University of Colorado
Denver | Anschutz Medical Campus

Clinical Science Program Course Book

CLINICAL SCIENCE COURSES

CLSC 6060 Analysis, Modeling, and Design 3.0 cr.

Dr. M. Saleh (mohamad.saleh@ucdenver.edu) (Fall)
Cross listed: CU Denver ISMG 6060. Prereq: Application development experience.
Collaborative offering with Denver Campus, emphasizing information requirements analysis, logical system specification, detailed system design. Topics include structured system development methodologies, prototyping, file design, systems architecture, systems testing, software design strategies. Students use case tool to develop system specifications.

CLSC 6080 Database Management Systems 3.0 cr.

Z. Walter (zhiping.walter@ucdenver.edu) ((Fall)
Cross listed: CU Denver ISMG 6080. Prereq: Application development experience.
Offered as a collaborative offering with UCD, this course focuses on the development and management of database systems to support business operations. Important subjects include semantic data modeling, normalization, SQL, fourth generation languages, and client-server database applications.

CLSC 6210 Research Seminars in Clinical Science 1.0 cr

Dr. A. Prochazka (allan.prochazka@cuanschutz.edu) (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 3.0 cr.

Dr. L. Cicutto (lisa.cicutto@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 2.0 cr.

Dr. L. Caplan (liron.caplan@cuanschutz.edu) (Summer)
Prereq: For non-CLSC students, please seek consent of the instructor.
This course is designed for graduate students to master the theoretical and practical aspects of designing and executing a clinical trial. The focus will be on interventional studies and observational studies that require consent by subjects. Students will be introduced to good clinical practices and regulations related to the design and conduct of clinical trials. They will also be introduced to the broad array of research services available locally at UCD-AMC, UC Health, CHCO, and RMR VAMC. Engaging lecturers with expertise in the areas critical to designing and implementing ethical and responsibly conducted human subject research will present across the 7 weeks. Students will set up a mock clinical study (protocol, budget, clinical research team description), write a data and safety monitoring plan, plan recruitment strategies, characterize the informed consent process, and construct a study timeline.

CLSC 6270 Critical Appraisal Seminars in Clinical Science 1.0 cr.

Dr. L. Cicutto (lisa.cicutto@cuanschutz.edu) (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.

CLSC 6300 Scientific Grant Review Process: CCTSI Proposals – Masters 1.0 cr.

Drs. J. Maloney (james.maloney@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.

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CLSC 6460 Rare Diseases Translational Research and Clinical Trial Applications 1.0 cr.

Dr. M. Taylor (matthew.taylor@cuanschutz.edu) (Fall)
Prerequisites: Familiarity with biostats and study design is recommended.
The purpose of this course is to deepen understanding of human rare diseases and the translational research approaches to rare disease research. The course will broadly cover rare disease epidemiology, patient/subject identification and registries, data extraction from databases, subject recruitment, rare disease clinical trial designs, pediatric considerations, and grant funding.

CLSC 6560 Designs and Mixed Methods in Implementation Research 3.0 cr.

TBD (Spring)
This course is for D&I Certificate Students
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 6580 Qualitative and Mixed Methods in Health Research 3.0 cr.

Dr. S. Brewer (sarah.brewer@cuanschutz.edu) and Dr. T. Thompson (talia.thompson@cuanschutz.edu) (Spring)
This course is for CLSC Students
This course provides an in-depth examination of qualitative and mixed methods approaches that are pertinent to health research.

CLSC 6650 Guided Research Tutorial – Masters 1.0-3.0 cr.

Dr. Lisa Cicutto (cicuttol@njhealth.org) (Fall, Spring, Summer)
Prereq: Program consent, approved course plan (contact CLSC administrator for 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 6653 Key Concepts in Neuro-developmental Disabilities 1 2.0 cr.

S. Friedman and D. Johnson (dina.johnson@cuanschutz.edu) (Fall)
Prereq: A degree in health care profession or related field or instructor consent.
Course represents part one of 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 6654 Key Concepts in Neuro-developmental Disabilities 2 2.0 cr.

S. Friedman and D. Johnson (dina.johnson@cuanschutz.edu) (Spring)
Prereq: A degree in health care profession or related field and completion of CLSC 6653, or Instructor consent.
This course represents part two of a two-part interdisciplinary course series focused on service provision, intervention strategies and 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. S. Friedman, K Hightshoe, D. Johnson. 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. S. Friedman and D. Johnson (dina.johnson@cuanschutz.edu) 303-724-7673 (Spring)
Prereq: A degree in health care profession or related field or Instructor consent, CLSC 6661
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.

S. Friedman and R. Charlifue-Smith. 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 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 6668 Screening/Assessment for Children/Youth with Autism and Other 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.

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CLSC 6699 Masters Research Project – Publishable Paper 1.0-6.0 cr.

Dr. L. Cicutto (lisa.cicutto@cuanschutz.edu) (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. B. Kwan (bethany.kwan@cuanschutz.edu) ((Fall)
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 6770 D&I Grant Funding 2.0 cr.

Drs. C. Studts (christina.studts@cuanschutz.edu) and R. Glasgow (russell.glasgow@cuanschutz.edu) (Summer)
Prereq: Completion of CLSC 7653 Dissemination and Implementation Research in Health
This course provides an in-depth examination of issues in submitting successful grant proposals in Dissemination & Implementation research. The course will build upon good general practices in grant and manuscript preparation and submission

CLSC 6850 Advanced Research Topics in Dissemination and Implementation Science 1.0 cr.

Dr. A. Huebschmann (amy.huebschmann@cuanschutz.edu) and K. Trinkley (katy.trinkley@cuanschutz.edu) (Fall)
Prereq: CLSC 7653 or instructor permission
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 7101 Grant Writing I 1.0 cr.

Dr. L. Cicutto (cicuttol@njhealth.org) (Spring); M. Plomondon (meg.plomondon@cuanschutz.edu) and A. Prochazka (allan.prochazka@cuanschutz.edu) (Fall)
Prereq: BIOS 6601 and EPID 6630; Program consent (contact CLSC administrator for consent). 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.

CLSC 7102 Grant Writing II 1.0 cr.

Dr. L. Cicutto (cicuttol@njhealth.org) (Spring); M. Plomondon (meg.plomondon@cuanschutz.edu) and A. Prochazka (allan.prochazka@cuanschutz.edu) (Fall)
Prereq: BIOS 6601 and EPID 6630, CLSC 7101; Program consent (contact CLSC administrator for consent). 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 KO8, 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. S. Hogan (shea.hogan@cuanschutz.edu) and M. Kinney (mara.kinney@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 7152 Ethics and Responsible Conduct of Research in the Digital Age 1.0 cr.

Dr. W. Charles (wendy.charles@cuanschutz.edu) (Spring)
This course will provide an overview of the evolving ethical issues in clinical, translational and public health research involving digital data and technologies.

CLSC 7202 Clinical Outcomes and Applications 2.0 cr.

Drs. C. Battaglia (catherine.battaglia@cuanschutz.edu); A. Keniston (angela.keniston@cuanschutz.edu); J. Boggs (jennifer.boggs@cuanschutz.edu); R. Kilian (rachel.kilian@ucdenver.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. J. Maloney (james.maloney@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 BIOS 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.

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CLSC 7650 Guided Research Tutorial – Doctoral 1.0-3.0 cr.

Dr. L. Cicutto (lisa.cicutto@cuanschutz.edu) (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 3.0 cr.

Drs. B. Rabin (borsika.rabin@cuanschutz.edu) and C. Studts (christina.studts@cuanschutz.edu) (Fall)
Prereq: Program consent (contact CLSC administrator for consent)
Introduces dissemination and implementation (D&I) research and practice in the context of health (i.e., translational research in health).

CLSC 7663 Context and Adaptation in Dissemination & Implementation Research 2.0 cr.

Drs. C. Studts (christina.studts@cuanschutz.edu) and B. Rabin (borsika.rabin@cuanschutz.edu) (Spring)
Prereq: CLSC 7653 Dissemination and Implementation Research in Health; Program consent (contact CLSC administrator for consent)
This course covers concepts, frameworks, and methods for understanding and assessing context and guiding adaptations as relevant to dissemination and implementation (D&I) health research and practice.

CLSC 8990 Doctoral Thesis 1.0-10.0 cr.

Dr. L. Cicutto (lisa.cicutto@cuanschutz.edu) (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, and Cox regression. The statistical package SAS is used extensively. Multiple optional lab sessions offered.

BIOS 6611 Biostatistical Methods I 3.0 cr.

Prereq: differential calculus or permission of instructor.
This first course in applied statistics covers basic descriptive methods and probability; parametric and nonparametric inference for the one- and 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. 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.

EPID 6626 Research Methods in Epidemiology 3.0 cr.

Prereq: BIOS 6601, BIOS 6680, EPID 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.

EPID 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.

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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.

EPID 6631 Analytical Epidemiology 3.0 cr.
Prereq: EPID 6630 and BIOS 6601 or BIOS 6611
Fundamental analytical skills for assessing and reporting disease status, determinants of disease and their impact on public health including determining rates of disease occurrence, measures of associations between exposures and disease, and techniques for identifying and correcting for misclassifications, effect modifiers and confounder.

HLTH 6071 Introduction to Health Information Technology 3.0 cr.
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.

HSMP 6604 Health Care Economics 3.0 cr.
Uses economic theory to analyze and understand the U.S. health care system. Topics include: demand and supply of health and health care, health insurance, hospitals, 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 2-course sequence in empirical methods in health services research. The statistical theory underlying basic empirical methods and the thoughtful implementation/practice of these methods are 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.

HSMP 8990 Doctoral Thesis – Health Systems Management and Policy 1.0-10.0 cr.
Restriction: Permission of instructor.
Doctoral thesis work in Health Systems Management and Policy.

NURS 6290 Information Systems Life Cycle 4.0 cr.
Prereq: Minimum of one informatics course or permission of instructor.
This course focuses on a structured approach to information system, development, and implementation in healthcare settings. The course addresses the phases of the information systems life cycle.

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.

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SUGGESTED ELECTIVE COURSES

(for additional electives please see https://www.cuanschutz.edu/registrar/course-books)

BIOL 5064 Cell Biology of Disease 3.0 cr.

Builds on the foundations laid in the prerequisite courses. How alterations in membrane transport, autophagy, mitochondria, lysosomes, cilia, unfolded protein response and autophagy lead to major human diseases. A major emphasis is the control and integration of cellular activities. Restriction: Restricted to degree-granting graduate programs. 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, mRNA and protein detection in the context of gene editing. Experimental design and the theories underlying the techniques are also discussed. Restriction: Restricted to degree granting graduate programs on the downtown campus as well as the School of Medicine on the Anschutz Medical campus. Cross-listed with BIOL 4125. Term offered: spring.

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. Restriction: Restricted to degree-granting graduate programs. 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. Restriction: Restricted to degree-granting graduate programs. 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. Restriction: Restricted to degree-granting graduate programs. Cross-listed with BIOL 4144.

BIOL 5165 Neurobiology 3.0 cr.

Overview of neuroscience, covering the cellular basis of neuronal activity, sensory structures and the structure and function of the human brain. Restriction: Restricted to degree-granting graduate programs. Cross-listed with BIOL 4165.

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. Restriction: Restricted to degree-granting graduate programs. Cross-listed with BIOL 4550.

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. Restriction: Restricted to degree-granting graduate programs. Cross-listed with BIOL 4634.

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 application 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 2.0 cr.

Coreq: BIOS 6611 or consent of instructor
Students will gain experience with statistical consulting and common statistical problems and techniques encountered in consulting through a combination of instruction, real examples, and consultations with investigators. Emphasis will be on methods for effective 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.

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BIOS 6646 Survival Analysis 3.0 cr.

Prereq: BIOS 6611 & BIOS 6631 or instructor permission Coreq: BIOS 6612 & BIOS 6632 or instructor permission.
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.
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 6611, BIOS 6612 (can be co-req) or equivalent graduate level (bio)statistics course with instructor consent. Proficiency in coding in statistical software R.
This course is designed to give an introduction to statistical methods in genetic association studies. Topics include quantitative and population genetic concepts relevant to genetic association studies, design strategies, and analysis methods for case-control and family data.

BIOS 7712 Statistical Methods for Correlated Data 1.0 cr.

Prereq: BIOS 6643.
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.
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.

BSBT 7646 Tissue Biology and Disease Mechanism 1.0 cr.

Prereq: IDPT 7811, 7812, 7813, 7814, 7815 (BIOM Sci Core Courses)
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.

CBHS 6610 Social and Behavioral Factors in Health 3.0 cr.

Considers social, behavioral, and cultural factors that affect the health of individuals and populations, and contribute to health disparities. Development, implementation and evaluation of programs and policies to promote and sustain health environments and lifestyles are examined..

CBHS 6611 Foundations of Health Behavior 3.0 cr.

Course will cover basic theories, concepts, models from a range of social/behavioral disciplines used in public health research and practice. Applications of theoretical frameworks in specifying multiple targets and levels of intervention to public health research will be addressed.

CBHS 6612 Methods in Research and Evaluation 3.0 cr.

Prereq: BIOS 6601 and EPID 6630 strongly recommended prior to this course or taken concurrently.
Restriction: Must have sub plan in one of the following: Community & Behavioral Health, Global PH & Community Hlth Edu, DNP & MPH Dual Degree, Global PH & Maternal Chld Hlth, Leadership & Pub Hlth Practice, Maternal and Child Health, or Pop Men Hlth and Wellbeing.
Course covers social science research methods, including qualitative/quantitative research designs, data collection, and program evaluation (formative, process, outcome), to assess effectiveness of public health programs.

CBHS 6620 Survey Research 3.0 cr.

Course examines survey research methodology, including face-to-face, telephone, mail and Internet surveys, includes: developing and ordering questions; formatting; reliability and validity; sampling; implementation; maximizing response rate; data issues; survey ethics and reporting.

CBHS 6624 Community Health Assessment 3.0 cr.

Prereq: EPID 6630 and either CBHS 6610 or CBHS 6611.
Course teaches how to assess the social, cultural, economic, physical, and environmental components of population health. Students use national/local demographic and health data. Includes working with community clients and off-campus community-based fieldwork.

CPBS 7655 Statistical Methods in Genetic Association Studies 3.0 cr.

Prereq: BIOS 6612 or permission of instructor.
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. Cross-listed: BIOS 6655.

CPBS 7659 Statistical Methods in Genomics 3.0 cr.

Prereq: BIOS 6611 or equivalent graduate level statistics course with consent of instructor.
This course will give an introduction to statistical methods for analyzing molecular sequences and genomic data. Topics include hidden Markov models for sequence alignment, molecular evolution and gene expression data analysis. Prereq: BIOS 6611 or equivalent graduate level statistics course with consent of instructor.

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CPBS 7660 Analysis of Genomics Data Using R and Bioconductor 2.0 cr.

Pre/Coreq: BIOS 6602 or 6612, or consent of instructor
This course provides students with hands on experience in solving real life biological problems using the statistical software R and Bioconductor. Students will work and communicate with participating researchers and clinicians on their case studies of genomics data.

CPBS 7711 Methods and Tools in Biomedical Informatics 4.0 cr.

An introduction to algorithms for the theory and practice of bioinformatics and computational biology. Topics include:1) Experimental design; 2) Statistical concepts; 3) Sequence alignment; 4) networks and systems biology.

DPTR 5151 Motor Control & Motor Learning 2.0 cr.

This course presents the foundation of motor learning and control as it applies to optimal movement across the lifespan. Emphasis is on variables related to the individual task composition, the environment and augmented information that enhance practice of motor skills. These principles are applied to physical therapist practice.

DSEP 6000 Academic Writing for Doctoral Students 1.0 cr.

Tailored for graduate students in education. Focuses on techniques for improving academic writing, particularly planning, organizing, drafting, revising, and editing papers, i.e. course assignments, portfolio products, doctoral proposals or dissertation chapters. Prereq: Admission to doctoral program. Repeatable. Max Hours: 3 Credits.

EHOH 6614 Occupational and Environmental Health 3.0 cr.

Students will learn about the relationship between the environment, workplace and health. Topics include facets of industrial hygiene, air and water pollution, radiation monitoring, toxicology, occupational medicine, policy, environmental justice and sustainability. Methods include risk assessment, GIS and epidemiology.

EHOH 6616 Toxic Effects of Environmental and Workplace Agents 3.0 cr.

Presents an overview of information needed to assess the relationship between the environment, workplace and health. Topics include facets of industrial hygiene, air and water pollution, radiation monitoring, toxicology studies, clinical occupational medicine and biologic monitoring.

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 Coreq: 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.

EPID 6622 Cancer Prevention and Control 2.0 cr.

Prereq: EHOH 6414, EPID 6630
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.

EPID 6629 Clinical Epidemiology 2.0 cr.

Prereq: EPID 6630
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.

EPID 6635 Infectious Disease Epidemiology 2.0 cr.

Prereq: EPID 6630.
This course considers the epidemiology of selected communicable diseases. Methods for their prevention and control, and assessment of these methods will be treated primarily through case studies.

EPID 6636 Chronic Disease Epidemiology 3.0 cr.

Prereq: EPID 6630
The major chronic diseases of Western countries will be reviewed including heart disease, cancer, stroke, diabetes, neurological diseases, and selected other conditions. Factual information about epidemiology of these diseases will be provided with the discussion of methodological issues which arise.

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EPID 6637 Injury & Violence Epidemiology and Prevention 2.0 cr.

Prereq: EPID 6630 or permission of Instructor.
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.

EPID 6638 Global Cardiovascular Epidemiology 2.0 cr.

Prereq: EPID 6630.
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.

EPID 6646 Methods for Conducting Systemic Review and Meta-Analysis 2.0 cr.

Prereq: EPID 6630
This course provides a broad understanding of the application of systemic reviews to public health, medicine and health policy introducing key steps for performing systemic reviews and meta-analyses through hands-on exercises, including formulating a research questions and hypothesis, developing a search strategy, identifying eligible studies, extracting data, assessing the risk of bias of included studies and synthesizing the evidence qualitatively and quantitatively. Focuses on analytical skills in performing pairwise meta-anallyses.

EPID 7632 Advanced Epidemiology 2 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.

EPID 7640 Genetic Epidemiology 2.0 cr.

Prereq: EPID 6630, BIOS 6601.
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.

EPID 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 Instructor.
PhD 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, casualty, missing data, etc. Students will analyze data sets currently on file using contemporary epidemiological methods.

HMGP 7600 Survey of Human Genetics 3.0-4.0 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.

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 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.

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.

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HSMP 6616 Introduction to Health Policy Analysis and Communication 1.0 cr.

Introduces a framework for systemically 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.

IMMU 7662 Immunology 6.0 cr.

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 (III) aspects of clinical immunology.

IPHY 7801 Molecular Mechanisms of Reproductive Endocrinology and Metabolism 3.0 cr.

Prereq: Core Courses IDPT 7811, 7812 , 7813, 7814, 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 actions/ regulation, regulation of water, ion, calcium balance, regulation of metabolism including insulin secretion/action will be discussed, the context of normal physiology, the mechanisms of endocrine dysfunction.

MICB 7701 Molecular Virology and Pathogenesis 3.0 cr.

Prereq: MICB 7706, MICB 7705 are desirable but not required. Restrictions: Permission of Instructor.
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.

MICB 7703 Molecular Mechanisms of Bacterial Disease 3.0 cr.

Prereq: Recommended Fundamentals of Microbiology Restrictions: Permission of the instructor.
The 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.

NRSC 7600 Cellular & Molecular Biology 3.0 cr.

A comprehensive, in-depth, discussion-based course intended for candidates for the Ph.D. 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 synaptic transmission.

NRSC 7610 Fundamentals of Neurobiology 3.0 cr.

Prereq: NRSC 7600 or equivalent at the discretion of the instructors.
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. Prereq: NRSC 7600 or equivalent at the discretion of the instructors.

NURS 6274 Semantic Representation 3.0 cr.

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.

NURS 6279 Knowledge Management 3.0 cr.

Prereq: Minimum of one informatics course or permission of instructor.
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.

NURS 6284 Digital Tools for Connected Health 3.0 cr.

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.

NURS 6285 HCI Design Principles 3.0 cr.

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. Online course skills.

NURS 6286 Foundations Informatics 3.0 cr.

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.

NURS 6794 Decision Support and Data Management 3.0 cr.

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.

PHSC 7310 Fundamentals of Pharmaceutical Sciences I 3.0 cr.

Cross-listed: TXCL7310
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.

PHOR 7611 Applied Cost-Effectiveness Modeling 4.0 cr.

Prereq: HSMP 6609 Cost Benefit/Cost Effectiveness Analysis.
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.

PHOR 7613 Pharmaceutical Economics 3.0 cr.

An introduction to pharmaceutical economics with emphasis on the role of pharmaceuticals and the pharmaceutical industry, regulation, and pricing. This course will also cover modeling microeconometric data including costs and health state preferences for advanced economic evaluation using primary data sources.

PHOR 7615 Pharmacoepidemiology 2.0-4.0 cr.

Crosslisted: EPID 7615. Prereq: EPID 6630, 2-course biostatistics series (either BIOS 6601-6602 or BIOS 6611-6612)
Restrictions: 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 included: the FDA approval process, mechanisms of adverse drug effects, methods and data systems for studying drug-effect relationships, and evaluating published pharmacoepidemiology studies.

ADDITIONAL RESOURCES FOR COURSE INFORMATION

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

Colorado School of Public Health
https://coloradosph.cuanschutz.edu/education

University of Colorado Denver School of Pharmacy
https://pharmacy.cuanschutz.edu/

University of Colorado Denver College of Nursing – Health Informatics
https://nursing.cuanschutz.edu/academics/advanced-ms-dnp-specialties/health-care-informatics

University of Colorado Physical Therapy Program
https://medschool.cuanschutz.edu/physical-therapy-program

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
https://graduateschool.cuanschutz.edu/

University Colorado Denver Office of the Registrar – Anschutz Medical Campus
https://www.cuanschutz.edu/registrar

University of Colorado Denver Anschutz Campus Course Books and Descriptions
https://www.cuanschutz.edu/registrar/course-books

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