Syllabus

94-706 Healthcare Information Systems – Spring 2024

1005 HbH
Class Time: M, W, 11:00am - 12:20pm ET
Recitation: Friday, 5:00pm – 6.20pm ET

Instructional Staff

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Introduction

Healthcare systems worldwide are under tremendous pressure on all fronts – cost, quality of care, access, and efficiency. Rapidly growing population segments, such as the elderly and disadvantaged, and increasing rates of chronic disease and complex health conditions are demanding efficient and effective care delivery that is outpacing supply of trained healthcare professionals and accessible facilities. The ongoing worldwide pandemic has further increased disparities in access and outcomes, but also accelerated adoption of information, communication and decision technologies for multi-modal care delivery at scale.

In the US, healthcare costs have reached more than 18% of the GDP but care quality and outcomes are falling behind other industrialized countries. Successive scientific reports by the National Academy of Medicine have called for wide adoption of Information Technology (IT) and advanced data analytics to improve access, quality of care, safety and efficiency, and reduce costs. IT and analytics have thus emerged as potentially powerful enablers in helping to achieve multiple goals within and across the healthcare eco-system.

The explosive advances in IT and analytics, particularly powered by the creation of vast data repositories in recent years, is also enabling new models of healthcare delivery. This has created the need for skilled individuals who can understand, develop, manage, and integrate clinical and administrative information, technologies, and systems to support timely and informed decision making by all stakeholders. Healthcare Informatics has been named one of the top careers in *U.S. News & World Report*, and the American Medical Informatics Association (www.amia.org) estimates that the US will need several thousand professionals trained in informatics immediately!

This course will provide a broad overview of the application of major information systems methodologies and approaches in the delivery and administration of modern healthcare systems. The development and use of decision support systems in the context of the Electronic Health Record (EHR) and associated clinical information systems, and mobile, ehealth and social media platforms for consumer self-health and public health management, enabled by interoperability via data and technology standards, and regulatory mechanisms, will be a major focus of the course.

Audience
The course is appropriate for graduate students who want to understand the landscape and role of information, communication and decision technologies in healthcare delivery and management and the interactions between the technologies, data analytics and healthcare challenges and opportunities in the current environment.

Learning Outcomes: Students should be able to:

1. Understand and appreciate the role and value of information, communication and decision technologies in potentially revolutionizing healthcare delivery, administration, education, and research;

2. Distinguish the various types of healthcare information, including knowledge, data, sources, processes and standards;

3. Identify major healthcare informatics applications and develop basic familiarity with healthcare IT products;

4. Analyze obstacles and success factors for implementation and integration of information, communication and decision technologies in healthcare using established frameworks;

5. Discuss the technical and policy implications of introducing informatics applications into healthcare for process efficiency and quality of care;

6. Develop teamwork skills to mediate the communication between healthcare professionals and information technology personnel; and,

7. Acquire hands-on experience in studying a problem arising in healthcare delivery and conceptualizing and implementing a solution using a healthcare informatics approach.

Course Structure
This course will be taught in discussion format via instructor, guest speakers, and student presentations, case study analyses, and software demonstrations. A semester-long group project is a cornerstone of this course that provides students with hands-on experience in conceptualizing, designing and implementing healthcare information systems.

Course Materials
Required materials: Harvard Business School Cases and Articles (all students MUST purchase the course pack; it is a violation of intellectual property agreements to copy HBS materials from each other)

Coursepack link: https://hbsp.harvard.edu/import/1138331

Weekly lectures will be published on the course site on canvas: https://canvas.cmu.edu/

Lists of recommended books, journals, magazines and articles are also available on the course website. Students will be guided to additional, multi-media-rich course materials to identify issues, obtain perspectives, review application demos and gain knowledge of current uses of information technology in healthcare.

Student Activities
Students are expected to participate actively in class discussions and discussion forum on Canvas, work cooperatively and independently on weekly assignments, present summaries on focused topics, analyze and debate two Harvard Business School (HBS) cases, complete two exams, and conceptualize, design, implement, and demo the final project - a working prototype of a healthcare decision support system application.

Grading Criteria
The final grade will be determined by the following five components:

1. Assignments and presentations:		20%
2. Two HBS case discussions (group effort):		15%
3. Exam 1 (closed materials):	on Monday, February 19	15%
4. Exam 2 (closed materials):	on Monday, April 1	15%
5. Final project proposal (group effort):	due Wednesday, March 13	5%
6. Final Project (group effort) and peer evaluations:	due Friday, April 26	30%

Expectations for the grading components:

- All students must be fully prepared for classes. This includes completing readings and homework for each class, preparing summary and critiques of the readings as specified, exploring and presenting IT solutions on relevant topics, and being an involved discussant in class.
- Analyze, present and discuss two **HBS cases** in a logical, clear and in-depth manner. The format for the case discussion sessions will be provided prior to submission.
- The 2-page **project proposal** should outline the problem you intend to explore using a DSS approach. Include the motivation and context, a brief overview of the requirements that need to be addressed, the dataset you will utilize and 3 DSS questions that will be answered by your IT-enabled solution. A sample proposal is available on Canvas.
- You will use MySQL for database + Python packages for data analytics to implement the healthcare-related decision support application. The project deliverables will include a written report, final presentation slides, and a working prototype application (using MySQL+Python). This technology prototype of a Healthcare Decision Support System (due in the final week of the semester) will investigate issues associated with a specific healthcare industry problem from the perspective of a key stakeholder. Stakeholders may be providers, patients, caregivers, insurers, state and federal governments, IT vendors, or the general consumer.
  - Examples include predictive analytics for complex clinical conditions, e-health initiatives, mobile health initiatives, ACO models, compliance reporting, claims administration, patient safety initiatives, medication management and disease management.
- The final project report should include several components that are listed later.

- **What is a healthcare Decision Support System?**

A decision support system (DSS) can be defined as any computer system composed of data management and analysis tools, designed to support decision-making. In this course, one can broadly think of three main types of decision support systems: clinical, administrative and consumer/public-focused (public health, patient self-management, etc.). Clinical decision support systems help to improve delivery of healthcare by supporting health professionals to make more informed clinical decisions. Administrative decision support systems help management professionals, such as finance, operational and human resource managers, to make decisions to improve management and organization of healthcare resources. Consumer focused decision support systems support patients, caregivers and the public in proactive self-health management, wellness care and population health management.

The underlying conceptual architecture of a generic decision support system consists of a user interface component, problem processing/analytics system, and knowledge/data system (Holsapple and Whinston, 1996). The user interface component of a DSS helps the user to access the system (for instance, an electronic health record) and interact with it. The knowledge system is a systematically organized collection of knowledge that is accessible electronically and interpretable by the computer. A database, data warehouse, or a medical knowledge base consisting of a vocabulary with relationships that capture the medical literature and expert domain knowledge, are examples of knowledge systems. The problem processing system provides a reasoning strategy or analytical approach to harness the knowledge system. An example is the set of drug-drug interaction rules that can be applied to a database of drugs before a transaction takes place. Patient data in the form of an electronic medical record makes up the final database component that triggers the rules when the patient is prescribed a new medication.

- **Check List for Final Project Report**

The report, composed as a Word document in 12point font and double-spaced, should not exceed 20 pages, including references and appendices. It should be justified on both sides and include page numbering, appropriate section titles, and references. The final in-class presentation and prototype demo by each group should not exceed 15 minutes. The final report should include all the following components. All components, including any security feature that has been implemented using password protection functionality, should be submitted as a zipped file to the course Canvas site by Friday, April 26.

- Describe the problem and the context such as what is the problem, why is it a problem, who are the stakeholders, the potential role of IT in providing an effective decision support solution strategy for the problem, etc.
- Describe the policy and management issues relevant to your specific problem
- Describe the key activities associated with the process and depict the process model for your problem
- Identify a software vendor and product that provide a potential solution to the problem
- Discuss the gaps between the existing product and the specific requirements of your problem
- Explain the major components of your IT solution and their content by mapping the decision support requirements of the problem, including the impact of standards and HIPAA, on the technology architecture of your IT solution
- Describe the data sources used, the data elements extracted from these sources and the structure of your final database (submit the dataset along with the rest of your project components)
- Apply the PEIT framework to develop an implementation and deployment plan for your DSS application
- Examine the solution for "what-if" scenarios
- Policy implications of your project (both health policy and IT policy)
- Conclusions and specific recommendations
- Peer Evaluation will be included in the grading of the project

Note: The final presentation may include a relevant subset of the above components.

Assignment Due Dates

Requests for extensions of assignment due dates or for course incompletes will be granted only for medical reasons with evidence of medical need.

Students with Disabilities

If you have a qualifying disability, please feel free to request accommodation from the instructor. In addition, Carnegie Mellon recommends that you contact Equal Opportunity Services (EOS). Contact EOS Coordinator at eos@andrew.cmu.edu or check for further information at https://www.cmu.edu/hr/resources/hr-partners/eos.html.

Academic Integrity: Cheating and Plagiarism

The Heinz College prepares students for positions of public trust, and therefore must uphold the highest standards of academic integrity. As the instructor of this course, I am committed to this principle and intend to enforce it rigorously. All work presented in this class must be accurately represented for what it is, with every source clearly identified. Creative, original thinking is valued, as is a capability to tap into the wealth of accumulated knowledge. I expect and require that submitted work be an honest representation of what each student has done. Sources found in books, magazines, newspapers and the web must be properly cited. Discussions with friends, family and fellow students must be identified. Use of AI tools such as ChatGPT must be reported.

As a student in this class, you must accept responsibility for the work that you submit. You must be much more than a collector of other people's ideas and expressions and produce your independent work. You will benefit greatly from in-class discussions and discussions outside of the classroom of topics covered in the course. Go beyond this to put your individual stamp on each thing that you do. Be fair and honest in clearly indicating what has been the source of and inspiration for your work. Infractions of this policy will not be tolerated and can lead to failure of the course and dismissal from the College.

See also the "Carnegie Mellon University Policy on Cheating and Plagiarism." Students will be expected to be familiar with this policy which can be found on the web at: https://www.cmu.edu/policies/student-and-student-life/academic-integrity.html. Consult the Student Handbook for Academic Disciplinary Actions at: https://www.cmu.edu/student-affairs/theword/academic-discipline/index.html.

Healthcare Information Systems - Spring 2024 Class Schedule			
Week	**Date**	**Class Content**	**Due Dates**
Week 1	Jan 17	What is Healthcare Informatics? Course Overview	
	Jan 19	No review session	
Week 2	Jan 22	Process Fundamentals - Motivation and Modeling Constructs	
	Jan 24	Process Modeling and Analysis: Models and Metrics	HW 1
	Jan 26	Process Modeling Review	
Week 3	Jan 29	Process Modeling and Analysis: Metrics and Methods	
	Jan 31	Process Modeling and Analysis: PEIT Framework	HW 2
	Feb 2	Process Analysis Review	
Week 4	Feb 5	Electronic Health Records (EHR): Demo & Content	
	Feb 7	Electronic Health Records (EHR): Technology & Adoption	HW 3
	Feb 9	EHR review	
Week 5	Feb 12	Introduction to Healthcare Decision Support Systems (DSS)	
	Feb 14	Computerized Physician Order Entry (CPOE) & Electronic Prescribing (eRx)	HW 4
	Feb 16	Exam 1 Review	
Week 6	Feb 19	**Exam 1**	
	Feb 21	HIPAA & Health IT Privacy, Security and Confidentiality	Project ideas submission
	Feb 23	Review Session: DSS project proposal discussion	
Week 7	Feb 26	HBS Case 1 Analysis	Case Study 1
	Feb 28	HBS Case 1 Analysis (contd.)	
	Mar 1	No Review Session	
Week 8	Mar 4	SPRING BREAK – NO CLASSES	
	Mar 6	SPRING BREAK – NO CLASSES	

	Mar 8	SPRING BREAK – NO CLASSES	
Week 9	Mar 11	Data Analysis Life Cycle	
	Mar 13	Model-based DSS: A Statistical Approach	Project proposal
	Mar 15	Review Session: DSS lab session I	
Week 10	Mar 18	Healthcare Data and Technology Standards	HW 5
	Mar 20	Healthcare Data and Technology Standards (contd.)	
	Mar22	Review Session: DSS lab session II	
Week 11	Mar 25	Model-based DSS: A Machine Learning Approach	HW 6
	Mar 27	Model-based DSS: An Optimization Approach	
	Mar 29	Exam 2 Review	
Week 12	Apr 1	**Exam 2**	
	Apr 3	eHealth technologies and applications	
	Apr 5	DSS Project Review Session	
Week 13	Apr 8	HBS Case 2 Analysis	Case Study 2
	Apr 10	HBS Case 2 Analysis (contd.)	
	Apr 12	Spring Carnival – no recitation session	
Week 14	Apr 15	mHealth technologies and applications	HW 7
	Apr 17	Interoperability - Health Information Exchanges	
	Apr 19	DSS Project Review Session	
Week 15	Apr 22	Final Project Presentation and Prototype Demo	Final project due
	Apr 24	Final Project Presentation and Prototype Demo	
	Apr 26	HW peer evaluations and DSS project peer evaluations	Peer evaluations