Syllabus

94-706 Healthcare Information Systems – Spring 2021

Class Time: M, W, 10:10am - 11:30am
Recitation: Friday, 4.50pm – 6.10pm

Instructional Staff

Instructor: **Dr. Rema Padman**
Trustees Professor of Management Science and Healthcare Informatics
Web: https://www.heinz.cmu.edu/faculty-research/profiles/padman-rema
Office: 2101D Hamburg Hall
Phone: (412) 268-2180
Email: rpadman@cmu.edu
Office Hours: M, W 11.30am – 12.30pm or by appointment

Teaching Assistants & TA Hours:
Xinyu Yao (xinyuyao@andrew.cmu.edu), Saturday from 12 noon till 1:30 pm ET
Arpita Tripathi (arpitat@andrew.cmu.edu), Friday from 12 noon till 1:30 pm ET

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 care delivery at scale.

In the US, healthcare costs have reached almost 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, efficiency and quality of care, 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 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;

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/801400

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, 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 on weekly assignments, present summaries on focused topics, analyze and debate two Harvard Business School (HBS) cases, complete a midterm exam, 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.	Course Exam 1 (closed materials):	on Wednesday, March 3	15%
4.	Course Exam 2 (closed materials):	on Wednesday, April 7	15%
5.	Final project proposal (group effort):	due Monday, March 22	5%
6.	Final Project (group effort) and peer evaluations:	due Monday, May 10	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 1-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, and 3 DSS questions that will be answered by the IT-enabled solution. A sample proposal is available on Canvas.
- You will use the Microsoft Office suite (Word, Excel, Access, and PowerPoint) to implement a healthcare-related, desktop, decision support application. The project will include a written report (using Word), a hallway poster and presentation slides (using PowerPoint), and a prototype application (using Access and Excel), all linked to each other. The integration of all the components is an important requirement of the prototype. 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 include providers, patients, 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 address
  - who are the stakeholders
  - what is the problem
  - why this is a problem
  - what proposals have been made for resolution
  - what is the status of the proposal and
  - what is the role of IT in providing an effective decision support solution strategy for the problem. Discussion of the role of IT also requires identification of a major vendor of software products for the problem, and identification of the gaps in existing solutions to the problem.

- **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-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 and wellness care.

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 patient 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 May 10.

- Describe the problem and the context
- 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
- Apply the PEIT framework to develop an implementation and deployment plan for your DSS application
- Examine the solution for "what-if" scenarios

- Conclusions and specific recommendations
- Peer Evaluation will be included in the grading of the project

Note: The 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.

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 2021 Class Schedule			
Week	**Date**	**Class Content**	**Deadline**
Week 1	Feb 1	What is Healthcare Informatics? Course Overview	
	Feb 3	The Case for Healthcare Informatics: Illustrative Examples of Clinical, Consumer and Public Health Informatics	
	Feb 5	No review session	
Week 2	Feb 8	Process Fundamentals - Motivation and Modeling Constructs	HW 1 due
	Feb 10	Process Modeling and Analysis: Models and Metrics	
	Feb 12	Process Modeling Review	
Week 3	Feb 15	Process Modeling and Analysis: Metrics and Methods	HW 2 due
	Feb 17	Process Modeling and Analysis: PEIT Framework	
	Feb 19	Arena Simulation Tutorial	
Week 4	Feb 22	Electronic Health Records (EHR): Demo & Content	HW 3 due
	Feb 24	Electronic Health Records (EHR): Technology & PEIT model	

	Feb 26	Exam review	
Week 5	Mar 1	Electronic Health Records (EHR): Technology & Adoption	HW 4 due
	Mar 3	**Exam 1**	
	Mar 5	Review Session: DSS project proposal discussion	
Week 6	Mar 8	Healthcare Data and Technology Standards	HW 5 due
	Mar 10	Healthcare Data and Technology Standards (contd.)	
	Mar 12	Review Session: DSS lab session I	
Week 7	Mar 15	Guest speaker – Highmark Health	Final project proposal due
	Mar 17	Introduction to Healthcare Decision Support Systems (DSS); Computerized Physician Order Entry (CPOE) & Electronic Prescribing (eRx)	
	Mar 19	NO CLASSES	
Week 8	Mar 22	HBS Case 1 Analysis	Case Study 1 due
	Mar 24	HBS Case 1 Analysis (contd.)	
	Mar 26	Review Session: DSS lab session II	
Week 9	Mar 29	Data Analysis Life Cycle – Guest Speaker; Model-based DSS: A Machine Learning Approach	HW 6 due
	Mar 31	Model-based DSS: An Optimization Approach	
	Apr 2	Exam Review	
Week 10	Apr 5	NO CLASSES	
	Apr 7	**Exam 2**	
	Apr 9	Review Session: DSS lab session III	
Week 11	Apr 12	HBS Case 2 Analysis	Case Study 2 due
	Apr 14	HBS Case 2 Analysis (contd.)	
	Apr 16	Final Project Review Session	
Week 12	Apr 19	mHealth technologies and applications	HW 7 due
	Apr 21	eHealth technologies and applications – Mayo Clinic	
	Apr 23	Final Project Review Session	
Week 13	Apr 26	HIPAA & Health IT Privacy, Security and Confidentiality	HW 8 due
	Apr 28	Interoperability - Health Information Exchanges	
	Apr 30	Final Project Review Session	
Week 14	May 3	Public Health Informatics I	HW 9 due
	May 5	Public Health Informatics II – Global health	
	May 7	Final Project Review Session	
Week 15	May 10	Final Project Presentation and Prototype Demo	Final project due
	May 12	Final Project Presentation and Prototype Demo	
	May 14	HW peer evaluations and Final project peer evaluations	Peer evaluations due