# Biomedical and Health Informatics

Medical Education via Innovation in-Technology (MediTec)

# Introduction to Database Concepts and Applications

- **Course Description**
  - This course will provide an introductory look at database concepts, emphasizing the relational database model. The course will also illustrate concepts and application of the entity relationship diagram as well as the principles and application of normalization. The student will understand the use of structured query language (SQL) to extract information from the database. We will also take a broad overview at some advanced databases topics such as, Web Database Development, Data Warehouses and Database Administration.

- **Learning Objectives**

  By the end of this course, students will be able to:

  1. Describe the reasons and purpose of using a database
  2. Explain the conceptual foundation of the relational model for databases
  3. Demonstrate basic SQL statements for creating, querying, modifying and deleting data from a relational database
  4. Discuss the basic stages of database development and the role of the data model. Describe basic database design principles
  5. Explain the need for and importance of database administration and the need for security, backup and recovery
  6. Describe Web database processing
  7. Describe the basic concepts of data warehousing, OLAP, and data mining.

Medical Education via Innovation in-Technology (MediTec)

# Introduction to Database Concepts and Applications (Cont.)

- **Objectives/Topics**
    - Introduction to Databases
    - Relational Data Modeling and Normalization on
    - Data Modeling and the Entity Relationship Diagram (ERD)
    - Structured Query Language (SQL)
    - Database Design
    - Database Administration
    - Advanced Database Concepts
    - Database Processing Applications

- **Prerequisites:**
    - None

Medical Education via Innovation in-Technology (MediTec)

# Introduction to Bio statistical Methods

- **Course Description**

  - This course is a sophisticated introduction to the concepts and methods of bio statistical data analysis. The topics include descriptive statistics, probability, standard probability distributions, sampling distributions, point and confidence interval estimation, hypothesis testing, power and sample size estimation, one and two-sample parametric and non-parametric methods for analyzing continuous or discrete data, and simple linear regression. The SAS statistical software package will be used for data management and statistical analyses

- **Learning Objectives**

  By the end of this course, students will be able to:

  1. Describe the role biostatistics serves in the discipline of public health.
  2. Differentiate among different sampling methods and discuss their strengths and limitations.
  3. Describe the strengths and limitations of designed experiments and observational studies.
  4. Distinguish among different measurement scales, choose the appropriate descriptive and inferential statistical methods based on these distinctions, and interpret the results.
  5. Determine preferred methodological alternatives to commonly used statistical methods when assumptions are not met.
  6. Apply basic concepts of probability, random variation, and commonly used statistical probability distributions.
  7. Use statistical software to analyze public health data.
  8. Develop presentations based on statistical analyses for both public health professionals and educated lay audiences.

Medical Education via Innovation in-Technology (MediTec)

# Introduction to Bio statistical Methods (Cont.)

- **Objectives/Topics**
    - Exploratory Data Analysis
    - Producing Data and Probability
    - Random Variables and Sampling Distribution
    - Introduction to Statistical Inference
    - Inference for Relationships

- **Prerequisites:**
    - None

Medical Education via Innovation in-Technology (MediTec)

# Health Information Systems

- **Course Description**

  - This course will focus on the use of electronic information systems in healthcare. It integrates medical administrative and clinical record management and computer technology for performing common medical practice functions. The course covers computer hardware and software components, network and World Wide Web technologies, decision support systems, health information standards, information system acquisition or in-house development, implementation, evaluation, user training, and maintenance. Basic database use and management will be explored. Students will practice the use of request for proposals and the stages of the procurement process. Students will complete a basic tutorial to view a real electronic health record.

- **Learning Objectives**

  By the end of this course, students will be able to:

  1. Articulate how information systems function in healthcare organizations to assist healthcare providers and administrators.
  2. Describe the role health information systems in improving healthcare quality.
  3. Evaluate health information systems and data storage design.
  4. Explain the legal issues concerning the protection and dissemination of electronic health information.
  5. Recommend elements included in the design of audit trails and data quality monitoring programs.
  6. Collaborate in the design and implementation of risk assessment, contingency planning, and data recovery procedures.
  7. Manage the planning, design, selection, implementation, integration, testing, evaluation, and support of health information technologies.
  8. Recommend device selection based on workflow, ergonomic and human factor.
  9. Plan the development of networks, including intranet and Internet applications.
  10. Apply knowledge of database architecture and design to meet organizational needs.
  11. Evaluate system architecture, database design, and data warehousing.

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# Health Information Systems (Cont.)

- **Objectives/Topics**
  - Introduction to Computers in HIM
  - Information Integrity and Data Quality and Security
  - Databases and Computers in HIM
  - System Selection and Implementation
  - Electronic Health Records
  - Administrative Information Systems; Clinical Information Systems
  - Consumer Informatics
  - Role of HIM Professionals in Information Systems.
  - The Future of Computers in Healthcare

- **Prerequisites:**
  - None

Medical Education via Innovation in-Technology (MediTec)

# Healthcare Information Systems Analysis & Design

- **Course Description**

  - This graduate course is designed to provide you a solid understanding in Healthcare Informatics development, and have an ability to critically analyze these Information Systems requirements within the theoretical framework. It provides a well-rounded understanding of requirements, design, and control of major business processes that are integral within a healthcare enterprise system. Topics include Systems Analysis and Design methodologies and techniques for Healthcare Information System development, issues of privacy and confidentiality, fraud and abuse, as well as controls for systems reliability. The course benefits both Information Systems students interested in working in the growing Healthcare industry and Healthcare professionals interested in designing and implementing effective Information Systems to support their business.

- **Learning Objectives**

  By the end of this course, students will be able to:

  1. Understand and demonstrate the applications of knowledge of the requirements, design, and control of major business processes that are integral within a healthcare enterprise system including registration, order entry and result reporting, clinical documentation, scheduling and patient billing.

  2. Understand and demonstrate the applications of knowledge systems analysis & design methodologies and techniques including: requirement analysis, development strategies, project management, and system implementation / operation.

  3. Understand and demonstrate the applications of knowledge of control and audit of healthcare information systems including: controls for privacy and confidentiality, controls for computer crimes (fraud and abuse) and systems reliability (information security, processing integrity, and availability.)

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# Healthcare Information Systems Analysis & Design (Cont.)

- **Objectives/Topics**
    - Healthcare Information Systems
    - Systems Development Process & Health Care Settings
    - Strategic Planning for IT Projects
    - Electronic Health Record
    - Standard Terminology and Language in Healthcare
    - Personal Health Record
    - Health Information Exchanges
    - Selecting a Healthcare Information System
    - Usability of Health Informatics Applications
    - System Maintenance and Support

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# Healthcare Information Systems Analysis & Design (Cont.)

- **Objectives/Topics**
    - Information Systems Training
    - Information Security and Confidentiality
    - Systems Integration and Interoperability
    - Legal and Regulatory Issues

- **Prerequisites:**
    - Healthcare Technology Management

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# Data Visualization in the Health Science

- **Course Description**

  - The world is growing increasingly reliant on collecting and analyzing information to help people make decisions. Because of this, the ability to communicate effectively about data is an important component of future job prospects across nearly all disciplines. In this course, students will learn the foundations of information visualization and sharpen their skills in communicating using health science data. Throughout the semester, we will use R and other software to explore concepts in graphic design, storytelling, data wrangling and plotting, and biostatistics as they apply to data driven communication. Whether you're an aspiring data scientist or you just want to learn new ways of presenting health science information, this course will help you build a strong foundation in how to talk to people about data.

- **Learning Objectives**

  By the end of this course, students will be able to:

  1. Construct sophisticated data displays that adequately express the meaning of their data.

  2. Recommend the best types of data visualizations to use for a given type of data.

  3. Critique/Evaluate/Assess the appropriateness of a data display

Medical Education via Innovation in-Technology (MediTec)

# Data Visualization in the Health Science (Cont.)

- **Objectives/Topics**
    - Introduction and R Background
    - Telling Stories with Data
    - Theory
    - Handling Data
    - Basic Plotting
    - Displaying Data Over Time
    - Displaying Genetics Data
    - Displaying Spatial Data
    - Visuals for Modelling
    - Interactive Displays and Dashboards (IDD)

- **Prerequisites:**
    - Introduction to Bio statistical Methods

Medical Education via Innovation in-Technology (MediTec)

# Healthcare Data Analytic

- **Course Description**
  - This introductory course is designed for graduate students who intend to understand the process of analysis of patient data, genomic databases, and electronic health records (EHR) to improve patient care, and to achieve greater efficiencies in public and private healthcare systems. The course explores the concept of clinical intelligence and the role of analytics in supporting a data-driven learning healthcare system. The aim is to focus beyond data collection, to analyzing available data and making it into actionable information. Key topics include the value-driven healthcare system, measuring health system performance, existing quality/performance measurement frameworks (HEDIS), Analytics maturity model (DELTA), comparing healthcare delivery, attributes of high performing healthcare systems, and the IT infrastructure and human capital needed to leverage analytics for health improvement. We will also look at open-source and web-based warehousing tools to perform practical use of healthcare analytics.

## Learning Objectives

By the end of this course, students will be able to:

1. Describe the changing context of healthcare services, including the trend value-based healthcare systems and the role of data in promoting improved outcomes

2. Import data from electronic health record (EHR) systems into data warehousing system and use analytics tools.

3. Design data models that integrate patient data from multiple sources to create comprehensive, patient-centered views of data

4. Design an analytic strategy to frame a potential issue and solution relevant to the health improvement of patient populations

5. Analyze the distribution of disease and health outcomes in relevant populations of interest(e.g., general population, health system members, patient subgroups) as well as geographic regions and represent data on Maps (GIS tools)

6. Apply clinical analytics to various contexts of quality improvement (e.g., chronic disease, patient use, population health, public health)

Medical Education via Innovation in-Technology (MediTec)

# Healthcare Data Analytic (Cont.)

- **Objectives/Topics**
    - Basics of data analysis for the healthcare system
    - Healthcare Data Acquisition and Management
    - Applied Statistics for Healthcare Analytics
    - Quantitative Methods in Healthcare Management
    - Data Mining for Healthcare Analytics
    - Systems Medicine for Predictive Analytics

- **Prerequisites:**
    - None

Medical Education via Innovation in-Technology (MediTec)

# Introduction to Artificial Intelligence with Python

- **Course Description**
    - This course explores the concepts and algorithms at the foundation of modern artificial intelligence, diving into the ideas that give rise to technologies like game-playing engines, handwriting recognition, and machine translation. Through hands-on projects, students gain exposure to the theory behind graph search algorithms, classification, optimization, reinforcement learning, and other topics in artificial intelligence and machine learning as they incorporate them into their own Python programs. By course's end, students emerge with experience in libraries for machine learning as well as knowledge of artificial intelligence principles that enable them to design intelligent systems of their own.

- **Learning Objectives**

    By the end of this course, students will be able to:

    1. The difference between the two main types of machine learning methods: supervised and unsupervised
    2. Supervised learning algorithms, including classification and regression
    3. Unsupervised learning algorithms, including Clustering and Dimensionality Reduction
    4. How statistical modeling relates to machine learning and how to compare them
    5. Real-life examples of the different ways machine learning affects society

Medical Education via Innovation in-Technology (MediTec)

# Introduction to Artificial Intelligence with Python (Cont.)

- **Objectives/Topics**
  - Introduction to Machine Learning
    - Applications of Machine Learning
    - Supervised vs Unsupervised Learning
    - Python libraries suitable for Machine Learning
  - Regression
    - Linear Regression
    - Non-linear Regression
    - Model evaluation methods
  - Classification
    - K-Nearest Neighbour
    - Decision Trees
    - Logistic Regression
    - Support Vector Machines
    - Model Evaluation

Medical Education via Innovation in-Technology (MediTec)

# Introduction to Artificial Intelligence with Python (Cont.)

- **Objectives/Topics**
    - Unsupervised Learning
        - K-Means Clustering
        - Hierarchical Clustering
    - Density-Based Clustering
        - Recommender Systems
        - Content-based recommender systems
        - Collaborative Filtering

- **Prerequisites:**
    - Probability and statistics
    - Mathematics

Medical Education via Innovation in-Technology (MediTec)

# Programming for Information Science

- **Course Description**

    - This course introduces object-oriented design and programming concepts and methods using the Python programming language. Object-oriented programs are built as collections of "objects", which are software representations of real-world entities and concepts. Objects combine data (attributes) with functionality (methods), and work through communicating with each other as the code is executed. By encapsulating code complexity within objects, OOP allows use and reuse of existing code in a relatively simple and easy manner. Advanced OOP concepts such as inheritance facilitate development of complex code without sacrificing robustness and possibility of code reuse. We apply computational thinking approaches such as abstraction, decomposition, algorithmic design, generalization, evaluation, and debugging.

- **Learning Objectives**

    By the end of this course, students will be able to:

    1. Explain OOP concepts, principles, design patterns and methods.
    2. Design, program and debug Python applications to solve non-trivial problems.
    3. Test and assess the quality of object-oriented code.
    4. Write clear and effective documentation.
    5. Explain how programming is situated in and reflects social issues (e.g. racism, classism or sexism) and describe actions that individuals or organizations are taking to counteract disparities and inequities.

Medical Education via Innovation in-Technology (MediTec)

# Programming for Information Science (Cont.)

- **Objectives/Topics**
    - Introduction and R Background
    - Computational thinking, Programming patterns and Variables, expressions, statements
    - Conditionals , Functions, Iteration and Strings
    - Lists and Tuples and Dictionaries
    - Classes and objects; methods and attributes
    - Encapsulation, Composition and Inheritance
    - Critical perspectives on programming

- **Prerequisites:**
    - Introduction to Artificial Intelligence with Python
    - Object oriented

Medical Education via Innovation in-Technology (MediTec)

# Database Design for Information Systems

- **Course Description**

    - This course focuses on approaches to and methods for designing relational and contemn almost half a century of development, and challenges from various competing paradigms, relational databases remain to be the major portray non-relational (NoSQL) databases. Aft paradigm for data persistence. A high-quality relational database can help leverage an organization's data and information assets for better fulfillment of its mission. On the other hand, a poorly designed database can complicate even the simplest data-driven functions within the organization. This course covers principles and methods for logical and physical database design, the theoretical considerations behind the relational paradigm, as well as SQL, a language for maintaining relational databases and managing data held in relational databases. Once relational database design and administration fundamentals are established, the focus of the course will move to limitations posed by relational databases, and approaches to addressing those limitations within and beyond the relational paradigm, including some of the NoSQL solutions developed over the last decade.

- **Learning Objectives**

    By the end of this course, students will be able to:

    1. Understand and define fundamental concepts in relational databases

    2. Develop a logical database design

    3. Develop entity-relationship diagrams

    4. Normalize relational database tables

    5. Develop a physical database based on a logical design

    6. Perform CRUD (create, read, update, delete) operations on relational databases

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# Database Design for Information Systems (Cont.)

- **Objectives/Topics**
  - Stored program development; Stored procedures; Stored functions; Triggers; Events; Transactions
  - Entity- relationship diagrams; Defining entities, attributes, and data types; Defining relationships
  - Normalization
  - Physical design principles; Indexes; Physical design via MySQL Workbench; Forward and reverse engineering
  - Limitations of relational databases; New database paradigms; Data model
  - Graph databases
  - Document databases
  - Distribution models; Replication; Partitioning/Sharing; Consistency
  - Derived data; Processing approaches; Data warehousing

- **Prerequisites:**
  - Introduction to Database Concepts and Applications

Medical Education via Innovation in-Technology (MediTec)

# Design Innovation for Health System

- **Course Description**

  - This course explores the complex challenges existing within our health system and teaches a design-innovation framework to identify solutions. It uses the aging population and increasing advanced chronic disease as the main case study. Initially, the course examines how major health care services are organized and financed in Ontario, Canada, how this affects care, and what are the strengths, challenges, and opportunities in the current system. The course then applies design innovation framework to generate system-level solutions. Students will work in groups to identify a problem, learn about its root causes through interviews, design a solution through analysis, and present a prototype.

- **Learning Objectives**

  By the end of this course, students will be able to:

  1. To understand how the current complexities within Ontario's health system create systemic challenges for patients, providers, and administrators.
  2. To understand the value and stages of the human-centered design process.
  3. To apply this process to generate solutions to current health system issue.

Medical Education via Innovation in-Technology (MediTec)

# Design Innovation for Health System (Cont.)

- **Objectives/Topics**
    - Intro to Course; View of the Future & Laying Big Bets
    - Pain points in the Homecare Sector
    - Pain points in the Physician Sector
    - Pain points in the Hospital Sector
    - Innovation Strategies
    - Business Models
    - Intro to Human-Centered Design

- **Prerequisites:**
    - Introduction to Database Concepts and Applications

Medical Education via Innovation in-Technology (MediTec)

# Introduction to Big Data Analysis and Artificial Intelligence in Healthcare

- **Course Description**
  - This course explores the complex challenges existing within our health system and teaches a design-innovation framework to identify solutions. It uses the aging population and increasing advanced chronic disease as the main case study. Initially, the course examines how major health care services are organized and financed in Ontario, Canada, how this affects care, and what are the strengths, challenges, and opportunities in the current system. The course then applies design innovation framework to generate system-level solutions. Students will work in groups to identify a problem, learn about its root causes through interviews, design a solution through analysis, and present a prototype.

- **Learning Objectives**

  By the end of this course, students will be able to:

  1. To understand how the current complexities within Ontario's health system create systemic challenges for patients, providers, and administrators.
  2. To understand the value and stages of the human-centered design process.
  3. To apply this process to generate solutions to current health system issue.

Medical Education via Innovation in-Technology (MediTec)

# Introduction to Big Data Analysis and Artificial Intelligence in Healthcare (Cont.)

- **Objectives/Topics**

  - Intro to Course; View of the Future & Laying Big Bets

  - Pain points in the Homecare Sector

  - Pain points in the Physician Sector

  - Pain points in the Hospital Sector

  - Innovation Strategies

  - Business Models

  - Intro to Human-Centered Design

- **Prerequisites:**

  - Programming

Medical Education via Innovation in-Technology (MediTec)

# Information Technology in the Healthcare System of the Future

- **Course Description**
  - Innovation in healthcare requires leaders who are trained to think and act like entrepreneurs. Whether at a hospital bedside, patient's home, or resource-poor region of the U.S. or a developing nation, healthcare leaders must understand both the business of running a healthcare organization and how to provide timely, affordable, quality patent care. Each week, the course features a lecture and skills-based tutorial session led by an industry or academic leader. The lecture provides the foundation for faculty-mentored work on industry, student, or non-profit sponsored projects that may involve creation of a market or business plan, product development, or a study design.

- **Learning Objectives**

  By the end of this course, students will be able to:

  1. Improved economies of scale
  2. greater technical efficiencies in the delivery of care
  3. advanced tools for patient education and self-care
  4. network-integrated decision support tools for clinicians
  5. opportunities for e-health delivery over the internet

Medical Education via Innovation in-Technology (MediTec)

# Information Technology in the Healthcare System of the Future (Cont.)

- **Objectives/Topics**
  - Welcome and course introduction Evolution of cyber medicine
  - Industry overview: the future of healthcare
  - Federal policy as a driver for HIT innovation
  - eHRs, pHRs & xHRs!
  - The role of innovation in enterprise computing
  - Classroom simulation for a product design process
  - From disease management to population health management
  - Patient power; medical home; patient-centric care
  - funding sources for for-profit and social entrepreneurship
  - Innovation
  - Entrepreneurs panel

- **Prerequisites:**
  - None

Medical Education via Innovation in-Technology (MediTec)

# Introduction Information Systems Security

- **Course Description**
  - Introduces students to the various elements of information systems security. Topics include information security planning, logical and physical security design, security plan implementation and administration, and legal and liability issues surrounding information systems. Students explore various security threats and learn how to protect an organization against malicious attacks through processes that ensure confidentiality, availability, and data integrity.

- **Learning Objectives**

  By the end of this course, students will be able to:

  1. Recognize network vulnerabilities. (Example: routers, switches and wireless access points.)
  2. Recognize application vulnerabilities. (Example: Microsoft Office, web browsers, shareware.)
  3. Recognize operating system vulnerabilities.
  4. Propose changes to remediate network vulnerabilities.
  5. Propose changes to remediate application vulnerabilities.
  6. Propose changes to remediate operating system vulnerabilities.
  7. Distinguish between access control methods.
  8. Distinguish between authentication methods.
  9. Identify the components of a disaster recovery plan.

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# Introduction Information Systems Security (Cont.)

- **Objectives/Topics**
  - Access Control Systems and Methodology
  - Telecommunications and Network Security
  - Security Management Practices
  - Cryptography
  - Security Architecture and Models
  - Business Continuity Planning and Disaster Recovery Planning
  - Laws, Investigations, and Ethics
  - Physical Security

- **Prerequisites:**
  - None

Medical Education via Innovation in-Technology (MediTec)

# Cybersecurity in Healthcare

- **Course Description**
  - This course begins by introducing the opportunities and challenges that digitalization of healthcare services has created. It explains how the rise of technologies and proliferation of (medical) data has become an attractive target to cybercriminals, which is essential in understanding why adequate cybersecurity measures are critical within the healthcare environment. In later modules, course contents cover the threats, both inside and outside of healthcare organizations like e.g. social engineering and hacking. Module 4 on Cyber Hygiene describes how to improve cybersecurity within healthcare organizations in practical ways. Module 5 looks deeper into how organizational culture affects cybersecurity, the cybersecurity culture, focusing on the interaction between human behavior and technology and how organizational factors can boost or diminish the level and attention to cybersecurity in healthcare.

- **Learning Objectives**

  By the end of this course, students will be able to:

  1. You will gain an understanding of the role of digitalization and cybersecurity in the healthcare context
  2. You will learn about different ways to improve and maintain cybersecurity, highlighting the interaction between technology and human behavior
  3. You will learn about the opportunities and threats that the healthcare sector faces due to digitalization and the proliferation of (medical) data
  4. You will discover how a positive cybersecurity culture is an important influence on an organization's

  level of cybersecurity

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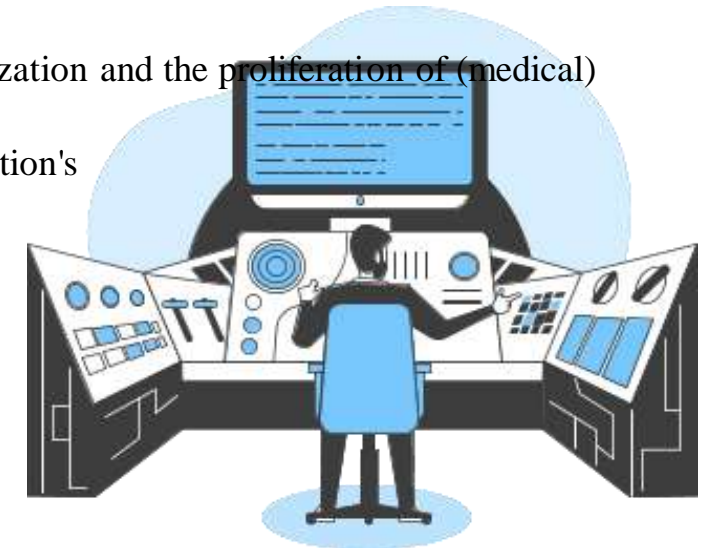
# Cybersecurity in Healthcare (Cont.)

- **Objectives/Topics**
    - Cybersecurity in healthcare: technology, data, and human behavior
        - What is cybersecurity
        - Challenges and opportunities for healthcare
        - Types of data in healthcare
        - Digital medical technologies
        - Threats to cybersecurity in healthcare
    - Social aspects of cybersecurity: social engineering and social media
        - Human behavior in cybersecurity
        - Social engineering
        - Social media use
    - Data breaches, hackers, and malware in healthcare
        - Data breaches
        - Introduction to hacking
        - Malware

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# Cybersecurity in Healthcare (Cont.)

- **Objectives/Topics**
  - Cyber hygiene: practices to improve cybersecurity
    - Cyber hygiene
    - Digital communication and safe emailing
    - Encryption
    - Device management
    - Password management
    - Software, updates, and backups
  - Security culture: creating positive environment to practice cybersecurity

- **Prerequisites:**
  - Introduction Information Systems Security

Medical Education via Innovation in-Technology (MediTec)

# Digital Health

- **Course Description**
    - The course offers students basic frameworks and a starting point in their journey into the world of digital health. This is achieved through interactive discussion, guest lectures and group projects. The goal is to disseminate key terminology, processes and concepts, thus preparing students for leading digital health projects, across disciplines. The course is divided into three broad themes- Business, Technical / Medical and Culture. The curriculum has been constructed as a roadmap for leveraging technological innovation to improve holistic performance and outcomes. Lectures are presented in an experiential, case learning format combining exposure to design, technology, informatics, innovation and data science, implementation and business development.

- **Learning Objectives**

    By the end of this course, students will be able to:

    1. Provide deep understanding of the fundamentals underlying digital health in a clinical setting
    2. Build skills for digital health project analysis, management and implementation across cultures, including US, China, India, Israel
    3. Gain experience in planning digital health projects
    4. Determine and validate the business and strategic drivers for successful digital health implementation
    5. Strategic analysis frameworks for navigating the digital health landscape
    6. Innovation Thinking applied toward digital health, including design thinking, intrapreneurship, business model canvas, minimum viable product (MVP), ideation and lean startup applied toward digital health
    7. Practice exercises building on core concepts and frameworks

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# Digital Health (Cont.)

- **Objectives/Topics**
  - Healthcare System Overview
  - Barriers to IT Adoption Health Systems
  - Ideation
  - Business Model Canvas
  - Healthcare Marketing
  - Biomedical Informatics:
  - Patient Centered Outcomes and the Health System of the Future
  - Regulatory Issues in Digital Health
  - Design Thinking
  - The Future of Medicine- a Clinician's Perspective.

- **Prerequisites:**
  - None



Medical Education via Innovation in-Technology (MediTec)

# The Data Science of Health Informatics

- **Course Description**
  - This is achieved through Health data are notable for how many types there are, how complex they are, and how serious it is to get them straight. These data are used for treatment of the patient from whom they derive, but also for other uses. Examples of such secondary use of health data include population health (e.g., who requires more attention), research (e.g., which drug is more effective in practice), quality (e.g., is the institution meeting benchmarks), and translational research (e.g., are new technologies being applied appropriately). By the end of this course, students will recognize the different types of health and healthcare data, will articulate a coherent and complete question, will interpret queries designed for secondary use of EHR data, and will interpret the results of those queries.

- **Learning Objectives**

  By the end of this course, students will be able to:

  1. Articulate different forms of clinical and population level data.
  2. Describe the data required to answer a healthcare information problem.
  3. Distinguish between data questions and data queries when dealing with a healthcare information problem.

Medical Education via Innovation in-Technology (MediTec)

# The Data Science of Health Informatics (Cont.)

- **Objectives/Topics**
  - Introduction to Databases and Data Types
    - Introduction to Databases
    - Databases in Clinical Informatics
    - Common Data Types
    - Emerging Data Types
  - Data Sources and Data Challenges
    - Common Clinical Data Sources
    - Population-Level Data Sources
    - Data Challenges
  - Formulating Data Questions
    - Formulating a Data Query
    - Real World Data Questions
  - Real World Applications of Data Science in Health Informatics

- **Prerequisites:**
  - None

Medical Education via Innovation in-Technology (MediTec)

# Electronic Health Records in the Medical Practice

- **Course Description**
    - An introduction to the electronic health record (EHR). Students will study the use of the EHR in improving healthcare quality, accessibility, and cost-effectiveness. EHR implementation and its use within the internal clinical office will be examined. The EHR will be studied in the context of a comprehensive Health Information System (HIS) supporting our society's interdisciplinary clinical healthcare system.

- **Learning Objectives**

    By the end of this course, students will be able to:

    1. Articulate different forms of clinical and population level data.
    2. Define the terminology associated with the EHR
    3. Describe how implementation of the EHR improves patient quality, access, and cost-savings within the context of an interdisciplinary healthcare system.
    4. Analyze the characteristics of the Electronic Health Record (EHR) as a component of a comprehensive Health Information Systems (HIS).
    5. Understand the role of EHR software for improving workflow efficiency within the context of a medical clinic.
    6. Identify privacy and security concerns involving the adoption and use of the EHR.
    7. Utilize an EHR software package to: document patient care; create electronic orders; search, sort, and filter data; analyze clinical trends; improve workflow efficiency; generate reports, flow sheets, and anatomic drawings; and improve patient safety through clinical accuracy. .

Medical Education via Innovation in-Technology (MediTec)

# Electronic Health Records in the Medical Practice (Cont.)

- **Objectives/Topics**
    - The ONC and EHR Terminology
    - Overview of the Electronic Health Record (HER)
    - Clinical Workflow and Coding Systems
    - Data Capture & Functional Benefits
    - Data Entry at the Point of Care and Electronic Orders
    - Longitudinal Patient Records, Problem List, Flow Sheets, & Anatomical Drawings
    - Using the EHR to Improve Patient Health
    - Privacy and Security
    - Using the Internet to Expedite Patient Care
    - EHR Coding for Reimbursement, EHR & Health Information Exchange and Population Health Functions of the HER

- **Prerequisites:**
    - None

Medical Education via Innovation in-Technology (MediTec)

# Telemedicine and Imaging Informatics

- **Course Description**
  - Telemedicine is a rapidly developing application of clinical medicine where medical information is transferred through interactive audiovisual media for the purpose of consulting, and sometimes remote medical procedures or examinations. Dermatology, radiology, and pathology are common specialties that are conducive to asynchronous telemedicine. Radiology in Telemedicine, called Teleradiology, is the most popular use for telemedicine and accounts for at least 50% of all telemedicine usage. Teleradiology is the ability to send radiographic images (x-rays, CT, MR, PET[5]/CT, SPECT/CT, MG, US...) from one location to another.

- **Learning Objectives**

  By the end of this course, students will be able to:

  1. Execute formal training in areas of technology applied to healthcare including computer sciences and telecommunication technologies to facilitate the deployment of telemedicine.
  2. Understand the basic requirements for the delivery of telemedicine services.
  3. Differentiate and apply telemedicine technologies and practices in a variety of health care environments.
  4. Be aware of basic knowledge of the Telemedicine Standards.
  5. The course will also be committed as a public awareness tool to promote and advocate the use of advanced communication technology to expand health care outreach and overcome geographic barriers to deliver patient care and education.

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# Telemedicine and Imaging Informatics (Cont.)

- **Objectives/Topics**
  - Healthcare Delivery in Low Resource Settings by using Advanced Technologies
    - Healthcare in high- and low-resource settings.
    - Healthcare distributions in Low resource settings and corresponding problems.
    - Definition of telemedicine for low-resource settings.
    - Block diagram of telemedicine system in low-resource settings.
    - Telehealth, Telecare, Teleradiology, Teleoncology, Telesurgery Telecatriology scope, Benefits.
    - Potential and limitations of Telemedicine and Tele-Health in low resource settings
    - Basic structures of Telemedicine and Tele-Health in low resource settings
    - Legal and ethical issues in Low resource settings
  - Introduction of Telemedicine
    - Why use Telemedicine?
    - History
    - Terminology
    - Types of Telemedicine Systems
    - Examples of Telemedicine in Clinical Practice
    - Values to the Patient, Clinician, and Health Care Organization
    - Challenges to Successful Implementation  Internet in Medicine

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# Telemedicine and Imaging Informatics (Cont.)

- **Objectives/Topics**
  - 3. Clinical
    - Medical images
    - Electronic Medical Records
  - 4. Technical
    - Site Selection and Planning
    - Telemedicine Systems
    - Connectivity Options
    - Bandwidth Limitations
    - Asynchronous vs. Real-time Interactive
    - Data applications
    - The World Wide Web

- **Prerequisites:**
  - Mathematics
  - Physics
  - Mat lab

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# Mobile Health (mHealth) Technology

- **Course Description**
  - The course will cover theories of health Advances in communications, computer, and medical technology have facilitated the practice of personalized health, which utilizes sensory computational communication systems to support improved and more personalized healthcare and healthy lifestyle choices. The current proliferation of broadband wireless services, along with more powerful and convenient handheld devices, is helping to introduce real-time monitoring and guidance for a wide array of patients. Indeed, a large research community and a nascent industry is beginning to connect medical care with technology developers, vendors of wireless and sensing hardware systems, network service providers, and data management communities. Students in the course and labs will explore cutting-edge technologies in 1) mobile computing technologies and 2) healthcare/medical applications, through lectures, lab assignments, exams, presentations, and final projects. The overall course objectives are to introduce electrical engineering, computer engineering, and computer science students the fundamentals of wearable sensors, mobile health informatics, big data analysis, Internet of Things (IoT), and human computer interaction considerations.

## Learning Objectives

By the end of this course, students will be able to:

1. Draw the general model of a personalized health system, describe the function of each of the blocks, define technical terms relevant to the model, and the data mining modules.

2. Design mobile app to transmit medical and health data across wireless channels and understand the wearable sensor sensing, sampling, and communication principles.

3. Survey state-of-art wireless-sensor-based hardware. This includes wearable IMU, force sensor, head mounted display, and other wearable sensor design.

4. Learn to search scientific studies using CWRU library resources and use Latex for technical writing.

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# Mobile Health (mHealth) Technology (Cont.)

- **Objectives/Topics**
    - Overview mHealth Technology and Applications.
    - Mobile Computing and Application Development using Android
    - Android User Interface and Data Collection
    - Mobile-Health: Using Mobile Computing for Remote Monitoring
    - Machine Learning Algorithms for Data Analysis
    - Vision-based Technologies for Human Computer Interaction
    - Big Data Analysis Tool and Evaluation Metrics
    - Smartphone and Microcontroller Communication
    - Bless and Curse: Limitations of the Mobile and IoT Environment

- **Prerequisites:**
    - Programming

Medical Education via Innovation in-Technology (MediTec)

# Health Informatics & Emerging Healthcare Technologies

- **Course Description**
  - This course provides a fundamental understanding health informatics, healthcare information systems, and emerging healthcare technologies, starting with the core informatics competencies and the foundation of knowledge model. Key topics will include: cognitive science, legal and ethical aspects, HIPAA privacy and security regulations, systems development life cycle, electronic security, electronic health records, patient engagement, community health, telehealth, data mining, IT certifications, evidence-based practice and translational research. The course will also provide an in-depth look at current technologies to include wearable sensor-based systems for health monitoring and prognosis and the use of mobile health (mHealth) applications in the medical and healthcare sectors to gain an understanding of their emerging role in health informatics.

- **Learning Objectives**

  By the end of this course, students will be able to:

  1. Apply core health informatics principles to examine emerging health care technologies and their role in acquisition, transmission, processing, storage, and retrieval of medical and healthcare sector information.

  2. Apply the systems development life cycle (SDLC) process to a case scenario to fit with the strategic alignment of an organization.

  3. Identify and discuss the key elements of the HIPAA Security Rule in relation to current HIPAA violations.

  4. Identify barriers- legal, ethical, and regulatory issues associated with technology-based connection and engagement strategies.

  5. Define the roles of federal, state, and local public health agencies in the development of public health informatics.

  6. Evaluate evidence-based practice and translational research related to health Informatics and emerging healthcare technologies

Medical Education via Innovation in-Technology (MediTec)

# Health Informatics & Emerging Healthcare Technologies (Cont.)

- **Objectives/Topics**
    - Course Introduction & Syllabus
    - Introduction to Information, Information Science, and Information Systems
    - Computer Science and the Foundation of Knowledge Model
    - Introduction to Cognitive Science, Informatics and Artificial Intelligence
    - Ethical and Legal Aspects of Health Informatics
    - Systems Development Life Cycle: Informatics and Organizational Decision Making
    - Administrative Information Systems
    - The Human– Technology Interface
    - Electronic Security Infographic assignment
    - Informatics Tools to Promote Patient Safety, Quality Outcomes, and Interdisciplinary Collaboration
    - Informatics Tools to Support Healthcare Professionals Education and Continuing Education
    - Bioinformatics, Biomedical Informatics, and Computational Biology

- **Prerequisites:**
    - None

Medical Education via Innovation in-Technology (MediTec)

# Healthcare Technology Management

- **Course Description**

  - This course provides students with a basic understanding of the principles of healthcare technology planning and management - assessment, budgeting, acquisition, deployment, education/training, patient safety, maintenance, and replacement/disposal. Planning and management will focus on medical devices, clinical information systems, and converged technologies.

- **Learning Objectives**

  By the end of this course, students will be able to:

  1. To give students a basic understanding of the guiding principles of healthcare technology planning and management

  2. Provide a methodology for improving the quality of medical devices, clinical information systems and converged technology through effective planning, and management

  3. Help students better communicate with technical staff, clinicians, regulators, administrators, and technology vendors.

  4. Develop the student's interest, and prepare them for further study and more advanced application of the principles.

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# Healthcare Technology Management (Cont.)

- **Objectives/Topics**
  - Healthcare technology management (HTM) overview
  - Medical devices and systems
  - Healthcare Information Technology
  - Convergence of Medical Devices and Information Technology
  - Technology planning and policy
  - New Technology Assessment
  - Technology Replacement Planning
  - Net Present Value Analysis
  - Technology Acquisition and Deployment

- **Prerequisites:**
  - None

Medical Education via Innovation in-Technology (MediTec)

# Ethical Issues, Security Management and Compliance

- **Course Description**

  - As indicated by its title, this course is intended to cover three broad subject areas in health information management. The fifteen lessons are organized into three modules. Module I includes Lessons 1 and 2, which give a broad-stroke introduction to medical laws, ethics, and healthcare information security management. Module II comprises nine lessons, Lessons 3 to 11, which teach most of the crucial elements in information security management. Topics covered range from security planning, policies and procedures, models and standards, risk assessment and management, protection mechanisms, to personnel issues. The final four lessons (12 to 15) in Module III progressively introduce the legal system and its influence on healthcare, the issues surrounding medical records and their digitization, patient data confidentiality, HIPAA regulation, and other laws affecting the healthcare industry. Compliance with regulations will also be taught from a practical perspective

- **Learning Objectives**

  By the end of this course, students will be able to:

  1. Execute formal training in areas of technology applied to healthcare including computer sciences and telecommunication technologies to facilitate the deployment of telemedicine.

  2. Understand the relationship between medical ethics and laws, and know how to apply ethical decision making models.

  3. Achieve a comprehensive understanding of the general framework of information security management in healthcare

  4. Understand the critical components of information security management including planning, policy development and enforcement, security management models, risk management, and basic protection mechanisms against security threats.

  5. Perform a cost benefit risk analysis of system security applications. 5.

  6. Apply healthcare policies and laws, as well as the regulatory trends. 6. Develop a basic compliance program for a healthcare organization.

Medical Education via Innovation in-Technology (MediTec)

# Ethical Issues, Security Management and Compliance (Cont.)

- **Objectives/Topics**
    - Fundamentals of Ethics in Medicine and Information Security Management
        - Introduction to Law, Ethics, and Security Management
        - Ethical and Bioethical Issues in Medicine
    - Management of Information Security in Organizations
        - Information Security Planning
        - Information Security Policy
        - Information Security Program
        - Information Security Management Models
        - Risk Management
        - Protection Mechanisms
        - Personnel Issues

# Ethical Issues, Security Management and Compliance (Cont.)

- **Objectives/Topics**
  - The Legal Environment of Medical Information and Compliance with Healthcare Laws
    - The U.S. Legal System and Its Importance to Healthcare
    - The Medical Record
    - Patient Confidentiality and HIPAA
    - Compliance Today and in the Future

- **Prerequisites:**
  - Health Information Systems
  - Health Information Management

Medical Education via Innovation in-Technology (MediTec)

# Healthcare law

- **Course Description**
  - A study of the national crisis in health care and some leading proposals for reform. Topics include issues of health care need, cost and quality control, Medicare and Medicaid, access to health care, the business roles of health institutions, health care contracts and claims, right to treatment, and federal health plans vs. private health coverage.

- **Learning Objectives**

  By the end of this course, students will be able to:

  1. Define and evaluate the distribution of Health Care as a resource
  2. Distinguish the legal concepts incorporated in the delivery of healthcare involving both the providers of care and the consumers of that care
  3. Analyze the measurement of quality within the healthcare delivery system as well as the practitioners who render that care ☐ Examine the financial aspects of healthcare delivery
  4. Interpret current status of reform efforts on the current state of healthcare
  5. Assess the role of government in the delivery of healthcare including access, control, costs, and financing
  6. Discuss the challenges in representing clients within and among the healthcare industry.

Medical Education via Innovation in-Technology (MediTec)

# Healthcare law (Cont.)

- **Objectives/Topics**
  - Cost, Quality, Access, and Choice
  - Patient Safety
  - Quality Control Regulation
  - Professional-Patient Relationship
  - Informed Consent
  - Professional Liability
  - Malpractice Defenses
  - Institutional Liability
  - Tort Liability and Reform
  - Health Care Cost/Access
  - Private Health Insurance and Managed Care
  - Health Care Financing

- **Prerequisites:**
  - None

Medical Education via Innovation in-Technology (MediTec)

# Leadership for Quality, Safety and Health Policy

- **Course Description**
    - The principles, and factors germane to leadership will be explored in relation to complex organizations and the development of leadership styles and policy making within microsystems, mesosystems, and macro-systems to transform those healthcare systems..

- **Learning Objectives**

    By the end of this course, students will be able to:

    1. Integrate scientific findings from nursing and related sciences, including genetics and genomics, into the delivery of advanced nursing care to populations in diverse settings.

    2. Demonstrate organizational and systems leadership to assure ethical and critical decision-making at all systems' levels for quality and patient safety.

    3. Incorporate performance improvement strategies for quality, safety, and patient-centered care delivery.

    4. Use improvement science to achieve optimal patient care and care environment outcomes.

    5. Integrate meaningful and usable information systems and healthcare technologies to support safe, quality patient care and healthcare systems effectiveness.

    6. Lead inter-professional teams using collaborative strategies to effect quality patient care and population health outcomes.

    7. Analyze and incorporate broad ecological and social health determinants to design and deliver evidence-based clinical prevention and population healthcare and services to individuals, families, and aggregates/identified populations.

    8. Integrate the advanced competencies expected of a master's prepared nurse to design, deliver, and evaluate outcomes of systems of care for individuals, families, and diverse populations.

Medical Education via Innovation in-Technology (MediTec)

# Leadership for Quality, Safety and Health Policy (Cont.)

- **Objectives/Topics**
  - Leadership theories
  - Organizational structure and behavior
  - Chaos and complexity
  - Change theory and leadership for quality outcomes
  - Conflict resolution strategies, Crisis management and Emotional competence
  - Toxic organizations and workplace violence
  - Consultation and inter-professional collaboration
  - Innovation in healthcare, quality and safety
  - Risk management: Learning through error and transforming punitive cultures
  - Leadership and advocacy
  - Ethical dimensions of advanced nursing roles
  - Legal implications related to advanced nursing roles:  scope of practice, credentialing, state and national regulation
  - Policy formulation and implementation in healthcare and the influence of political and economic forces.
  - Legislation impacting employers including the current legal and regulatory climate, workforce and healthcare systems

- **Prerequisites:**
  - None

Medical Education via Innovation in-Technology (MediTec)

# Leadership in Complex Healthcare Systems

- **Course Description**
  - Individual development of leadership skills for the transformation of healthcare and nursing practice is the focus of this course with emphasis on innovation and change. This course prepares nurses to assume leadership in complex healthcare systems through advanced communication, team building, conflict & board management, decision making, and collaborative skills.

- **Learning Objectives**

  By the end of this course, students will be able to:

  1. Analyze personal characteristics that facilitate and pose barriers to effective leadership, team building, conflict and board management, decision making and collaboration.
  2. Critique effective communication and collaborative skills in the development and implementation of practice models, peer review, practice guidelines, health policy, standards of care and other scholarly products.
  3. Apply decision-making models as they relate to innovation and change.
  4. Explore opportunities and challenges in leading intra/inter-professional teams in the analysis of complex practice and organizational issues.
  5. Evaluate consultative models with intra /inter-professional teams to create change in healthcare and complex healthcare delivery systems.

Medical Education via Innovation in-Technology (MediTec)

# Leadership in Complex Healthcare Systems (Cont.)

- **Objectives/Topics**
  - Executive leadership for complex situations
    - Inventories of leadership style
    - Self reflection
  - Tools for executive leadership
    - Advanced communication
    - Conflict management
    - Decision making model
    - Facilitating design driven innovation
    - Systems Thinking for Change
    - Board Management
    - Team Building
  - Consultative models
  - Adaptive leadership

- **Prerequisites:**
  - Leadership for Quality, Safety and Health Policy



Medical Education via Innovation in-Technology (MediTec)

# Consumer Health Informatics

- **Course Description**
  - Consumer health informatics (CHI) is a rapidly-expanding area of informatics practice, with career opportunities emerging in the public, non-profit and private sectors. Broadly, the field aims to give individual health care consumers, as well as their families and communities, the information and tools that they need to help them become more involved in their health and health care. In this course, students will become familiar with a range of CHI applications, including the needs/problems that the applications address, their theoretical bases, their technical architectures, and relevant evaluation results. Building on this prior CHI work, students will acquire an ability to evaluate existing applications, and to generate theory-informed design and implementation strategies for CHI applications. Students will also learn to assess the needs and technological practices of potential users, with a particular focus on groups that experience health and information access disparities, and to select appropriate evaluation approaches based on an application's technological maturity.

- **Learning Objectives**

  By the end of this course, students will be able to:

  1. Compare and evaluate a range of consumer health informatics (CHI) applications.

  2. Generate CHI design and implementation principles and guidelines that incorporate theories from the behavioral, social and environmental sciences.

  3. Assess consumers' health-related needs, resources and technology-oriented practices, and evaluate their implications for CHI applications.

  4. Plan the design, implementation and evaluation of a new, theory-informed CHI application to address the health need(s) of a particular audience.

  5. Develop a commitment to CHI practice with diverse user groups.

Medical Education via Innovation in-Technology (MediTec)

# Consumer Health Informatics (Cont.)

- **Objectives/Topics**
  - Introduction
  - Health behavior change
  - Socio-cognitive theory (SCT) to the design of consumer health
  - Tracking, Records and Remote Monitoring
  - Consumer health informatics (CHI) applications.
  - Theory-informed CHI application
  - Social support and informal care
  - Community and Environmental Health

- **Prerequisites:**
  - None

Medical Education via Innovation in-Technology (MediTec)