Clinical Science Program Course Book
2019-2020

CLINICAL SCIENCE COURSES

CLSC 6060  Analysis, Modeling, and Design
Dr. E. Dincelli (erisin.dinselli@cuanschutz.edu) (Fall)
Cross listed: CU Denver ISMG 6060. Prereq: Application development experience.
Provides an understanding and application of systems analysis and design processes. Students are exposed to system development life cycle (SDLC), structured systems analysis and design methods, object-oriented analysis and design methods, prototyping and commercial off-the-shelf package software approaches, and joint and rapid application development. Emphasizes the skills required for system analysts such as analytical, interpersonal, technical, fact-finding, and project management skills. Topics include data, process and object modeling, input-output and user interface design, and systems implementation and support. To provide an opportunity to develop these skills, an information system project is completed by a group of students. Students use a Case tool for their group project.

CLSC 6080  Database Management Systems
Dr. M. Mannino (michael.mannino@cuanschutz.edu); Z. Walter (zhiping.walter@cuanschutz.edu) (Fall)
Cross listed: CU Denver ISMG 6080. Prereq: Application development experience.
The success of today’s business often hinges on the ability to utilize critical information to make the right decisions quickly and efficiently. Transforming mountains of data into critical information to improve decision making is a skill every business decision maker must posses. This focus course covers the database design topics with a focus on enabling business decision making. Detailed topics include collecting, capturing, querying and manipulating data (using SQL and QBE) for simple to medium complex business applications. Commercial database products (e.g. ORACLE and ACCESS) are utilized to demonstrate the design of database applications in management, marketing, finance, accounting, and other business areas. Students will be able to design and implement simple to medium complex database applications after successful completion of this course.

CLSC 6210  Research Seminars in Clinical Science
Dr. L. Cicutt, (lcicutt@njhealth.org) (Fall, Spring)
Course is taken over two semesters (register once)
This course provides an overview of the types of clinical translational studies being conducted by senior CLSC doctoral students. The interactive seminar series structure allows for interdisciplinary scientific dialogue among students at various stages of training, mentors and faculty.

CLSC 6211  Immersion in Community Engagement
Dr. L. Cicutt, (lcicutt@njhealth.org) and Dr. J. Westfall (jack.westfall@cuanschutz.edu) (Summer)
Prereq: Program consent (contact CLSC administrator for consent)
This course focuses on community-based participatory research, community engagement and understanding health disparities through a community immersion experience.

CLSC 6260  Conducting Clinical Trials for Investigators
Dr. B. Hammack (Barbara.Hammack@cuanschutz.edu) (Summer)
Prereq: For non-CLSC students, please seek consent of the instructor.
This course is designed for investigators involved in the operations of conducting clinical trials. The course will cover good clinical practices and regulations that surround setting up and running clinical trials. Clinical studies and popular press articles highlighting what can go wrong in clinical trials will be reviewed and discussed.

CLSC 6270  Critical Appraisal Seminars in Clinical Science
Dr. L. Cicutt, (lcicutt@njhealth.org) (Fall)
This course provides an overview of the approaches for the critically appraising common study designs published in the clinical and translational sciences literature, as well as other sources of information.
Clinical Science Program Course Book 2019-2020

CLSC 6300 Scientific Grant Review Process: CCTS
I Proposals – Masters 1.0 cr.
Drs. T. Campbell (thomas.campbell@cuanschutz.edu) and K. Nadeau (kristen.nadeau@cuanschutz.edu) (Spring)
Prereq: Completion of required courses in biostatistics (BIOS 6601 and 6602 or BIOS 6611 and 6612).
Students will understand and participate in the process of scientific review of human subject research protocols submitted to the University of Colorado Denver Clinical Translational Research Centers at University Hospital and The Children's Hospital.

CLSC 6560 Designs and Mixed Methods in Implementation Research 2.0 cr.
Dr. J. Holtrop (jodi.holtrop@cuanschutz.edu) (Spring)
This course provides an in-depth examination of study designs, comparative effectiveness research, and qualitative, quantitative and mixed methods approaches to dissemination and implementation research. The focus is application to health care and public health settings.

CLSC 6650 Guided Research Tutorial – Masters 1.0-3.0 cr.
Dr. Lisa Cicuttointo@njhealth.org) (Fall, Spring, Summer)
Prereq: Program consent, approved course plan (contact CLSC administrator for consent)
This course provides an in-depth examination of study designs, comparative effectiveness research, and qualitative, quantitative and mixed methods approaches to dissemination and implementation research. The focus is application to health care and public health settings.

CLSC 6653 Key Concepts in Neuro-developmental Disabilities 1 2.0 cr.
P. LaVesser. Program contact: Dina Johnson (dina.johnson@cuanschutz.edu) 303-724-7673 (Fall)
Prereq: A degree in health care profession or related field or instructor consent.
This is an independent study course developed by the student and appropriate faculty member based on the area of study. Students meet regularly with the selected course instructor. The student and course instructor will develop a course plan prior to registration of the course.

CLSC 6654 Key Concepts in Neuro-developmental Disabilities 2 2.0 cr.
P. LaVesser. Program contact: Dina Johnson (dina.johnson@cuanschutz.edu) 303-724-7673 (Spring)
Prereq: A degree in health care profession or related field or completion of CLSC 6653, or Instructor consent.
This course represents part of a two-part interdisciplinary course series focused on systems, options for diagnosis/assessment and alternatives for service provision related to children/youth/young adults with neurodevelopmental and related disabilities and their families to address this population’s special health care needs.

CLSC 6661 Leadership Dialogues I 2.0 cr.
Dr. K. Kennedy. Program contact: Dina Johnson (dina.johnson@cuanschutz.edu) 303-724-7673 (Summer)
Prereq: A degree in health care profession or related field or instructor consent.
This interdisciplinary leadership course focuses on leadership strategies needed for providing family-centered, culturally competent, community-based services for children with special needs and their families.

CLSC 6662 Leadership Dialogues II 1.0 cr.
Dr. K. Kennedy. Program contact: Dina Johnson (dina.johnson@cuanschutz.edu) 303-724-7673 (Spring)
Prereq: A degree in health care profession or related field or Instructor consent.
This interdisciplinary leadership course focuses becoming change agents to better provide family-centered, culturally competent, community-based services for children with special needs and their families.

CLSC 6663 Intervention for Individuals with Developmental Disabilities 3.0 cr.
P. LaVesser. Program contact: Dina Johnson (dina.johnson@cuanschutz.edu) 303-724-7673 (Spring)
Prereq: A degree in health care profession or related field or consent of instructor.
This interdisciplinary course reviews evidence-based practices in intervention for children with autism and other neurodevelopmental disorders, presented through lectures, critical readings of the literature, case discussions, and case presentations.

CLSC 6664 Leadership Dialogues III 1.0 cr.
Dr. K. Kennedy. Program contact: Dina Johnson (dina.johnson@cuanschutz.edu) 303-724-7673
Prereq: Degree in health care profession or related field or consent of instructor. Restrictions: Instructor Consent.
This interdisciplinary leadership course focuses on leadership strategies needed for providing family-centered, culturally competent, community-based services for children with special needs and their families. (Nursing only)

CLSC 6665 Leadership Dialogues IV 1.0 cr.
Dr. K. Kennedy. Program contact: Dina Johnson (dina.johnson@cuanschutz.edu) 303-724-7673
Prereq: Degree in health care profession or related field or consent of instructor and CLSC6664.
Leadership Dialogues IV builds upon skills addressed in Leadership Dialogues III with the addition of content that integrates critical and systems thinking and ethical decision making with the leadership and team concepts and skills developed in LD III. (Nursing only)
Clinical Science Program Course Book 2019-2020

CLSC 6668  Screening/Assessment for Children/Youth with Autism and Neurodevelopmental Disabilities  3.0 cr.
Drs. T. Katz and S. Friedman. Program contact: Dina Johnson (dina.johnson@cuanschutz.edu) 303-724-7673 (Fall)
Prereq: Degree in health care profession or related field or consent of instructor.
This interdisciplinary course presents best practices in screening/assessment for autism, focusing on: identification of symptoms of autism; differentiation of autism from other disorders; recognition of symptoms; examination of culture on clinical presentation; and approaches to share observations.

CLSC 6699  Masters Research Project – Publishable Paper  1.0-6.0 cr.
Dr. L. Cicutto (lcicuttol@njhealth.org) (Fall, Spring, Summer)
Prereq: Program consent (contact CLSC administrator for consent)
During this course students working with his/her research mentor and research project committee to plan, execute, and write the Final Research Project in the form of a publishable paper. In addition, students will prepare for the Final Research Project Examination. This is a capstone course.

CLSC 6750  Designing for Dissemination and Sustainability  2.0 cr.
Drs. E. Morrato (elaine.morrato@cuanschutz.edu) and B. Kwan (bethany.kwan@cuanschutz.edu) (Summer)
This course is one of three that focuses on dissemination and implementation research. This course reviews the organization and financing of interventions for health care systems and public health systems. The role of ethics, evidence, and health equity are examined.

CLSC 6800  Introduction to Health Information Technology  3.0 cr.
Dr. J. Khuntia (jiban.khuntia@cuanschutz.edu) (Spring)
Cross listed: CU Denver HLTH 6071
Examines what needs transforming in healthcare to improve value, safety, and appropriateness of care, and what the role of IT is in that transformation. IT also examines the challenges of cultural change and IT strategy in succeeding with clinical information projects. Differences between installation, implementation, transition and actual transformation are suggested, and methods for managing subcultures in healthcare (IT, clinical, administrative) are reviewed.

CLSC 6820  Management of Health Information Technology  3.0 cr.
Drs. D. Jacobs and H. Haugen (heather.haugen@cuanschutz.edu) (Fall)
Cross-listed: CU Denver HLTH 6072. For non-CLSC students, please seek consent of the instructor.
Provides an introduction to the management of information technology in healthcare. A description of information processing, the origin, content, evolution of healthcare information systems, and the methodologies deployed to acquire and manage information requirements are discussed.

CLSC 6830  Practicum in Developmental Disabilities  1.0 - 4.0 cr.
P. LaVecser. Program contact: Dina Johnson (dina.johnson@cuanschutz.edu) 303-724-7673 (Fall, Spring, Summer)
Prereq: Consent of instructor.
Practicum in developmental disabilities individually designed to give students and post-graduates observational experiences in clinical, teaching, or research service settings and systems for persons with developmental disabilities of all ages.

CLSC 6831  Practicum in Developmental Disabilities II  3.0 cr.
Program contact: Dina Johnson (dina.johnson@cuanschutz.edu) 303-724-7673
Prereq: Instructor consent and CLSC 6830.
Practicum in developmental disabilities individually designed to give students and post graduates hands-on experiences in clinical, teaching, or research service settings and systems for persons with developmental disabilities of all ages.

CLSC 6850  Advanced Research Topics in Dissemination and Implementation Science  1.0 cr.
Dr. A. Huebschmann (amy.huebschmann@cuanschutz.edu) (Fall, Spring)
Prereq: CLSC 7653
Hybrid - Provides an overview of intermediate and advanced dissemination and implementation (D&I) science research methods in a small group discussion format. This interactive seminar series structure allows for interdisciplinary scientific dialogue among students at various stages.

CLSC 6950  Masters Research Project – Thesis  1.0-6.0 cr.
Dr. L. Cicutto (lcicuttol@njhealth.org) (Fall, Spring, Summer)
Prereq: Program consent(contact CLSC administrator for consent).
During this course students plan, execute, and write the Final Research Project in the form of a Masters thesis. In addition, students will prepare for the Final Research Project Examination. This is a capstone course.

CLSC 7101  Grant Writing I  1.0 cr.
Dr. L. Cicutto (lcicuttol@njhealth.org) (Spring); M. Plomondon (meg.plomondon@cuanschutz.edu) (Fall)
Prereq: Program consent (contact CLSC administrator for consent), BIOS 6601 and EPID 6630. For non-CLSC students, please seek consent of the instructor.
This course prepares students to write research grant submissions. Topics covered include writing the various sections of grants: background, specific aims, hypotheses, methods, analysis, potential problem, and the summary. A fully prepared grant submission is required at the end of the course.
Clinical Science Program Course Book
2019-2020

CLSC 7102  Grant Writing II  1.0 cr.
Dr. L. Cicutto (cicuttol@njhealth.org) (Spring); M. Plomondon (meg.plomondon@cuanschutz.edu) (Fall)
Prereq: Program consent (contact CLSC administrator for consent) BIOS 6601 and EPID 6630, CLSC 7101. For non-CLSC students, please seek consent of the instructor. This course builds on CLSC 7101 and further prepares students for subsequent grant submissions. Strategies for preparation (including hypothesis generation, experimental design, statistical considerations, and potential problems) will be discussed. At the end of the course, a K08, R23, or equivalent national grant application will be completed for submission. A fully prepared grant submission is required at the end of the course.

CLSC 7150  Ethics and Responsible Conduct of Research  1.0 cr.
Dr. L. Ensign (lisa.ensign@cuanschutz.edu) (Fall)
Prereq: Program consent (contact CLSC administrator for consent). This course will provide an overview of the field of ethics in clinical research. It is designed for investigators who will be conducting research involving human subjects. Participants will learn the historical background, current regulations, and IRB requirements related to human subjects protection issues. Hands-on experiences will be provided to participants to learn how to develop approaches to address conducting ethical human subjects' research in an optimal manner. In addition, participants will learn the essentials of responsible conduct of research.

CLSC 7202  Clinical Outcomes and Applications  3.0 cr.
Drs. C. Battaglia (catherine.battaglia@cuanschutz.edu) and R. Everhart (rachel.everhart@cuanschutz.edu) (Fall)
Prereq: BIOS 6601 and BIOS 6602 or BIOS 6611 and EPID 6630. For non-CLSC students, please seek consent of the instructor. This course provides students with both the theory of clinical outcomes research and an opportunity to apply it through case studies. Clinical Outcomes Research focuses on methodologies used in clinical care, costs, health systems, policy and health outcomes research.

CLSC 7300  Scientific Grant Review Process: CCTSI Proposals – Doctoral  1.0 cr.
Drs. T. Campbell (thomas.campbell@cuanschutz.edu) and K. Nadeau (kristen.nadeau@cuanschutz.edu) (Spring)
Prereq: Completion of required core courses in biostatistics (BIOS 6601 and BIOS 6602 or BIOS 6611 and EPID 6630). Students will understand and participate in the process of scientific review of human subject research protocols submitted to the University of Colorado Denver Clinical Translational Research Centers at University Hospital and The Children's Hospital.

CLSC 7650  Guided Research Tutorial – Doctoral  1.0-3.0 cr.
Dr. L. Cicutto (cicuttol@njhealth.org) (Fall, Spring, Summer)
Prereq: Program consent (contact CLSC administrator for consent), approved course plan. This is an independent study course developed by the student and appropriate faculty member based on the area of study. Students meet regularly with the selected course instructor. The student and course instructor will develop a course plan prior to registration of the course.

CLSC 7653  Dissemination and Implementation Research in Health  2.0 cr.
Dr. B. Rabin (borsika.rabin@cuanschutz.edu) (Fall)
Prereq: Program consent (contact CLSC administrator for consent) and EPID 6630
Introduces dissemination and implementation (D&I) research and practice in the context of health (i.e., translational research in health).

CLSC 8990  Doctoral Thesis  1.0-10.0 cr.
Dr. L. Cicutto (cicuttol@njhealth.org) (Fall, Spring, Summer)
Prereq: Program consent(contact CLSC administrator for consent) This course involves the student working with his/her research mentor and research project committee to develop, design and execute a clinical science doctoral study as well as to write up the project as a thesis. This course is the capstone to the PhD degree. Work may be associated with preparing for the written and oral component of the thesis defense examination.

REQUIRED CORE COURSES

BIOS 6601  Applied Biostatistics I  3.0 cr.
Applied biostatistical methods including descriptive and statistical inference; odds ratio and relative risk, probability theory, parameter estimation, tests for comparing statistics of two or more groups, correlation and linear regression and overviews of: multiple and logistic regression and survival analysis.

BIOS 6602  Applied Biostatistics II  3.0 cr.
Prereq: BIOS 6601. A continuation of BIOS 6601 extending the basic principles of descriptive and inferential statistics to modeling more complex relationships using linear regression, logistic regression, Poisson regression, and Cox regression. The statistical package SAS is used extensively.
Clinical Science Program Course Book
2019-2020

BIOS 6611  Biostatistical Methods I  3.0 cr.
Restrictions: Enrollment in ColoradoSPH PhD, MS or DrPH program. Prereq: Calculus 1 and 2 with at least a B; a previous course in applied probability and statistics with at least a B; coursework or experience with a statistical package (e.g. SAS, Stata, SPSS); linear algebra is highly recommended and will be used extensively in the course; or permission of instructor. Students without this preparation, or seeking a less challenging course, should consider BIOS 6601/6602 This course in applied statistics covers simulation, random sampling, nonparametric inference for the two-sample location problem; ANOVA, ANCOVA, and multiple linear regression. Matrix notation, R and SAS are used.

BIOS 6612  Biostatistical Methods II  3.0 cr.
Prereq: BIOS 6611. This is a continuation of BIOS 6611 covering univariate linear modeling and emphasizing multiple regression and analysis of variance. Logistic regression and methods for correlated data are also covered. Matrix algebra and the statistical package SAS will be used.

BIOS 6648  Design and Conduct of Clinical Research  3.0 cr.
Prereq: BIOS 6601 or BIOS 6611 or consent of instructor. Restrictions: Offered in odd years. Design and conduct of clinical research studies. Intended for non-biostatistics students. Topics include specifying the research question, study endpoints, study populations, study interventions, sample size evaluation, and choice of comparison groups. Common study designs and methods for study conduct are described.

EPI 6626  Research Methods in Epidemiology  3.0 cr.
Prereq: BIOS 6601, BIOS 6680. EPI 6630. Principles, concepts and methods for conducting ethical, valid and scientifically correct observational studies in epidemiological research are the focus of this class. Lectures and practical experience reinforce hypothesis formulation, study design, data collection and management, analysis and publication strategies.

EPI 6630  Epidemiology  3.0 cr.
This course provides an introduction to descriptive and analytic methods in epidemiology and their application to research, preventive medicine and public health practice.

REQUIRED TRACK COURSES

BIOS 6680  Data Management Using SAS  3.0 cr.
Students will learn how to use SAS software for data management to prepare data for analyses. Main topics include importing and exporting data, variable and dataset manipulations. Introductions to producing reports, basic statistics, figures and SAS macros are also covered.

EPI 6631  Analytical Epidemiology  3.0 cr.
Prereq: EPI 6630 and BIOS 6601 or BIOS 6611. This course will provide the fundamental analytical skills for assessing and reporting disease status, determinants of disease and their impact on public health. Students will learn methods of determining rates of disease occurrence, measures of associations between exposures and disease, and techniques for identifying and correcting for misclassification, effect modifiers and confounders. This is a skill-building course. The SAS course is not a prerequisite but is strongly encouraged.

HSMP 6604  Health Care Economics  3.0 cr.
Uses economic theory to analyze and understand the US health care system. Topics include: Demand and supply of health and health care, health insurance, hospital, pharmaceuticals, and physicians. Analyzes institutional and legal incentives that affect physician, patient, and insurer decision-making.

HSMP 7010  Foundations in Health Services Research  1.0 cr.
Restriction: Permission of instructor required. Introduces students to the academic health services research literature. This seminar course requires students to participate in small seminars led by faculty on different health services research topics plus attending larger HSMP departmental seminars. Evaluation is based on weekly papers.

HSMP 7607  Methods in Health Services Research I  3.0 cr.
Prereq: BIOS 6611 The first of a two-course sequence in empirical methods in health services research. The statistical theory underlying basic empirical methods and the thoughtful implementation/practice of these methods is emphasized. Topics covered include: OLS, Gauss-Markov assumptions, logit/probit. Stata will be used.

HSMP 7609  Methods in Health Services Research II  3.0 cr.
Prereq: HSMP 7607, enrolled in PhD or DrPH or permission of instructor. Students will learn how to specify and estimate econometric models to test theory-driven hypotheses. The course builds on HSMP 7607 and covers advanced methods related to panel/longitudinal, multinomial, survival, and count data models. Stata software will be used.

Restriction: Permission of instructor.
Doctoral thesis work in Health Systems Management and Policy.
Clinical Science Program Course Book  
2019-2020

NURS 6289  IT Systems Life Cycle  4.0 cr.
Dr. D. Skiba (diane.skiba@cuanschutz.edu) 303-724-8527  
Prereq: Minimum of one informatics course or permission of instructor.
This course focuses on a structured approach to information system development and implementation. The course addresses the five phases of the life cycle: planning, analysis, design, implementation and evaluation.

NURS 6293  Database Management Systems  3.0 cr.
Dr. D. Skiba (diane.skiba@cuanschutz.edu) 303-724-8527  
Prereq: NURS 6304 or permission of instructor.
An interdisciplinary course focused on design and application challenges in database management systems. Concepts of database modeling, querying, and reporting are explored. Students apply database concepts to clinical registries and Meaningful Use queries.

PUBH 6600 Foundations in Public Health  2.0 cr.
This course examines the historical and conceptual bases of public health, the key issues and problems faced by the public health system, and the tools available for the protection and enhancement of the public’s health.

SUGGESTED ELECTIVE COURSES
(for additional electives please see http://www.ucdenver.edu/anschutz/studentresources/Registrar/CourseListings/Pages/default.aspx)

BIOL 5051  Advanced Topics in Microbiology  3.0 cr.
An in-depth study of microbial concepts, including prokaryotic and eukaryotic structure and function; properties of biological macromolecules; microbial growth kinetics; and microbial diversity. Emphasis is on one of the following: virology, microbial physiology, environmental microbiology, microbial biotechnology and nucleic acids. Prereq: Graduate standing or permission of instructor. Cross-listed with BIOL 4051.

BIOL 5054  Developmental Biology  3.0 cr.
Covers gametogenesis, fertilization, cleavage and development of the embryo with an emphasis on the biochemical and biophysical aspects. Prereq: Graduate standing or permission of instructor. Cross-listed with BIOL 4054.

BIOL 5064  Advanced Cell Biology  3.0 cr.
Builds on the foundations laid in the prerequisite courses. Major topics include the functions of cell membranes, energy transduction and regulation of metabolic pathways. A major emphasis is the control and integration of cellular activities. Prereq: Graduate standing or permission of instructor. Cross-listed with BIOL 4064.

BIOL 5125  Molecular Biology Lab  3.0 cr.
Provides hands-on experiences in molecular biology and an appreciation for using the tools of molecular biology to study biological systems. Emphasis is placed on DNA cloning, PCR, mutagenesis and protein purification techniques. Experimental design and the theories underlying the techniques are also discussed. Prereq: Graduate standing or permission of instructor. Cross-listed with BIOL 4125.

BIOL 5126  Molecular Genetics  3.0 cr.
Examines molecular techniques and their application to experimental genetics, specifically organization and mapping of genomes, application and model systems in defining hereditary components of disease, and mechanisms of identifying mutations and their implications for disease. Also addresses application of recombinant DNA technology. Prereq: General genetics and one year of organic chemistry (or equivalent) with grades of “C” (2.0) or higher; biochemistry strongly recommended. Graduate standing or permission of the instructor. Cross-listed with BIOL 4126.

BIOL 5134  Human Genetics  3.0 cr.
Advanced survey of the current status of the field. Emphasis on understanding, diagnosis and treatment of genetic disease and on the impact of molecular biology on human genetics. Prereq: Graduate standing or permission of instructor. Cross-listed with BIOL 4134.

BIOL 5144  Medical Microbiology  3.0 cr.
Provides an understanding of the relationship between pathogenic organisms and their host. Emphasis is placed on the area of medical bacteriology, with attention given to mechanisms of pathogenesis, genetics of disease, serology and treatment. Prereq: Graduate standing or permission of instructor. Cross-listed with BIOL 4144.

BIOL 5165  Neurobiology  3.0 cr.
Overview of neuroscience, covering the cellular basis of neuronal activity, muscle, sensory structures and the structure and function of the human brain. Prereq: Graduate standing or permission of instructor. Cross-listed with BIOL 4165.

BIOL 5475  Mechanisms of Human Pathology  3.0 cr.
Studies physiological, cellular and biochemical processes in human diseases, with particular focus on non-communicable diseases such as diabetes, cardiovascular disease and diseases of aging such as osteoporosis and macular degeneration. Prereq: Graduate standing or permission of instructor. Cross-listed with BIOL 4475.

For edits, additions, and/or deletions please contact galit.mankin@cuanschutz.edu
BIOL 5550  Cell Signaling  3.0 cr.
Lecture by faculty and student presentations cover mechanism of hormones and regulation of various cellular processes through second messenger systems. Prereq: Graduate standing or permission of instructor. Cross-listed with BIOL 4550.

BIOL 5622  Topics in Immunology  3.0 cr.
An in-depth study of immunological concepts. Topics will vary from semester to semester and may range from specifics of immune cell responses to tolerance and autoimmunity. Delivery will include lecture, student presentations, and discussion. Prereq: One year of general biology with a grade of ‘C’ or higher; general cell biology and general genetics are recommended. Graduate standing or permission of the instructor. Cross-listed with BIOL 4622.

BIOL 5634  Biology of Cancer  3.0 cr.
Cancer is the second leading cause of death in the United States. This course offers an overview of recent research into the causes, treatments and possible prevention of cancer. Includes a detailed look at the mechanisms of action of various oncogenes. Prereq: Graduate standing or permission of instructor. Cross-listed with BIOL 4634.

BIOL 5674  Endocrinology  3.0 cr.
This systematic survey of the endocrine system looks at the cellular basis and biochemical characteristics of individual endocrine tissues. Their function in the regulation of other endocrinological, physiological, and behavioral events is analyzed. The course emphasizes the human system and complements studies in physiology, behavior and neurobiology. Prereq: Graduate standing or permission of instructor. Cross-listed with BIOL 4674.

BIOS 6606  Statistics for the Basic Sciences  3.0 cr.
Restrictions: Enrollment in UCD-AMC graduate program or permission of the instructor. This course is designed for those wishing to obtain a basic understanding of statistics and its applications in biological research. Students will develop statistical literacy and an ability to perform basic statistical analyses, basic graphical statistics, data summarizations, and estimation and inference using statistical software.

BIOS 6621  Statistical Consulting I  1.0 cr.
Coreq: BIOS 6611 and consent of instructor/program director. Students will gain experience with statistical consulting and common statistical problems and techniques encountered in consulting through a combination of real examples and consultations with investigators. Emphasis will be on methods for effective consulting and communication with investigators.

BIOS 6631  Statistical Theory I  3.0 cr.
Prereq: Differential and integral calculus. This course presents an introductory coverage of the theory of discrete and continuous random variables and applications to statistical problems. Topics include probability theory, transformations and expectations, common families of distributions, multiple random variables, and properties of a random sample.

BIOS 6632  Statistical Theory II  3.0 cr.
Prereq: BIOS 6631 and differential and integral calculus. This course covers theoretical and applied fundamentals of statistical inference. The course is a continuation of BIOS 6631. The primary topics include point estimation, hypothesis testing, interval estimation and asymptotic methods.

BIOS 6646  Survival Analysis  3.0 cr.
Pre/Coreq: BIOS 6612 and BIOS 6632 or instructor permission. Restrictions: Offered in even years. This course covers the analysis of time-to-event data with applications to biology, medicine, and public health. Nonparametric methods for group comparisons and semi-parametric regression models will be emphasized. Parametric methods and distribution theory for survival analysis will also be included.

BIOS 6649  Clinical Trials: Statistical Design and Monitoring  3.0 cr.
Pre/Coreq: BIOS 6612 or instructor permission. Restrictions: Offered in odd years. Statistical and scientific design of clinical trials. Intended for biostatistics graduate students. Topics include scientific and statistical aspects of the research question, endpoints, treatments, sample size evaluation. A wide range of trial designs including group sequential and adaptive trial designs are covered.

BIOS 6655  Statistical Methods in Genetic Association Studies  3.0 cr.
Prereq: BIOS 6612 or permission of instructor. Restrictions: Offered in variable years. This course is designed to give an introduction to statistical methods in genetic association studies. Topics include an introduction to population genetics topics relevant to genetic association studies, design strategies, and analysis methods for case-control and family data.

BIOS 6772  Statistical Methods for Correlated Data  1.0 cr.
Prereq: BIOS 6643. Restrictions: offered variable years. This course will cover statistical models and methods for serially correlated data, including autoregressive models, Markov models, and Markov chain Monte Carlo methods.

BIOS 7713  Statistical Methods for Missing Data  1.0-2.0 cr.
Prereq: BIOS 6643. Restrictions: offered variable years in either 1 credit or 2 credits course version. This course covers methodological research being carried out for longitudinal studies with missing data. Topics may include missing data mechanisms, non-ignorable missing data, multiple imputation, mixture models and sample size determinations. 1 credit or 2 credit course versions offered in variable years.
Clinical Science Program Course Book
2019-2020

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<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>CBHS 6610</td>
<td>Social and Behavioral Factors in Health</td>
<td>3.0 cr.</td>
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<tr>
<td>CBHS 6611</td>
<td>Foundations of Health Behavior</td>
<td>3.0 cr.</td>
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<tr>
<td>CBHS 6612</td>
<td>Methods in Research and Evaluation</td>
<td>3.0 cr.</td>
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<td>CBHS 6620</td>
<td>Survey Research</td>
<td>2.0 cr.</td>
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<td>CBHS 6624</td>
<td>Community Health Assessment</td>
<td>3.0 cr.</td>
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<td>CPBS 7655</td>
<td>Statistical Methods in Genetic Association Studies</td>
<td>3.0 cr.</td>
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<td>CPBS 7659</td>
<td>Statistical Methods in Genomics</td>
<td>3.0 cr.</td>
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<td>CPBS 7660</td>
<td>Analysis of Genomics Data Using R and Bioconductor</td>
<td>2.0 cr.</td>
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<tr>
<td>CPBS 7711</td>
<td>Methods and Tools in Biomedical Informatics</td>
<td>4.0 cr.</td>
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<tr>
<td>DPTR 5151</td>
<td>Motor Control &amp; Motor Learning</td>
<td>2.0 cr.</td>
</tr>
<tr>
<td>DSEP 6000</td>
<td>Academic Writing for Doctoral Students</td>
<td>1.0 cr.</td>
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<tr>
<td>EHOH 6614</td>
<td>Occupational and Environmental Health</td>
<td>3.0 cr.</td>
</tr>
<tr>
<td>EHOH 6616</td>
<td>Environmental &amp; Occupational Toxicology</td>
<td>3.0 cr.</td>
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</tbody>
</table>

For edits, additions, and/or deletions please contact galit.mankin@cuanschutz.edu

Rev. 10/30/19
Clinical Science Program Course Book
2019-2020

EHOH 6617  Environmental & Occupational Epidemiology  3.0 cr.
Prereq: EHOH 6614
Overall goal of course is to provide a background in epidemiology of diseases related to environmental and/or occupational exposures. Application of epidemiologic research methods to determine and prevent such diseases will be discussed.

EHOH 6618  Environmental Health Policy and Practice  3.0 cr.
Prereq: EHOH 6614
Examine the environmental policy-making and planning and regulatory and non-regulatory approaches to controlling environmental hazards. A wide variety of topics will be introduced with cross-disciplinary perspectives ranging from water and air to the built environment and climate change.

EHOH 6619  Environmental Exposures and Health Effects  3.0 cr.
Prereq: EHOH 6614 Course: EPID 6630. This course integrates earth sciences, exposure sciences and biological sciences to understand conditions and circumstances of recent env/occ exposure events, the methods to assess exposures; and related health impacts. Case studies and laboratory exercises are used to guide instruction.

EPI 6622  Cancer Prevention and Control  2.0 cr.
Prereq: EHOH 6414, EPID 6630  Restriction: Offered alternate years
Course provides overview of preventable cancers, epidemiology and contributing factors. Phases of cancer control research and appropriate methodologies are discussed. Basic principles of intervention development are reviewed. Psychosocial issues related to cancer are discussed. Students research topic related to course.

EPI 6629  Clinical Epidemiology  2.0 cr.
Prereq: EPID 6630  Restriction: Offered in variable years
This course provides an overview of the design, conduct and appraisal of clinical research. Topics include study design, issues in randomized trials, measurement error, assessment of diagnostic and screening tests, measurement of health-outcomes, meta-analysis and use of questionnaires.

EPI 6632  CU Advanced Epidemiology  3.0 cr.
Prereq: EPID 6630, EPID 6631, BIOS 6601.
This is an advanced course on epidemiologic methods designed to improve the student’s ability to conduct and interpret observational epidemiologic studies.

EPI 6635  Communicable Disease Epidemiology  2.0 cr.
Prereq: EPID 6630. This overview course covers a broad range of topics including basic epidemiologic concepts, vaccines, emerging pathogens, hospital infection control, foodborne illness and outbreaks. Specific pathogens are also reviewed due to their public health importance or their ability to demonstrate important epidemiologic principles.

EPI 6636  Chronic Disease Epidemiology  3.0 cr.
Prereq: EPID 6630. The epidemiology of major chronic diseases of Western countries will be reviewed including heart disease, cancer, stroke, diabetes, neurological diseases, and selected other conditions. Methodologic issues related to the study of these diseases, disease surveillance and strategies for prevention will also be covered.

EPI 6637  Injury & Violence Epidemiology and Prevention  2.0 cr.
Prereq: EPID 6630 or permission of Instructor. Restriction: Offered in even years.
Students will learn the major causes of and risk factors for injuries and violence, identify and use key data sources to characterize injury problems, develop and evaluate injury control and prevention strategies, critically analyze literature and explore injury related research questions.

EPI 6638  Global Cardiovascular Epidemiology  2.0 cr.
Prereq: EPID 6630. Restriction: Offered variable terms and years
A review of the major issues in global cardiovascular disease epidemiology, including trends, the extent of the disease nationally and internationally, implications of major epidemiologic studies, and strategies for prevention. Emphasis of the course will be on review and interpretation of the cardiovascular epidemiology literature.

EPI 6646  Introduction to Systematic Reviews  1.0 cr.
Prereq: EPID 6630, or permission of instructor. Restriction: Offered in variable years
Introduces methods of conducting systematic reviews to identify the best available evidence about health and public health interventions. Topics will include the design and implementation of reviews, publication bias, search strategies, meta-analysis and reporting results through the Cochrane library.

EPI 7640  Genetic Epidemiology  2.0 cr.
Prereq: EPID 6630, BIOS 6601. Restriction: Offered alternate years.
This course will be a problem-based class, covering basic genetic principles and teaching epidemiologic methods employed in the investigation of the genetic susceptibility to chronic disease.

EPI 7911  Epidemiologic Field Methods  1.0-4.0 cr.
Prereq: EPID 6626, EPID 6630, EPID 6631, EPID 6632, BIOS 6611, BIOS 6612. Course Restrictions: Enrollment in Epidemiology PhD Program or permission of
Clinical Science Program Course Book
2019-2020

Instructor.
Ph.D. students have the opportunity to work with faculty on current epidemiologic projects to develop skills in field research, proposal writing, budget development, staff hiring and training, protocol and instrument development and implementation, and specific methods topics.

**EPID 7915 Analytic Methods in Epidemiology**
1.0-4.0 cr.
Prereq: EPID 6626, EPID 6630, EPID 6631, EPID 6632, BIOS 6601/BIOS 6602 or BIOS 6611/BIOS6612. Course Restrictions: Permission of instructor is required. Advanced treatment of techniques in the analysis of epidemiological studies, including longitudinal, time-dependent, survival data, causality, missing data, etc. Students will analyze data sets currently on file using contemporary epidemiological methods.

**HMG 7600 Survey of Human Genetics**
3.0 cr.
Survey of human genetics, including Mendelian and other types of inheritance, chromosomes and cytogenetics, molecular and biochemical basis of genetic disease, quantitative genetics and gene mapping, developmental and cancer genetics, clinical genetics, and genetic screening and prenatal diagnosis.

**HMG 7620 Advanced Genome Analysis**
2.0 cr.
Introduction to genomics emphasizing gaining familiarity with: analysis, utilization of genomic data. Topics: sequencing, mapping genomes, transcriptomics, human genome, evolution, genomic disorders, bioinformatics, statistics, population variation, epigenomics, proteomics, metagenomics, microbiome analysis, functional genomics, ethics. Crosslisted Course: CPBS 7620, STBB 7620, and MICB 7620

**HSMP 6602 Health Equity**
3.0 cr.
Addresses health inequities affecting the poor, racial and ethnic minorities, prisoners, rural residents, disabled, GLBTI and other populations. The course studies: 1) measurement/data issues in health inequity research; 2) institutionalized, personally mediated and internalized causes; and 3) solutions/challenges.

**HSMP 6605 Health Policy**
3.0 cr.
Course focuses on important U.S. health policy issues and analysis, implementation, and communication skills for the practice of health policy. Evaluation is based on in-class labs, group projects, and analysis paper of a health policy case example.

**HSMP 6606 Public Health Administration**
2.0 cr.
Course provides an introduction to public health management and administration. Components aim to stimulate interactions around important problems and issues including managerial decision-making and increasing practical knowledge, tools, and strategies required by organizational decision-makers. Business plans are produced.

**HSMP 6607 Current Legal Issues in Health Care**
2.0 cr.
Offered in variable terms and years
Course trains students in foundational Constitutional principles that guide public health law at the state and federal levels. It also explores cornerstone public health law problems and encourages analysis of contemporary legal questions in public health and health care administration.

**HSMP 6608 Ethical and Legal Issues in Public Health**
2.0 cr.
Course explores the legal and ethical dimension of public health. It focuses on topics that generate legal and ethical controversies, including governmental duties to protect citizens, nature and extent of the government’s ability to regulate conduct, and responses to epidemics.

**HSMP 6609 Cost Benefit and Effectiveness in Health**
2.0 cr.
Prereq: HSMP 6604 or permission of instructor.
Introduces students to the basics of economic evaluations of health care interventions or technology. Economic evaluations provide a method to assimilate different cost and health outcomes associated with medical treatments into a common metric.

**HSMP 6616 Introduction to Health Policy Analysis and Communication**
1.0 cr.
Introduces a framework for systematically and critically evaluating the health policy literature. Reviews effective oral and written communication skills for presenting policy analyses. Evaluation is based on a written analysis of a policy paper of the student’s choosing.

**IDPT 7200 Scientific Writing for Doctoral Students**
2.0 cr.
Restrictions: Must have passed preliminary examination; permission of instructor.
Scientific writing course for students engaged in research. Focuses on critical thinking, analytical writing, and oral presentation. Taught as a writing workshop, the course emphasizes effective communication with both professional and non-technical audiences.

**IDPT 7646 Tissue Biology and Disease Mechanism**
3.0 cr.
Prereq: IDPT 7811, IDPT 7812, IDPT 7813, IDPT 7814, IDPT 7815.
This course provides an overview of organ systems and disease through 1) a survey of the major systems, including the cellular and molecular mechanisms underlying their function and repair, integrated with 2) common diseases, current therapies, and their mechanistic basis.
## Clinical Science Program Course Book
### 2019-2020

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
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<tbody>
<tr>
<td>IMMU 7662</td>
<td>Immunology</td>
<td>6.0 cr.</td>
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<tr>
<td></td>
<td>This course covers the basic principles of the immune system. Included are discussions on (i) the innate and adaptive immune responses, (ii) the molecular and cellular basis of immune specificity and (ii) aspects of clinical immunology.</td>
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<tr>
<td>MICB 7701</td>
<td>Molecular Virology and Pathogenesis</td>
<td>3.0 cr.</td>
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<td>Prereq: MICB 7700, MICB 7705 are desirable but not required. Restrictions: Permission of Instructor.</td>
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<td></td>
<td>Topics in this course include viral structure and genome organization, replication and expression of viral genomes, mechanism of action of tumor viruses, molecular aspects of virus-host cell interactions, animal models of infectious diseases and pathogenesis of human viruses.</td>
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<tr>
<td>MICB 7702</td>
<td>Molecular Mechanisms of Bacterial Disease</td>
<td>3.0 cr.</td>
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<td>Restrictions: Permission of the instructor.</td>
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<td></td>
<td>Course focuses on molecular processes that bacteria utilize to cause disease in humans. The course content will use specific examples from pathogenic bacteria to illustrate common virulence mechanisms utilized to initiate, maintain and survive interactions with host cells.</td>
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<tr>
<td>MICB 7704</td>
<td>Host Response to Infectious Disease</td>
<td>1.0 cr.</td>
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<td></td>
<td>Prereq: Biomedical Core Courses.</td>
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<tr>
<td></td>
<td>This interactive graduate course, which provides an overview and specific examples of the host response to infectious disease. Current research and future directions in the field are discussed. Students are assessed via presentations, participation, and an exam.</td>
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<tr>
<td>MICB 7705</td>
<td>Medical Microbiology</td>
<td>4.0 cr.</td>
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<td></td>
<td>The course will focus on Microbiology, Infectious Diseases. Course content will focus on: pathogenicenic bacteria, viruses, fungi, parasites; emphasis on microbial virulence determinants, host-pathogen interactions emphasizing host immune responses, signs, symptoms of disease presentation, epidemiology, and diagnosis of infectious diseases.</td>
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<tr>
<td>NRSC 7600</td>
<td>Cellular &amp; Molecular Neurobiology</td>
<td>3.0 cr.</td>
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<td>A comprehensive, in-depth, discussion-based course intended for candidates for the PhD in Neuroscience. Topics include ion channel structure and function, ionic basis of the resting and action potential, and the biochemistry and physiology of direct and indirect synaptic transmission.</td>
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<tr>
<td>NRSC 7610</td>
<td>Fundamentals of Neurobiology</td>
<td>3.0 cr.</td>
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<td>Prereq: NRSC 7600 or equivalent at the discretion of the instructors.</td>
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<td></td>
<td>This course will provide basic knowledge on the structure and function of the nervous system. The lectures will be supplemented by discussion of primary research literature in neurobiology.</td>
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<tr>
<td>NURS 6274</td>
<td>Semantic Representation</td>
<td>3.0 cr.</td>
</tr>
<tr>
<td>D. Skiba</td>
<td>(<a href="mailto:diane.skiba@cuanschutz.edu">diane.skiba@cuanschutz.edu</a>) 303-724-8527</td>
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<tr>
<td></td>
<td>Introduces the concept of classifying nursing phenomena to facilitate data management and retrieval. Topics include: minimum data sets, nursing language, classification systems and vocabularies, and relates each topic to nursing practice, administration, and research.</td>
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</tr>
<tr>
<td>NURS 6279</td>
<td>Knowledge Management</td>
<td>3.0 cr.</td>
</tr>
<tr>
<td>D. Skiba</td>
<td>(<a href="mailto:diane.skiba@cuanschutz.edu">diane.skiba@cuanschutz.edu</a>) 303-724-8527</td>
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<td>Prereq: Minimum of one informatics course or permission of instructor.</td>
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<td>The need for knowledge discovery, distribution, and management in clinical settings is examined. Knowledge Management techniques (probabilistic/statistical models, machine learning, data mining, queuing theory, computer simulation) are examined. The specification of a knowledge management comprehensive system for healthcare is developed.</td>
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</tr>
<tr>
<td>NURS 6284</td>
<td>Digital Health Tools</td>
<td>3.0 cr.</td>
</tr>
<tr>
<td>D. Skiba</td>
<td>(<a href="mailto:diane.skiba@cuanschutz.edu">diane.skiba@cuanschutz.edu</a>) 303-724-8527</td>
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<tr>
<td></td>
<td>This course examines the use of digital tools to foster engagement of patients, families and consumers in their health care. This course examines the evidence and the legal, ethical, social and policy issues within the context of connected health.</td>
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</tr>
<tr>
<td>NURS 6285</td>
<td>HCI Design Principles</td>
<td>3.0 cr.</td>
</tr>
<tr>
<td>D. Skiba</td>
<td>(<a href="mailto:diane.skiba@cuanschutz.edu">diane.skiba@cuanschutz.edu</a>) 303-724-8527</td>
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<td></td>
<td>Examines the relationship of interface design to effective human interaction with computers. This course examines principles, theory and models to design and evaluate optimal interfaces to promote human computer interaction in health care informatics applications.</td>
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<tr>
<td>NURS 6286</td>
<td>Foundations Informatics</td>
<td>3.0 cr.</td>
</tr>
<tr>
<td>D. Skiba</td>
<td>(diane.skiba@ucdenver) 303-724-8527</td>
<td></td>
</tr>
<tr>
<td></td>
<td>This introductory course focuses on core concepts, skills, tools that define the informatics field and the examination of health information technologies to promote safety, improve quality, foster consumer-centered care, and efficiency.</td>
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Page 11
# Clinical Science Program Course Book
## 2019-2020

<table>
<thead>
<tr>
<th>Course Code</th>
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<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>NURS 6794</td>
<td>Decision Support</td>
<td>3.0 cr.</td>
</tr>
<tr>
<td></td>
<td>D. Skiba (<a href="mailto:diane.skiba@cuanschutz.edu">diane.skiba@cuanschutz.edu</a>) 303-724-8527</td>
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<tr>
<td></td>
<td>This course focuses on decision making models and their application using diverse data sources for high quality and safe care delivery. Decision support tools used in various health settings will be explored.</td>
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<tr>
<td>PHSC 7310</td>
<td>Fundamentals of Pharmaceutical Sciences</td>
<td>3.0 cr.</td>
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<td>Cross-listed: TXCL7310</td>
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<td></td>
<td>Core course explores key aspects of Pharmaceutical Sciences. Major themes will focus on macromolecular interactions, pharmaceutics, pharmacokinetics, pharmacodynamics, apoptosis, signal transduction and immunology. Critical thinking and problem solving skills will be emphasized via lectures, discussions, and computer-based data analyses.</td>
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<tr>
<td>PHOR 7611</td>
<td>Applied Cost-Effectiveness Modeling</td>
<td>4.0 cr.</td>
</tr>
<tr>
<td>(Fall) Prereq: HSMP 6609 Cost Benefit/Cost Effectiveness Analysis. Restrictions: Successful completion of HSMP 6609 or permission of primary instructor. This is an applied course in cost-effectiveness analysis. This course will apply the theory and methods learned in HSMP 6609 to develop competency in conducting cost-effectiveness analysis in health and medicine. Students will complete their own cost-effectiveness model.</td>
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<tr>
<td>PHOR 7613</td>
<td>Pharmaceutical Economics</td>
<td>3.0 cr.</td>
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<tr>
<td>(Spring). Prerequisite: BIOS 6601 or 6611</td>
<td>This course will cover the theoretical underpinnings of pricing and regulation in the pharmaceutical market. Students will gain an understanding of drug policy at the national and global level. Students will also employ methods for patient-level pharmacoeconomic analyses including techniques for analyzing utilization, patient preference, and cost data</td>
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</tr>
<tr>
<td>PHOR 7615</td>
<td>Pharmacoepidemiology</td>
<td>2.0-4.0 cr.</td>
</tr>
<tr>
<td>(Fall) Crosslisted: EPID 7615. Prereq: EPID 6630, 2-course biostatistics series (either BIOS 6601-6602 or BIOS 6611-6612) Consent of instructor to determine level of credit to be taken. This course builds upon fundamental concepts and methods of epidemiology, applied to the study of pharmaceuticals. Topics include: the FDA approved process, mechanisms of adverse drug effects, methods and data systems for studying drug-effect relationships, and evaluating published pharmacoepidemiology studies.</td>
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<tr>
<td>RPSC 7801</td>
<td>Molecular Mechanisms of Reproductive Endocrinology and Metabolism</td>
<td>3.0 cr.</td>
</tr>
<tr>
<td>Prereq: Core Courses IDPT 7811, IDPT 7812 ,IDPT 7813, IDPT 7814, IDPT 7815. Restrictions: CU-AMC grad students; others by permission of the Course Director. Endocrine systems will be covered from the molecule to the systems level. Pituitary secretions and their actions and regulation, regulation of water, ion, calcium balance, and regulation of metabolism including insulin secretion and action will be discussed, the context of normal physiology, the mechanisms of endocrine dysfunction.</td>
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</table>
ADDITIONAL RESOURCES FOR COURSE INFORMATION

University of Colorado Denver Clinical Science Program
https://www.cuanschutz.edu/cctsi/training/clsc

Colorado School of Public Health
http://ucdenver.edu/academics/colleges/PublicHealth/Academics/academics/Pages/CoursesRegistration.aspx

University of Colorado Denver School of Pharmacy
http://www.ucdenver.edu/academics/colleges/pharmacy/Pages/SchoolofPharmacy.aspx

University of Colorado Denver College of Nursing – Health Informatics
http://www.ucdenver.edu/academics/colleges/nursing/Pages/default.aspx

University of Colorado Denver Physical Therapy Program
http://www.ucdenver.edu/academics/colleges/medicalschool/education/degree_programs/pt/Pages/PT.aspx

University Colorado Denver Business School – Health Administration – Downtown Denver Campus
http://ucdenver.edu/academics/colleges/business/degrees/ms/health-admin/Pages/Degree-Requirements.aspx

University of Colorado Denver Anschutz Medical Campus – Graduate School
http://www.ucdenver.edu/academics/colleges/Graduate-School/Pages/default.aspx

University Colorado Denver Office of the Registrar – Anschutz Medical Campus
http://www.ucdenver.edu/student-services/resources/registrar/Pages/default.aspx

University of Colorado Denver Anschutz Campus Course Books and Descriptions
http://www.ucdenver.edu/anschutz/studentresources/Registrar/CourseListings/Pages/default.aspx

University of Colorado Jake Jabs Center for Entrepreneurship
https://jakejabscenter.org/