Biomedical Informatics. 100 Units.** Most Health and Biomedical Informatics (HBMI) Graduate Programs around the country have independently come to the conclusion that the computational methods that informatics graduate students need to be familiar with is too broad and numerous to be addressed by a series of independent courses. Therefore, most programs have created a set of integrated courses that expose the students to a wide variety of informatics methods in short modules. Typically, these required methods series are organized as a series of required courses taken during the first year of graduate study. This course is the result of discussions by Health and Biomedical Informatics researchers and educators from the Chicago Biomedical Informatics Training (CBIT) initiative. This course is designed as the first course of a year-long sequence and is worth 100 units. Registration for the full year is expected.

Instructor(s): S. Volchenboum, D. McClintock, UIC & NU faculty Terms Offered: Autumn. Course location rotates between Northwestern's downtown campus, UChicago, and UIC
Prerequisite(s): Basic understanding of Python programming language; prior or simultaneous enrollment in Health & Biomedical Informatics (HBMI) intro course.

**CCTS 47006. Methods in Health and Biomedical Informatics II. 100 Units.** Most Health and Biomedical Informatics (HBMI) Graduate Programs around the country have independently come to the conclusion that the computational methods that informatics graduate students need to be familiar with is too broad and numerous to be addressed by a series of independent courses. Therefore, most programs have created a set of integrated courses that expose the students to a wide variety of informatics methods in short modules. Typically, these required methods series are organized as a series of required courses taken during the first year of graduate study. This course is the result of discussions by Health and Biomedical Informatics researchers and educators from the Chicago Biomedical Informatics Training (CBIT) initiative. This course is designed as the second course of a year-long sequence and is worth 100 units. Registration for the full year is expected.

Instructor(s): David McClintock and Samuel Volchenboum; Northwestern and UIC faculty Terms Offered: Winter. Course location rotates between Northwestern's downtown campus, UChicago, and UIC
Prerequisite(s): CCTS 47005 in Autumn Quarter.

**CCTS 47007. Methods in Health and Biomedical Informatics III. 100 Units.** Most Health and Biomedical Informatics (HBMI) Graduate Programs around the country have independently come to the conclusion that the computational methods that informatics graduate students need to be familiar with is too broad and numerous to be addressed by a series of independent courses. Therefore, most programs have created a set of integrated courses that expose the students to a wide variety of informatics methods in short modules. Typically, these required methods series are organized as a series of required courses taken during the first year of graduate study. This course is the result of discussions by Health and Biomedical Informatics researchers and educators from the Chicago Biomedical Informatics Training (CBIT) initiative. This course is
Committee on Clinical and Translational Science

designed as the third course of a year-long sequence and is worth 100 units. Registration for the full year is expected.
Instructor(s): David McClintock and Samuel Volchenboum; Northwestern and UIC faculty Terms Offered: Spring. Course location rotates between Northwestern’s downtown campus, UChicago, and UIC
Prerequisite(s): CCTS 47005 in Autumn Quarter and CCTS 47006 in Winter Quarter.

CCTS 47100. Bioinformatics Analysis of Integrative ‘Oomics Data. 100 Units.
The workshop will focus on the integration of multiple ’omic/clinical data sets to answer complex questions on Biomedical research. Strong focus will be placed on the use of NGS based ChIP-seq analysis pipeline and its integration with gene expression and clinical information.
Equivalent Course(s): CCTS 27100