The Committee on Clinical and 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 the Center for Health and the Social Sciences (http://chess.bsd.uchicago.edu) (CHeSS) and the Institute for Translational Medicine (http://itm.uchicago.edu), the CCTS mobilizes faculty from across the University to enhance course offerings in clinical and translational science. While most courses offered in CCTS are designed for graduate-level trainees, postdoctoral fellows, and junior faculty, there are also specific courses designed for undergraduate students interested in health and social sciences. For more information, contact committee administrators Kelsey Bogue at kbogue@bsd.uchicago.edu and Absera Melaku at amelaku@bsd.uchicago.edu.

Current areas of concentration include:

- Comparative Effectiveness Research
- Translational Informatics
- Health Services Research
- Quality and Safety
- Clinical Research
- Community-Based Research
- Global Health
- Pharmacogenomics

Below is a list of undergraduate courses that have been offered in the past. Refer to the CCTS section of the CHeSS website at chess.uchicago.edu/training-and-education/academic-courses for current course offerings and prerequisites for each course.

### EXAMPLES OF PREVIOUSLY OFFERED CO-UNDERGRADUATE/GRADUATE COURSES

#### CCTS 20400. 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 20408, BIOS 25327, GNSE 30408, CCTS 40400, HLTH 20400

#### CCTS 20500. 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 scale 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
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 40500
CCTS 21005. 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

Note(s): This course is limited to those who have been accepted into the Emerging Scholars Cohort in Bioethics (Hyde Park Institute, https://hydeparkinstitute.org/esc). Depending on space availability, other students interested in enrolling will need prior approval from Course instructor(s). This course is a yearlong course with several 2-hour lecture discussions throughout the year, 2 all-day Saturday sessions (Fall/Spring), and an off-site practicum. Registration in Autumn, Winter, and Spring Courses is required. The spring quarter course will be worth 50 units.

Equivalent Course(s): MEDC 31005, CCTS 41005

CCTS 21007. 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, methodological, 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): CCTS 43007, PBPL 23007, HLTH 21007, BIOS 29329

CCTS 21008. 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

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 41008

CCTS 21012. Religion, Medicine, and the Experience of Illness. 100 Units.

This course introduces students to both the dynamic relationship between religion and medicine and the role of religion as it relates to the experience of illness. Through a survey of a broad selection of religious traditions, textual genres, and case studies, students will evaluate how religion offers a pliable explanatory system (through myths, symbols, rituals, etc.) to address questions of causation, coping, and curing vis-à-vis illness. The historical relationship between religions and medical systems has been fascinatingly complex. We will encounter examples where religion and medicine work in tandem as complementary explanatory systems, e.g., with devotion to holy figures such as Saint Jude. We will also discuss what happens when religion usurps the explanatory role of medicine, e.g., when the activity of spirits becomes the diagnostic explanation for a medical condition such as epilepsy. Drawing upon literature from art history, medical anthropology, sociology, history, and theology, this course surveys the impressive variety of responses to illness both across religious traditions and within those traditions. Prior knowledge of religious studies and/or medical history is not required for the course.

Instructor(s): Mark Lambert
Terms Offered: Winter

Equivalent Course(s): RLIST 26302, KNOW 26302, SOCI 20542, HIST 24923, HIPS 26312, HLTH 26302

CCTS 21013. Medical Innovation and Religious Reform in Early Modernity. 100 Units.

Through a survey of innovative medical authorities and religious reformers, students will investigate the co-constitution of two bodies of knowledge at a historical moment (the sixteenth and seventeenth centuries)
when questions of authority and epistemology are in considerable flux. Often construed as a period haunted by recurrent outbreaks of plague and the oppression of religious superstition, early modernity has long been implicated in the "conflict thesis"-a hugely influential argument that portrays the centuries-long relationship between religion and science/medicine as an inherently adversarial one. This course shall scrutinize that argument through a discussion of seemingly contradictory examples where reformers that touted the all-encompassing reach of divine providence also promoted intricate public health infrastructures; where the Vatican increasingly relied on university-trained physicians to validate saints and their miracles; where theologians were viewed as authorities on Galen and responsible for medical breakthroughs; and where medicine and metaphysics were considered complementary pursuits. Ultimately, students will unveil a portrait not of conflict, but of a symbiotic relationship between religion and medicine.

Instructor(s): Mark Lambert Terms Offered: Spring
Equivalent Course(s): RLST 26316, HIST 24924, HLTH 26316

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): MOLM 33000, MEDC 33000

CCTS 40006. Pharmacogenomics: Discovery and Implementation. 100 Units.
Pharmacogenomics is aimed at advancing our knowledge of the genetic basis for variable drug response. Advances in genetic knowledge gained through sequencing have been applied to drug response, and identifying heritable genetic variants that predict response and toxicity is an area of great interest to researchers. The ultimate goal is to identify clinically significant variations to predict the right choice and dose of medications for individuals-"personalizing medicine." The study of pharmacogenomics is complicated by the fact that response and toxicity are multigenic traits and are often confounded by nongenetic factors (e.g., age, co-morbidities, drug-drug interactions, environment, diet). Using knowledge of an individual's DNA sequence as an integral determinant of drug therapy has not yet become standard clinical practice; however, several genetics-guided recommendations for physicians have been developed and are highlighted. The ethics and economics of pharmacogenomics are also discussed.

Instructor(s): R. S. Huang, B. Stranger Terms Offered: Spring
Prerequisite(s): Undergraduates (third- and fourth-years only) must have taken BIOS 20187 and are required to email instructors for approval (bstranger@medicine.bsd.uchicago.edu and rhuang@medicine.bsd.uchicago.edu) prior to registering.
Equivalent Course(s): CABI 47510