

Course Syllabus

#	LECTURE TITLE	LEARNING OBJECTIVES	CORE CONTENT AREAS COVERED
	WELCOME AND OVERVIEW	<ol style="list-style-type: none"> 1. Briefly review history of the newly established subspecialty of clinical informatics 2. Describe what the course developers know about the board certification exam 3. Describe the course structure 	None
1A	HISTORY AND CURRENT STATE OF INFORMATICS	<ol style="list-style-type: none"> 1. Define the terminology surrounding informatics and related disciplines and professions 2. Describe major milestones in history of informatics 3. Describe the major milestones in the evolution of the medical record (e.g., SOAP, EHR, PHR) 4. Define the major people and organizations in informatics 	1.1. Clinical Informatics <ol style="list-style-type: none"> 1.1.1 The discipline of informatics <ol style="list-style-type: none"> 1.1.1.1 Definitions of informatics 1.1.1.2 History of informatics 1.1.1.3 Domains/subspecialties of informatics 1.1.1.4 Careers in informatics 1.1.1.5 Professional organizations 1.1.1.6 Current & future challenges for Informatics 1.1.2 Key informatics concepts, models, and theories 1.1.3 Clinical Informatics Literature 1.1.4 International clinical informatics practices
1B	ETHICS, PRIVACY, LEGAL, AND REGULATORY ISSUES IN INFORMATICS	<ol style="list-style-type: none"> 1. Be familiar with international codes of practice and ethical codes relevant to clinical informatics. 2. Understand US legal and regulatory rulings most relevant to clinical informatics. 3. Understand oversight of clinical computing activities by local bylaws and compliance groups. 	<ol style="list-style-type: none"> 1.1.5 Ethics and professionalism 1.1.6 Legal and regulatory issues
1C	THE HEALTH SYSTEM	<ol style="list-style-type: none"> 1. Describe the structure and function of the US healthcare system 2. Understand the current problems and proposed solutions for the US healthcare system 3. Describe the vision captured in the Institute of Medicine reports over the last two decades and the context they set for informatics 	1.2. The Health System <ol style="list-style-type: none"> 1.2.1 Determinants of individual and population health 1.2.2 Primary domains, organizational structures, cultures, and processes <ol style="list-style-type: none"> 1.2.2.1 Health care delivery 1.2.2.2 Public health 1.2.2.3 Clinical research 1.2.2.4 Education of health professionals 1.2.2.5 Personal health 1.2.3 The flow of data, information, and knowledge within the health system

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			<p>1.2.4 Policy & regulatory framework</p> <p>1.2.5 Health economics and financing</p> <p>1.2.6. Forces shaping health care delivery</p> <p>1.2.7 Institute of Medicine quality components</p> <p> 1.2.7.1. Safety</p> <p> 1.2.7.2 Effectiveness</p> <p> 1.2.7.3 Efficiency</p> <p> 1.2.7.4 Patient-centeredness</p> <p> 1.2.7.5 Timeliness</p> <p> 1.2.7.6 Equity</p>
2A1	CLINICAL DECISION-MAKING	<ol style="list-style-type: none"> 1. Describe everyday techniques of decision-making and potential biases. 2. Understand the relevance of “choice under uncertainty” to medical decisions. 3. Demonstrate how decision analysis can be used to model complex decisions 4. Understand how definitions of utility and patient preference impact the value of an outcome. 5. Understand how cost effectiveness analysis can be used to make decisions about allocation of constrained healthcare resources. 6. Define sensitivity, specificity, PPV, and NPV using the syntax “the probability of X given Y”. 7. Understand applicability/limitations of sensitivity, specificity, PPV, and NPV to clinical decision-making, disease screening, and diagnostic testing. 	<p>2.1 Clinical Decision Support</p> <p>2.1.1 The nature and cognitive aspects of human decision making</p> <p> 2.1.1.1 General</p> <p> 2.1.1.2 Medical</p> <p>2.1.2 Decision science</p> <p> 2.1.2.1 Decision analysis</p> <p> 2.1.2.2 Probability theory</p> <p> 2.1.2.3 Utility & preference assessment</p> <p> 2.1.2.4 Cost effectiveness analysis</p> <p> 2.1.2.5 Test characteristics</p>
2A2	APPLIED DECISION-SUPPORT	<ol style="list-style-type: none"> 1. Describe the difference between interruptive/modal and non-interruptive/modeless alerts with possible applications to Clinical Decision Support (CDS) systems 2. Classify CDS interventions by area of clinical care (prevention, diagnosis, treatment, follow-up, care planning). 3. Classify CDS interventions by intervention intent (reminder, information, recommendation, corrective action / alerting). 4. Classify CDS interventions by intended audience. 	<p>2.1.3 Application of clinical decision support</p> <p> 2.1.3.1 Types of decision support</p> <p> 2.1.3.2 Users of decision support</p> <p> 2.1.3.3 Implementing, evaluating, and maintaining decision support tools</p>

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		<ol style="list-style-type: none"> 5. Describe the “five rights” of an effective CDS intervention. 6. Understand common limitations of evaluations of CDS interventions and ways to overcome these limitations. 7. Explain how interoperability, clinical terminology, and guideline representation standards could be used to facilitate broader adoption of CDS tools. 8. Describe common strategies for maintaining and updating decision support tools, and the risks of not having these strategies in place. 	
2A3	KNOWLEDGE ACQUISITION AND USE FOR CLINICAL DECISION SUPPORT	<ol style="list-style-type: none"> 1. Compare and contrast the various approaches to representing knowledge in clinical decision support systems from the past and present 2. Describe known problems of safety with health IT systems and how they can be minimized 3. Understand the current legal and regulatory framework for clinical decision support 	<ol style="list-style-type: none"> 2.1.4 Transformation of knowledge into clinical decision support tools <ol style="list-style-type: none"> 2.1.4.1 Knowledge generation 2.1.4.2 Knowledge acquisition 2.1.4.3 Knowledge modeling 2.1.4.4 Knowledge representation 2.1.4.5 Knowledge management and maintenance 2.1.5 Legal, ethical, and regulatory issues 2.1.6 Quality and safety issues 2.1.7 Supporting decisions for populations of patients
2B1	EVIDENCE-BASED MEDICINE	<ol style="list-style-type: none"> 1. Apply the principles of evidence-based medicine to clinical practice, from formulating an appropriate clinical question to finding and applying evidence 2. Critically appraise a clinical study addressing one of the fundamental clinical question types: treatment, diagnosis, harm, and prognosis 3. Be able to use common evidence grading schemes and apply them in information systems 4. Describe the structure, function, and limitations of clinical practice guidelines 5. Implement clinical guidelines in electronic health record systems 	<ol style="list-style-type: none"> 2.2 Evidence-based Patient Care <ol style="list-style-type: none"> 2.2.1 Evidence sources 2.2.2 Evidence grading 2.2.3 Clinical guidelines 2.2.4 Implementation of guidelines as clinical algorithms

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2B2	INFORMATION RETRIEVAL AND ANALYSIS	<ol style="list-style-type: none"> 1. Identify the major search systems used by clinicians and be able to use advanced features within them to retrieve the most relevant content 2. Identify the major search systems used by patients and be able to provide resources for their most effective use 3. Help clinicians and patients find the highest quality information possible for application in health and clinical decisions 	2.2.5 Information retrieval & analysis 2.1.5.1 Search skills 2.1.5.2 Critical analysis of biomedical literature
2C1	CLINICAL WORKFLOW ANALYSIS AND PROCESS REDESIGN	<ol style="list-style-type: none"> 1. State the components of a Workflow Analysis effort, and key questions that should be considered in the design of a Workflow study. 2. Understand the difference between Quantitative and Qualitative data collection methods. 3. Identify different methods of mapping and recording workflow data in the healthcare setting, and recognize what type of data each method is best suited to record. 4. Recognize the practical considerations and limitations of conducting observational fieldwork. 5. Recognize common types of questions that may be answered via analysis of workflow data. 6. Compare the impact that the design of a system, versus the people who work in a system, has on system performance (e.g., patient safety). 7. Recognize the contributions of timeliness and high reliability to the success of Workflow Re-engineering/ Process Redesign in the Healthcare Setting. 8. Recognize that more than one model of Workflow Re-engineering exists, and identify the benefits of applying a consistent model within and across a particular healthcare system. 9. Identify key components of a Workflow Re-engineering effort 	2.3 Clinical Workflow Analysis & Process Redesign 2.3.1 Methods of workflow analysis 2.3.2. Principles of workflow re-engineering

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2C2	HEALTHCARE QUALITY IMPROVEMENT	<ol style="list-style-type: none"> 1. Define healthcare quality from the standpoint of a patient, a healthcare provider, a society/community, and a payor; understand that these definitions are sometimes challenging to reconcile. 2. Distinguish healthcare quality indicators – structure, process, and outcomes 3. Understand that there are numerous well-established quality improvement (QI) frameworks in use in healthcare, such as Toyota Lean, Six Sigma, and Associates for Process Improvement (API); describe high-level concepts associated with each. 4. Describe how Ishikawa/fishbone diagrams and Pareto charts can be used to identify targets for QI efforts. 5. Describe a Plan-Do-Study-Act cycle 6. Understand the applicability of Control Charts to evaluation of healthcare QI efforts 7. Distinguish Control Charts from evaluation methods based on hypothesis testing, such as randomized trials. 	2.3.3 Quality improvement principles and practice
3A1	COMPUTER PROGRAMMING AND METHODS OF SOFTWARE DEVELOPMENT	<ol style="list-style-type: none"> 1. Understand high level differences between imperative, procedural, and object-oriented programming languages. 2. Give examples of common data structures; use the example of date representations to illustrate how choice of data structure influences its use. 3. Using pseudo-code, be able to define a clinical rule using each of the following control structures: "IF-THEN-ELSE", "CASE", "FOR loop", and "WHILE loop". 4. Recognize that different software development methodologies exist and that each has different approaches to requirement gathering, scope definition, and risk mitigation. 5. Understand at a high level how software systems may be 	3.1 Information Technology Systems 3.1.1 Computer Systems 3.1.1.1 Programming 3.1.1.2 Data and control structures 3.1.1.3 Software development methods 3.1.1.4 System integration 3.1.1.5 Quality

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		<p>integrated through interfaces, messaging standards, and web services.</p> <ol style="list-style-type: none"> 6. Distinguish "black-box" and "white-box" software testing. 7. Distinguish software verification and software validation. 8. Give clinical examples of software testing strategies such as beta testing, testing, and regression testing following system enhancement. 	
3A2	SYSTEMS, DATABASES, NETWORKS	<ol style="list-style-type: none"> 1. Distinguish hierarchical, relational, and object-oriented databases; list one advantage and disadvantage of each. 2. Understand how a UML Entity Relationship (ER) diagram can be used to describe the logical schema of a database. 3. Understand how the suite of UML diagrams are used to model a process and assist in software development and maintenance. 4. Understand how update, insert, and deletion anomalies in databases are prevented through database normalization. 5. Understand how denormalization of a database can be used to optimize certain queries, for example, in a clinical datamart. 6. Describe some of the common network topologies, such as star, tree, and bus networks. 7. Recognize the names and uses of common telecommunications standards. 	<p>3.1.1.6 Information systems design and analysis</p> <p>3.1.2 Architecture</p> <p>3.1.2.1 Systems</p> <p>3.1.2.2 Networks</p> <p>3.1.2.3 Data/database</p> <p>3.1.3 Networks</p> <p>3.1.3.1 Topologies</p> <p>3.1.3.2 Telecommunications</p>
3A3	SECURITY	<ol style="list-style-type: none"> 1. Understand key elements of the HIPAA Security Rule. 2. Understand policy, and technical measures to protect the security of identified patient health information. 3. Be familiar with 3 of these measures (firewalls, VPNs, and encryption) and the security context in which they are used. 	<p>3.1.4 Security</p> <p>3.1.4.1 The HIPAA Security Rule and other government regulations</p> <p>3.1.4.2 Firewalls</p> <p>3.1.4.3 Virtual private networks</p> <p>3.1.4.4 Encryption</p>

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3A4	HEALTHCARE DATA REUSE: CHALLENGES AND STRATEGIES	<ol style="list-style-type: none"> 1. Describe the use and limitations of clinical data for patient care and other uses 2. Understand the flow of data in clinical systems from collection to storage to analysis 3. Describe the uses and challenges for identification and anonymization of patient data 	<ol style="list-style-type: none"> 3.1.5 Data <ol style="list-style-type: none"> 3.1.5.1 Integrity 3.1.5.2 Mapping 3.1.5.3 Manipulation (e.g., querying, SQL, reporting) 3.1.5.4 Representation and types 3.1.5.5 Warehousing 3.1.5.6 Data mining and knowledge discovery 3.1.6 Technical approaches that enable sharing data <ol style="list-style-type: none"> 3.1.6.1 Integration versus interfacing 3.1.6.2 Dealing with multiple identifiers 3.1.6.3 Anonymization of data
3B	HUMAN COMPUTER INTERACTION	<ol style="list-style-type: none"> 1. Give examples of clinical errors that can be prevented through the application of human factors engineering principles. 2. Contrast usability inspection and usability testing 3. Understand the three components of discount usability engineering: scenario/mockups, simplified think-aloud exercise, and heuristic evaluation 4. Recognize commonly accepted standards of good interface design 	3.2 Human Factors Engineering <ol style="list-style-type: none"> 3.2.1 Models, theories, and practices of human-computer (machine) interaction (HCI) 3.2.2 HCI Evaluation, usability testing, study design and methods 3.2.3 Interface design standards and design principles 3.2.4 Usability engineering
3C	HEALTH INFORMATION SYSTEMS AND APPLICATIONS	<ol style="list-style-type: none"> 1. Understand architecture, technical and computing infrastructure underlying health information systems (HIS). 2. Understand breadth of HIS functionality and topics historically challenging to physicians. 3. Know telemedicine application areas and types. 	3.3 Health Information Systems and Applications <ol style="list-style-type: none"> 3.3.1 Types and functions offered by systems 3.3.2 Types of settings where systems are used 3.3.3 Electronic health/medical records systems as the foundational tool 3.3.4 Telemedicine
3D1-3	CLINICAL DATA STANDARDS	<ol style="list-style-type: none"> 1. Describe the importance and limitations of standards in clinical information systems 2. Discuss the major types of standards and their roles in clinical information systems 3. Define identifier standards and the major standards used for them 4. Define transaction standards and the major standards used for them 5. Define messaging standards and 	3.4 Clinical Data Standards <ol style="list-style-type: none"> 3.4.1 Standards development history and current process 3.4.2 Data standards and data sharing 3.4.3 Transaction standards 3.4.4 Messaging standards 3.4.5 Nomenclatures, vocabularies, and terminologies 3.4.6 Ontologies and taxonomies

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		<p>the major standards used for them</p> <p>6. Describe the major terminology standards in biomedicine, their uses, and their limitations</p>	<p>3.4.7 Interoperability standards</p>
3E1-2	IMPLEMENTATION AND OPERATION OF CLINICAL INFORMATION SYSTEMS	<p>1. Define several institutional governance models for clinical information systems</p> <p>2. List formal and informal methods to define and specify system requirements, and solicit vendor proposals</p> <p>3. Describe system conversion strategies and their relative merits</p> <p>4. Describe elements of a system implementation plan</p> <p>5. Describe key elements of clinical system operations and maintenance program.</p>	<p>3.5 Information System Lifecycle</p> <p>3.5.1 Institutional governance of clinical information systems</p> <p>3.5.2 Clinical information systems needs analysis and system selection</p> <p>3.5.3 Clinical information system implementation</p> <p>3.5.4 Clinical information system testing</p> <p>3.5.5 Clinical information system maintenance</p>
3E3	EVALUATION OF CLINICAL INFORMATION SYSTEMS	<p>1. Describe the measurement of outcomes and quality from use of clinical information systems</p> <p>2. Design an evaluation study of a clinical information system</p>	<p>3.5.6 Clinical information system evaluation</p> <p>3.5.6.1 Outcomes relevant to the clinical goals and quality measures</p> <p>3.5.6.2 Qualitative and quantitative methods for evaluating clinical information systems</p> <p>3.5.6.3 Evaluation plan design</p>
4A	LEADERSHIP MODELS, PROCESSES AND PRACTICES	<p>1. Identify dimensions of effective leadership and their relationship to successful management of technological change in the healthcare settings.</p> <p>2. Identify elements of good organizational governance that support effective technological change in healthcare settings.</p> <p>3. Recognize the contributions of effective techniques in Negotiation, Conflict Management, Collaboration, Motivation, and Decision Making for technological change in healthcare organizations.</p>	<p>4.1 Leadership Models, Processes, and Practices</p> <p>4.1.1 Dimensions of effective leadership</p> <p>4.1.2 Governance (e.g., processes; responsibility versus authority)</p> <p>4.1.3 Negotiation</p> <p>4.1.4 Conflict management</p> <p>4.1.5 Collaboration</p> <p>4.1.6 Motivation</p> <p>4.1.7 Decision making</p>
4B	BUILDING EFFECTIVE HEALTHCARE IT TEAMS	<p>1. Describe the different types of human expertise required for a team to be successful with a clinical information systems implementation plan</p> <p>2. List Human Resource factors that should be considered ahead of time when planning to recruit</p>	<p>4.2 Effective Interdisciplinary Teams</p> <p>4.2.1 Human resources management (e.g., hiring, performance reviews and feedback, professional development, termination)</p> <p>4.2.2 Team productivity and effectiveness (e.g., articulating</p>

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		<p>internally or externally for positions on a healthcare IT team</p> <ol style="list-style-type: none"> 3. List factors that are critical to a team's ability to work together effectively, and to be successful in turning out product 4. Discuss the characteristics of Team Goals that are likely to promote team effectiveness 5. Identify and characterize three processes commonly employed in Group Management 6. Describe elements for successful management of team meetings, and techniques for management of group deliberations 	<p>team goals, defining rules of operation, clarifying individual roles)</p> <ol style="list-style-type: none"> 4.2.3 Group management processes (e.g., nominal group, consensus mapping, Delphi method) 4.2.4 Managing meetings 4.2.5 Managing group deliberations
4C	COMMUNICATION STRATEGIES	<ol style="list-style-type: none"> 1. Distinguish between rich and lean types of communication 2. Identify the differences among three change concepts: Roger's "Diffusion of Innovations" concept, Lewin's Change Theory, and Bridge's Transition Theory, and discuss how each may apply to one-on-one or group communication during the execution of a clinical information system project in the healthcare setting 3. Identify 2 "new" modes or channels of communication that have been promoted by the use of Electronic Health Records in the healthcare setting 4. Give an example of when written communication would be most effective in a clinical information systems implementation. State how that written communication may need to differ with respect to informing clinical staff, versus informing patients, versus informing hospital board members of project plan expectations 5. State the effect of too much information on human performance and on communication effectiveness 6. Understand the pivotal role of a comprehensive communication plan in any information management project plan. 	<p>4.3 Effective Communications</p> <ol style="list-style-type: none"> 4.3.1 Effective presentations to groups 4.3.2 Effective one-on-one communication 4.3.3 Writing effectively for various audiences and goals 4.3.4 Developing effective communications program to support system implementation

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4D	PROJECT MANAGEMENT	<ol style="list-style-type: none"> 1. State the basic principles of Project Management 2. Define the "triple constraint" in Project Management planning 3. Identify five major process groups in the Project Management Lifecycle 4. Identify four major components of an effective Project Plan 5. Describe strategies in Project Planning that help to avoid scope creep 6. List Tools useful in Project Management 	4.4 Project Management <ol style="list-style-type: none"> 4.4.1 Basic principles 4.4.2 Identifying resources 4.4.3 Resource allocation 4.4.4 Project management tools (non-software specific) 4.4.5 Informatics project challenges <ul style="list-style-type: none"> - Scope creep - Managing expectations - Balancing competing priorities
4E-1	STRATEGIC PLANNING FOR CLINICAL INFORMATION SYSTEMS	<ol style="list-style-type: none"> 1. Understand the critical importance of aligning Strategic and Financial Planning for Clinical Information Systems, including mission statement and objectives, with the healthcare organization's overall strategic plan 2. Comprehend the basic tenets of three models of strategic planning for health IT (pull model, push model, component alignment model), and how they may be used to guide strategy formulation 3. Understand the benefit of performing a rigorous internal and external environmental scan of IT and CIS resources prior to formulating a long range strategic plan 4. Identify the components of sound strategy formulation, action plan development, and strategy implementation 	4.5 Strategic and Financial Planning for Clinical Information Systems <ol style="list-style-type: none"> 4.5.1 Establishing mission and objectives 4.5.2 Environmental scanning 4.5.3 Strategy formulation 4.5.4 Action planning and strategy implementation
4E-2	FINANCIAL PLANNING FOR CLINICAL INFORMATION SYSTEMS	<ol style="list-style-type: none"> 1. Understand general principles of capital and operating budgeting as they pertain to clinical information systems 2. Understand general principles of managerial accounting 3. Understand key financial concepts used in financial planning for clinical information systems 	<ol style="list-style-type: none"> 4.5.5 Capital and operating budgeting 4.5.6 Principles of managerial accounting 4.5.7 Evaluation of planning process
4F	CHANGE MANAGEMENT	<ol style="list-style-type: none"> 1. Understand Change management as an ongoing organizational process, rather than a means to a single event 2. Recognize the relevance of "People" and "Process" factors 	4.6 Change Management <ol style="list-style-type: none"> 4.6.1 Assessment of organizational culture and behavior 4.6.2 Change theories (e.g., precede-proceed, social influence theories, complex adaptive

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		<p>with respect to organizational readiness and willingness to participate in change</p> <ol style="list-style-type: none"> 3. Recognize how the different change theories can help us to understand specific organizational behavior, and guide development of a successful Change Management Strategy 4. Identify key components of a Change Management Strategy, and discuss the features of each component 5. Understand how a change management strategy can be tailored to promote adoption and effective use of clinical information systems in a particular setting 	<p>systems)</p> <ol style="list-style-type: none"> 4.6.3 Change management strategies 4.6.4 Strategies for promoting adoption and effective use of clinical information systems
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