CURRICULUM

A Model Curriculum for an Emergency Medicine Residency Rotation in Clinical Informatics

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ABSTRACT:

Audience: This curriculum is designed for emergency medicine residents at all levels of training. The curriculum covers basic foundations in clinical informatics for improving patient care and outcomes, utilizing data, and leading improvements in emergency medicine.

Length of Curriculum: The curriculum is designed for a four-week rotation.

Introduction: The American College of Graduate Medical Education (ACGME) mandated that all Emergency Medicine (EM) residents receive specific training in the use of information technology.[1,2] To our knowledge, a clinical informatics curriculum for EM residents does not exist. We propose the following standardized and reproducible educational curriculum for EM residents.

Educational Goals: The aim of this curriculum is to teach informatics skills to emergency physicians to improve patient care and outcomes, utilize data, and develop projects to lead change.[3] These goals will be

achieved by providing a foundational informatics elective for EM residents that follows the delineation of practice for Clinical Informatics outlined by the American Medical Informatics Association (AMIA) and the American Board of Preventive Medicine (ABPM).[4–6]

Educational Methods: The educational strategies used in this curriculum include asynchronous learning via books, papers, videos, and websites. Residents attend administrative sessions (meetings), develop a project proposal, and participate in small group discussions.

The rotation emphasizes the basic concepts surrounding clinical informatics with an emphasis on improving care delivery and outcomes, information systems, data governance and analytics, as well as leadership and professionalism. The course focuses on the practical application of these concepts, including implementation, clinical decision support, workflow analysis, privacy and security, information technology across the patient care continuum, health information exchange, data analytics, and leading change through stakeholder engagement.

Research Methods: An initial version of the curriculum was introduced to two separate institutions and was completed by three rotating resident physicians and one rotating resident pharmacist. A brief course evaluation as well as qualitative feedback was solicited from elective participants by the course director, via email following the completion of the course, regarding the effectiveness of the course content. Learner feedback was used to influence the development of this complete curriculum.

Results: The curriculum was graded by learners on a 5-point Likert scale (1=strongly disagree, 5 = strongly agree). The mean response to, "This course was a valuable use of my elective time," was 5 (sd=0). The mean response to, "I achieved the learning objectives," and "This rotation helped me understand Clinical Informatics," were both 4.75 (sd=0.5).

Discussion: Overall, participants reported that the content was effective for achieving the learning objectives. During initial implementation, we found that the preliminary asynchronous learning component worked less effectively than we anticipated due to a lower volume of content. In response to this, as well as resident feedback, we added significantly more educational content.

In conclusion, this model curriculum provides a structured process for an informatics rotation for the emergency medicine resident that utilizes the core competencies established by the governing bodies of the clinical informatics specialty and ACGME.

Topics: Clinical informatics key concepts, including definitions, fundamental terminology, history, policy and regulations, ethical considerations, clinical decision support, health information systems, data governance and analytics, process improvement, stakeholder engagement and change management.

Key words: Informatics, Emergency Medicine, Curriculum, Education, Resident.

USER GUIDE

List of Resources:

Learner Audience:
Junior Residents, Senior Residents

Length of Curriculum:
The curriculum is designed for a four-week rotation. Residents have the option of continuing their project proposal longitudinally upon completion of the rotation, if approved.

Topics:
Clinical informatics key concepts, including definitions, fundamental terminology, history, policy and regulations, ethical considerations, clinical decision support, health information systems, data governance and analytics, process improvement, stakeholder engagement and change management.

Objectives:
Residents will gain an introduction of the broad field of clinical informatics, with a focus on the key applications of informatics in EM. By the end of this rotation, the learner will be able to:

1. State the value proposition of clinical informatics.
2. Describe the federal policies and legislation that influence the adoption of health information technology in the United States.
3. Propose ideas for planning, implementation and support necessary for the successful use of a clinical information system.
4. Explain the need for standards, clinical terminologies, and ontologies.
5. Analyze the roles of computerized provider order entry, clinical decision support systems, health information exchanges and interoperability as related to health care delivery.
6. Recognize the need for data governance and analytics.
7. Utilize informatics techniques to perform research and quality improvement projects.
8. Develop and present a realistic informatics-based project plan for a problem in their clinical environment, with the option to pursue further research or quality improvement.

Brief introduction:
As hospitals and health care providers increasingly rely on and interact with clinical information systems, there is a growing demand for formalized training in the field of clinical informatics. Clinical informaticians transform health care by analyzing, designing, implementing, and evaluating information and communication systems to enhance individual and population health outcomes, improve patient care, and strengthen the clinician-patient relationship.[3,4]

In 2011, the American Board of Medical Specialties approved Clinical Informatics as a subspecialty, recognizing the importance of information management in health care quality to promote patient care that is safe, equitable, efficient, effective, timely, and patient-centered.[4,7,8] Recent updates to these core competencies maintain and promote the specialty's position in the health care system.[5,6]

Successful optimization of health information systems depends on the knowledge and skills of the individuals who apply the

core concepts, methods, and skills of clinical informatics. As residents enter an increasingly digital medical world, education must adapt to equip students with the necessary tools to further advancements in clinical care and health systems. It has been suggested that informatics should be a part of all formal medical education.[9]

While many medical schools and residencies have added educational content related to information retrieval and basic use of electronic health records, only a few have expanded their curricula to include the myriad of other ways physicians interact with electronic health information including clinical decision support, quality measurement and improvement, personal health records, telemedicine, and personalized medicine, despite established undergraduate medicine competencies and curricula.[10,11] The use of health information technology permeates graduate medical practice, yet only a handful of residency programs and national organizations have designed, integrated, or recommended formalized informatics curriculum into their training programs.[12–17]

Informatics is especially relevant to the specialty and practice of Emergency Medicine (EM). The efficient management of information from the rapid processing, analysis, and interpretation of patient data in an emergent setting is crucial to patient outcomes. Through the widespread use of electronic health records feeding data to community resources, emergency physicians can monitor and better care for specific populations of patients, thus bridging the gap between personal and population health. The use of technology has become a requirement in EM training from both the American Board of Emergency Medicine (ABEM) Knowledge, Skills and Abilities (KSAs)[18] and the Emergency Medicine Milestones Project, a joint venture between ABEM and the Accreditation Council for Graduate Medical Education (ACGME).[2,19] Specifically, milestone Systems-Based Practice (SBP) 3 focuses on use of technology, while milestone SBP1 focuses on patient safety. Milestone SBP2 focuses on system-based management. Milestone Practice-Based Learning and Improvement (PBLI) focuses on the practice of evidence-based medicine, while Milestone Interpersonal and Communication Skills (ICS) 2 focuses on team management.[2,19]

Developing and updating resident competencies in informatics is essential for the future of EM as a specialty, yet informatics education in EM graduate training is often absent or inconsistent in the US and abroad.[20,21] Currently, few options exist for residents to gain exposure to this field. Residents in departments that also host ACGME accredited fellowships may receive more exposure, but only four of these programs were documented in 2018 by the Emergency Medicine Residents Association (EMRA),[22] though other clinical informatics programs offer EM tracks.[23] There are also distance learning opportunities, including AMIA's 10x10 course created by Oregon Health and Science University. One section of this course is held in conjunction with the American College of Emergency Physicians (ACEP) annually. However, these courses span many months and cost approximately $2,000, which may limit the number of EM residents who take the course.[24] A residency curriculum in clinical informatics could help ensure the development of EM physicians who are able to use the tools of informatics to improve care for patients.

Curriculum Development Framework

Using Kern's six-step approach to medical education curriculum development as a framework,[25] we developed a curriculum for EM clinical informatics education that aids the next generation of emergency physicians in utilizing clinical informatics during a graduate medical education elective. We included a thematic breakdown of vital topics in EM informatics, as well as suggested content and readings.

Problem identification, general and targeted needs assessment:

The American College of Graduate Medical Education (ACGME) mandates that all EM residents receive specific training in the use of information technology.[2,19] EM physicians routinely interact with clinical systems in their medical practice. The ABEM and the ACGME mandated that all EM residents receive specific training in the use of information technology to optimize learning, improve patient care, and accomplish and document safe health care delivery.[2,18] Currently, a widely accessible, standardized informatics curriculum is not available to train EM residents. As a result, exposure to foundational clinical informatics remains inconsistent between training programs, leaving many EM residents with a deficit in training. We propose the following standardized and reproducible educational curriculum for EM residents.

Goals of the curriculum:

The aim of this curriculum is to teach informatics skills to emergency physicians to improve patient care and outcomes, utilize data, and develop leadership abilities. These goals will be achieved by providing a foundational informatics elective for EM residents that follows the delineation of practice for clinical informatics outlined by the American Medical Informatics Association (AMIA) and the American Board of Preventive Medicine (ABPM).[5,6]

Objectives of the curriculum:

Residents will gain an introduction of the broad field of clinical informatics, with a focus on the key applications of informatics in EM. By the end of this rotation, the learner will be able to:

1. State the value proposition of clinical informatics.

2. Describe the federal policies and legislation that influence the adoption of health information technology in the United States.
3. Propose ideas for planning, implementation and support necessary for the successful use of a clinical information system.
4. Explain the need for standards, clinical terminologies, and ontologies.
5. Analyze the roles of computerized provider order entry, clinical decision support systems, health information exchanges and interoperability as related to health care delivery.
6. Recognize the need for data governance and analytics.
7. Utilize informatics techniques to perform research and quality improvement projects.
8. Develop and present a realistic informatics-based project plan for a problem in their clinical environment, with the option to pursue further research or quality improvement.

Educational Strategies:
The curriculum will offer an introductory study of the basic concepts surrounding clinical information systems, focusing on the practical application of these concepts within the realm of EM. Asynchronous coursework will be combined with experiential learning to create a robust educational experience that can be replicated and implemented at a variety of EM residency training programs.

The curriculum fulfills the ACGME requirements pertaining to information technology for EM programs.[1] These include:

- IV.B.1.d) Practice-Based Learning and Improvement
    - Residents must demonstrate the ability to investigate and evaluate their care of
    - patients, to appraise and assimilate scientific evidence, and to continuously
    - improve patient care based on constant self-evaluation and lifelong learning.
    - IV.B.1.d.(1) Residents must demonstrate competence in:
        - IV.B.1.d).(1).(g) using information technology to optimize learning.
        - IV.B.1.d).(1).(i) using information technology to improve patient care.
- IV.B.1.e) Interpersonal and Communication Skills
    - Residents must demonstrate interpersonal and communication skills that result in the effective exchange of information and collaboration with patients, their families, and health professionals.
    - IV.B.1.e).(1) Residents must demonstrate competence in:
        - IV.B.1.e).(1).(f) maintaining comprehensive, timely, and legible medical records, if applicable.
- IV.B.1.f) Systems-based Practice
    - Residents must demonstrate an awareness of and responsiveness to the larger context and system of health care, including the social determinants of health, as well as the ability to call effectively on other resources to provide optimal health care.
    - IV.B.1.f).(1).(d) working in interprofessional teams to enhance patient safety and improve patient care quality.
    - IV.B.1.f).(1).(i) using technology to accomplish and document safe health care delivery.

Informatics is a rapidly developing field. We suggest the rotation director be an EM physician with experience in the field of clinical informatics, preferably board eligible or board certified. While the educational system is growing with certifications and fellowships, we do not feel these are necessary for the EM residency informatics rotation instructor. Many experts in the field acquired knowledge through experience and self-education. Most of the rotation will take place in the hospital setting. Learners should have access to the institutional health system with basic literacy in information retrieval.

The goal of this curriculum is for residents in EM to build basic competency in the field of informatics through education and clinical application. They will expand their knowledge beyond data access and retrieval. They should understand the broader role of health information technology (HIT) in health care delivery, public health and clinical research, and quality improvement. Clinical informaticians draw from the field of biomedicine and informatics to apply these tools to the practice of medicine. As per the AMIA white paper on Core Content for the Subspecialty of Clinical Informatics, clinical informatics encompasses three spheres of activity: clinical care, the health system, and information and communications technology. Through this elective, residents will gain a better understanding of the five major categories that form the core content of informatics: fundamentals, improving care delivery and outcomes, health information systems, data governance and data analytics, and leadership and professionalism.[4–6]

<u>I. Fundamentals</u>
The first core concept focuses on learning the fundamentals and basic knowledge needed for students to understand the environment in which an informaticist functions. This includes the history of informatics, key informatics concepts, models and theories, commonly cited literature, and an overview of the

health system.[4] The EM resident does not need to understand the entirety of clinical informatics but should appreciate its history, read several landmark articles, and understand the role that EM informaticists play in the emergency department and hospital system. This includes speaking the vocabulary within the culture of informatics as well as the technical and legislative developments that prompted evolution in the field. The resident will learn about policy and regulatory framework that led to the IT (Information Technology) application of coding guidelines and privacy laws of the 1990s, the creation of the Office of the National Coordinator of Health IT in 2004, the adoption of Health Information Technology for Economic and Clinical Health (HITECH) Act of 2009 to promote meaningful use, as well as the ongoing implementation of the 21st Century Cures Act.[26]

Residents will acquire knowledge of the fundamentals of informatics through online resources, reading materials, participating in both department and hospital level operations and committee meetings as well as small group sessions. Additionally, residents will be encouraged to set up one-on-one meetings with university librarians to establish competency with medical literature database searches and information retrieval. They will also meet with Electronic Health Record (EHR) informatics analysts and/or clinical informaticists to learn the basics of their learning environment's EHR, hospital information systems and leadership organization structure. After residents have a foundational knowledge of the key concepts of clinical informatics, they will then have an opportunity to apply these ideas to their clinical workflows. The fundamentals of clinical informatics align with milestones SBP3.[2,19]

II. Improving Care Delivery and Outcomes

Implementing and integrating clinical decision-making and care process improvement is the second core concept. One of the goals of this elective is for EM residents to understand their own decision-making through effective information analysis. Important concepts include evidence-based medicine (EBM), clinical decision support (CDS), and process redesign.[4] While most students have a rudimentary understanding of clinical decision support and electronic health record capabilities, through independent readings and project assignments, they will understand how to optimize the system capabilities and become better advocates for patient care.

To accomplish this, they will review active and passive CDS in use in the ED, from order sets to interactive alerts, and gain an appreciation for the CDS maintenance processes. Furthermore, they will expand these skills to answer questions regarding individual, institutional, and community health practices. Residents will have the opportunity to apply informatics core concepts to identifiable gaps in the clinical setting and apply process redesign to address those problems. Improving Care Delivery and Outcomes aligns with milestones SBP1, SBP2, SBP3, PBL1 and ICS2.[2,19]

III. Health Information Systems

The third core concept focuses on health information systems and interoperability. Themes in this concept include computer programming, networks and databases, data security, clinical data standards and information system lifecycles.[4] Information systems are complex networks encompassing people, processes, and technology. As residents move into new roles beyond training, they must not only know how to use health systems, but also how to evaluate the effectiveness of a system in meeting clinical goals. They need to be able to critically assess the advantages and disadvantages of technological tools and interpret the quality of data produced. Residents should not be expected to learn computer programming but instead appreciate the advantages and limitations of information systems and their associated software.

They will accomplish these objectives through independent readings and online tutorials.

The final project in our curriculum will allow residents to develop an informatics-based solution to a problem in their clinical environment. They will explain how they would implement an optimization or introduce a new workflow to their EHR, and develop measures of the effectiveness of that change, in terms of clinician behavioral change or patient outcomes. These skills enable residents to evaluate the reliability of data, provide feedback, and integrate their solution to provide better patient care.

IV. Data Governance and Data Analytics

The fourth concept focuses on standards of data governance, policies, and processes.[5,6] Through readings and online didactics, residents will learn best practices for data use, privacy and security, as well as the "data life cycle" and need for data validation and management to optimize data sharing across systems.

EM residents will gain an understanding of the basic principles of analytics techniques, as well as machine learning, data visualization and natural language processing through independent reading and small group discussion. Residents will apply this knowledge in their final project, maintaining appropriate methodologies of data governance and utilizing their understanding of analytics to propose methods of assessment and interpretation of their described intervention.

V. Leadership and Professionalism

Finally, the fifth core concept focuses on the organization of health care institutions and techniques to effectively introduce change into these organizations. Themes include identifying and engaging with stakeholders, building interdisciplinary teams, and project management.[4] As medicine becomes increasingly interdisciplinary, physicians must foster collaboration and effect change at the organizational level. It is useful to understand how informatics decisions for the ED can impact a diverse array of stakeholders – from patients and front-line staff to social work and case management, consultants, inpatient and outpatient clinicians, as well as regulatory and compliance, legal and financial stakeholders.

While a single rotation will not allow for full development of leadership skills, EM residents will experience some aspects of managing teams, effective communication, and group management processes. It is expected that residents will observe and understand administrative leadership roles by attending meetings with departmental and hospital leadership. Examples of administrative leadership meetings include the following: clinical decision support committee, computerized provider order management committee, quality and utilization committee, medical informatics committee, physician advisory council, analytics council, process excellence committee, and clinical pathways committee.

Residents will gain a basic understanding of leadership and professionalism through the lens of clinical informatics through reading and online video instruction. The residents will apply the knowledge they gained of the five core competencies to a project with an informatics-based solution. This will be based on a problem in their clinical setting. Ideas may include clinical decision support, hospital information systems, data analytics, and leadership skills to enact change.

Through this introduction to clinical informatics, we hope residents will gain a better understanding of the framework of information systems, including processes to enhance medical decision making and improve patient care. Demand will increase in the EM community to invest in informatics initiatives. It is our obligation to train students to optimize available tools and develop new solutions to improve the future of medicine.

Curriculum Design

This curriculum aims to provide a model for a structured informatics rotation for EM residents that fulfills ACGME requirements by following the Core Content for Clinical Informatics outlined by the American Medical Informatics Association (AMIA) and the American Board of Preventive Medicine (ABPM).[4–6]

The authors performed a PubMed (National Center for Biotechnology Information, Bethesda, MD) and Google Scholar search for terms associated with EM residency informatics curricula. We were unable to identify any published EM residency curricula in clinical informatics. Informatics curricula from other non-EM specialties, non-Graduate Medical Education (GME) courses, and medical student electives were adapted to meet the needs of an EM resident.[10,11,15–17,20,22–24] Expert opinion on the fields of EM informatics and education were included for the curriculum design: authors Carrie Baker, Benjamin Slovis, Nicholas Genes and Jeffrey Nielson all hold leadership positions in ACEP with extensive experience in EM informatics education. Benjamin Schnapp is a medical education fellowship trained EM physician with experience in resident education and curriculum design. William Hersh and Vishnu Mohan are leaders in clinical informatics with numerous academic and educational contributions to the field.

Results and tips for successful implementation:

Four learners participated in an initial version of the curriculum and provided feedback via the standardized follow-up survey as well as comments on the curriculum. These results were used to further develop the curriculum into its current state. Surveys included a 5-point Likert scale with 1 indicating “strongly disagree” and 5 indicating “strongly agree.”

The mean response ,“This course was a valuable use of my elective time,” was 5 (sd=0). The mean response to, “I achieved the learning objectives,” and “This rotation helped me understand Clinical Informatics,” were 4.75 (sd=0.5).

Free-form feedback from participants was also received. Comments included: “I got a good experience out of this rotation. I was able to get a good feeling for what an informatics fellowship could be like.” Rotators found that the leadership component was particularly effective, reporting “The exposure to the daily workload and workflow of the fellows greatly helped me to understand and appreciate the role of clinical informatics. Attending various meetings with the network’s informatics team allowed me to see the power of teamwork and quality improvement projects.” Another learner commented, “It showed me the general mindset and process of thinking as a clinical informaticist in how data is collected, processed, and applied in the clinical setting to take data and create knowledge. I also learned some of the terminology and language used in informatics which is important in understanding and communicating in the field.”

Targeted learners are either second or third-year EM residents who are expected to be in good standing with the residency program. Residents will have approximately four weeks to complete the curriculum, with asynchronous learning

performed at their own pace. Didactic sessions and administrative sessions will be attended at set times based on the system, course director, and lecturer schedules. Residents may be given the opportunity to implement their proposal after completion of the rotation as a longitudinal project.

Evaluation and Feedback:
Residents will provide feedback in a standardized follow-up survey administered to each resident after the rotation. Additionally, residents are expected to present their project proposal to the appropriate governing committee for feedback (ED leadership, EM core faculty, Quality Improvement Committee, Project Management Office, Business Development, etc.) The leadership reviewers will provide feedback in a standardized follow-up survey.

Comments from the initial rotators influenced modifications to the curriculum including further development of small group discussion topics and increasing emphasis on operational informatics.

Associated Content:
Appendix A. Curriculum Chart
Appendix B. Project Proposal Assignment
Appendix C. Sample Attendance Sheet and Time Log
Appendix D. Asynchronous Learning: Books, Papers, Videos, Websites
Appendix E. Small Group Discussions
- Appendix E.1. Clinical Informatics (CI) Fundamentals
  - Appendix E.1.a. CI Fundamentals PPT
  - Appendix E.1.b. CI Fundamentals Instructor Materials
  - Appendix E.1.c. CI Fundamentals Learner Materials
- Appendix E.2. Improving Care Delivery and Outcomes
  - Appendix E.2.a. Care Delivery Outcomes CDS PPT
  - Appendix E.2.b. Care Delivery Outcomes CDS Form
- Appendix E.3. Data Analytics and Governance
  - Appendix E.3.a. Data Analytics Governance PPT
  - Appendix E.3.b. Data Analytics Governance Instructor Material
  - Appendix E.3.c. Data Analytics Governance Learner Material
- Appendix E.4. Leadership and Professionalism
  - Appendix E.4.a. Leadership PPT
  - Appendix E.4.b. Leadership Form

Appendix F. Sample Schedule
Appendix G. Sample Survey

References/suggestions for further reading:

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DIDACTICS AND HANDS-ON CURRICULUM

Topic	Recommended Educational Strategy	Educational Content	Objectives	Learners	Timing, Resources Needed (Space, Instructors, Equipment, Citations of JETem pubs or other literature)	Recommended Assessment, Milestones Addressed
Clinical Informatics Fundamentals	Asynchronous Learning, Administrative Sessions, Faculty Presentation, Small Group Discussion, Case-Based Learning, Flipped Classroom, Active Learning, Muddiest Point, Problem-Based Learning, Team-Based Learning, Commitment-Based Learning	What is Clinical Informatics? Clinical Informatics in the Emergency Department Hospital Clinical Information Systems	Residents will gain an introduction of the broad field of clinical informatics with a focus on the key applications of informatics in emergency medicine. -Learners will describe clinical informatics. -Learners will describe the history of the field including federal policies influencing the use of electronic health records. -Learners will describe resources available to them for further development of their understanding of information retrieval and project management.	PGY 2-3 EM Residents	Computer, projector or large monitor for group discussion, access to asynchronous learning resources (See Appendix D). Learners will spend approximately 40 hours per week on rotation performing asynchronous learning, attending administrative sessions, participating in group discussions, and presenting their work. Depending on the level of experience and familiarity of the material to the instructor, pre-work times may vary. Instructors need to plan an introductory overview session and host the small group discussions weekly.	Assessment: Submission of Appendix E.1.b. CI Fundamentals, Learner Materials, Demonstration of understanding during small group discussion, Attendance and Time Log. Milestones: SBP2, SBP3, PBL1

DIDACTICS AND HANDS-ON CURRICULUM

Topic	Recommended Educational Strategy	Educational Content	Objectives	Learners	Timing, Resources Needed (Space, Instructors, Equipment, Citations of JETem pubs or other literature)	Recommended Assessment, Milestones Addressed
Improving Care Delivery and Outcomes	Asynchronous Learning, Administrative Sessions, Faculty Presentation, Small Group Discussion, Case-Based Learning, Flipped Classroom, Active Learning, Muddiest Point, Problem-Based Learning, Team-Based Learning, Commitment-Based Learning	What are Clinical Decision Support Systems? -How are Clinical Decision Support Systems affecting Emergency Medicine?	Propose ideas for planning, implementation, and support necessary for the successful use of a clinical information system. -Analyze the roles of computerized provider order entry, clinical decision support systems. -Learners will explain the role of Clinical Decision Support Systems in the practice of emergency medicine and healthcare at large. -Learners will analyze the positive and negative effects of decision support as well as unintended consequences.	PGY 2-3 EM Residents	Computer, projector or large monitor for group discussion, access to asynchronous learning resources (See Appendix D). Learners will spend approximately 40 hours per week on rotation performing asynchronous learning, attending administrative sessions, participating in group discussions, and presenting their work. Depending on the level of experience and familiarity of the material to the instructor, pre-work times may vary. Instructors need to host the small group discussions weekly.	Assessment: Submission of Appendix E.2.b. Care Delivery Outcomes CDS Development Form. Demonstration of understanding during small group discussion. Comprehension and assimilation of information into project proposal draft. Attendance and Time Log. Milestone: SBP2

Health Information Systems, Data Analytics and Data Governance	Asynchronous Learning, Administrative Sessions, Faculty Presentation, Small Group Discussion, Case-Based Learning, Flipped Classroom, Active Learning, Muddiest Point, Problem-Based Learning, Team-Based Learning, Commitment-Based Learning	What are Hospital Information systems? -Security -Programming What is data governance? Why is it important to ensure data quality and meaning across settings? How is data used to optimize clinical and business decision making?	Appreciate the advantages and limitations of information systems and their associated software. -Propose ideas for planning, implementation and support necessary for the successful use of a clinical information system. -Learn best practices for data use, privacy and appreciate the risk associated with security breaches and government recommendations on how to avoid them. -Develop a basic understanding of the concepts of analytics, machine learning, data visualization and natural language processing. Learners will review the IS Framework and gain a better understanding of hospital information systems.	PGY 2-3 EM Residents	Computer, projector or large monitor for group discussion, access to asynchronous learning resources (See Appendix D). Learners will spend approximately 40 hours per week on rotation performing asynchronous learning, attending administrative sessions, participating in group discussions and presenting their work. Depending on the level of experience and familiarity of the material to the instructor, pre-work times may vary. Instructors need to host the small group discussions.	Assessment: Submission of Appendix E.3b. Data Analytics Governance Learner Material. Demonstration of understanding during small group discussion, Comprehension and assimilation of information into project proposal draft. Attendance and Time Log. Milestones: SBP2 and SBP3

			Learners will appreciate the importance of Data Security in Healthcare. Learners will appreciate the role of health information exchanges in the emergency department. Learners will appreciate the concept of terminologies and their application in health information technology. Learners will understand the need for Healthcare Data standards. Learners will appreciate the concept of data analytics and its application in healthcare. Learners will develop a basic understanding of the concepts of data analytics for ED needs, including techniques of "AI" / machine learning, and natural language processing.			

DIDACTICS AND HANDS-ON CURRICULUM

Topic	Recommended Educational Strategy	Educational Content	Objectives	Learners	Timing, Resources Needed (Space, Instructors, Equipment, Citations of JETem pubs or other literature)	Recommended Assessment, Milestones Addressed
			Learners will understand strategies for data warehouse access and methods of conducting research and quality projects to improve ED care and operations. Learners will appreciate the utility of health information exchange in the ED, as well as some of the challenges of interoperability, necessity of data standards, and tradeoffs involved with different consent models.			

DIDACTICS AND HANDS-ON CURRICULUM

Topic	Recommended Educational Strategy	Educational Content	Objectives	Learners	Timing, Resources Needed (Space, Instructors, Equipment, Citations of JETem pubs or other literature)	Recommended Assessment, Milestones Addressed
Leadership and Professionalism	Asynchronous Learning, Administrative Sessions, Faculty Presentation, Small Group Discussion, Case-Based Learning, Flipped Classroom, Active Learning, Muddiest Point, Problem-Based Learning, Team-Based Learning, Commitment-Based Learning	-How to enact change. -How to promote an implementation and gain end-user buy-in.	Appreciate the role and need for project management, change management, and stakeholder engagement. Learn the basics of team management and effective communication skills. Appreciate the role emergency medicine physicians can play in departmental and hospital leadership. Learners will appreciate the complexity of change management and implementation science. Learners will understand the requirements needed to initiate and see through a project.	PGY 2-3 EM Residents	Computer, projector or large monitor for group discussion, access to asynchronous learning resources (See Appendix D). Learners will spend approximately 40 hours per week on rotation performing asynchronous learning, attending administrative sessions, participating in group discussions, and presenting their work. Depending on the level of experience and familiarity of the material to the instructor, pre-work times may vary. Instructors need to host the small group discussions and create an opportunity for the learners to present their final project at a regular leadership meeting or as a stand-alone event.	Assessment: Presentation of project proposal, Demonstration of understanding during small group discussion, Attendance and Time Log. Sample Survey. Milestone: ICS2

Appendix B:
Project Proposal Assignment

Resident Name: _____
Rotation Dates: _____

Identify a problem or need. Explain why this exists and why improvements or interventions are required. Paint a picture of the current state of this issue.

_____
_____

Describe your proposed intervention and ideal future state. Identify critical elements of your design, including how you will evaluate the current state of the problem, stakeholders involved, data sources, and plan for change.

_____
_____

Describe the key performance indicators and measurements used to determine success of your intervention. What data would you like to have?

_____
_____

Describe how you will implement your intervention. Who are the key stakeholders and subject matter experts? How will you generate buy-in and utilization? How will you mitigate dissent? Develop a communication plan.

_____
_____

Appendix C:
Sample Attendance Sheet and Time Log

Resident Name: _____ Rotation Block Dates: _____

	Description:	Date	Faculty/Admin Print	Faculty/Admin Signature
Administrative Sessions	Organizational Leadership Meeting Examples:			
	Clinical Decision Support			
	Computerized Provider Order Management			
	Quality & Utilization			
	Medical Informatics			
	Physician Advisory Council			
	Analytics Council			
	Process Excellence			
	Clinical Pathways			
Asynchronous Learning				
	Fundamentals			
	Care Delivery			
	IS/Data			
	Leadership			
Small Group Discussion				
	Fundamentals			
	Care Delivery			
	IS / Data			
	Leadership			
Presentation:				

Appendix D:
Asynchronous Learning: Books, Papers, Videos, Websites

Books

1. Finnell JT, Dixon BE, eds. *Clinical Informatics Study Guide.* 2nd ed. Springer; 2022.
   a. Ozkaynak M, Unertl KM, Johnson SA, Brixey JJ, Haque SN. Clinical Workflow Analysis, Process Redesign and Quality Improvement. In: Finnell JT, Dixon BE, eds. *Clinical Informatics Study Guide.* 2nd ed. Springer; 2022:103-118.
   b. Kasthurirathne SN, Grannis SJ. Analytics. In: Finnell JT, Dixon BE, eds. *Clinical Informatics Study Guide.* Springer; 2022: 227-239.
   c. Dixon BE, Holmgren AJ, Adler-Milstein J, Grannis SJ. Health Information Exchange and Interoperability. In: Finnell JT, Dixon BE, eds. *Clinical Informatics Study Guide.* Springer; 2022:203-219.
   d. Schleyer T, Zappone S, Wells-Meyers C, Saxton T. Effective Interdisciplinary Teams. In: Finnell JT, Dixon BE, eds. *Clinical Informatics Study Guide.* 2nd ed. Springer; 2022: 285-306.
2. Hersh WR, ed. *Health Informatics: Practical Guide*. 8th ed. Informatics Education. 2022.
   a. Hersh WR. Introduction to Biomedical and Health Informatics. In: Hersh WR, ed. *Health Informatics: Practical Guide*. 8th ed. Informatics Education; 2022:1-18.
   b. Hersh WR. A Short History of Biomedical and Health Informatics. In: Hersh WR, ed. *Health Informatics: Practical Guide*. 8th ed. Informatics Education; 2022:19-26.
   c. Hersh WR. Evidence-Based Medicine. In: Hersh WR, ed. *Health Informatics: Practical Guide*. 8th ed. Informatics Education. 2022:377-397.
   d. Hersh WR. Data Science, Machine Learning, and Artificial Intelligence. In: Hersh WR, ed. *Health Informatics: Practical Guide*. 8th ed. Informatics Education. 2022:89-115.
   e. Jenders RA. Clinical Decision Support. In: Hersh WR, ed. *Health Informatics: Practical* Guide. 8th ed. Informatics Education. 2022:117-130.
   f. Rasmussen J. Health Information Privacy and Security. In: Hersh WR, ed. *Health Informatics: Practical Guide*. 8th ed. Informatics Education. 2022:233-252.

Reference Books Suggested for Further Reading:

3. Levick D, Saldana L, Osheroff JA, eds. Healthcare Information and Management Systems Society. *Improving Outcomes with Clinical Decision Support: An Implementer's Guide*. 2nd ed. HIMSS; 2012.
4. Shortiliffe EH, Cimino JJ, eds. *Biomedical Informatics: Computer Applications in Health Care and Biomedicine. 4th Ed. London: Springer; 2014.*

Papers

1. Friedman CP. A "fundamental theorem" of biomedical informatics. *J Am Med Inform Assoc*. 2009;16(2):169-170. doi:10.1197/jamia.M3092

2. Bates DW, Kuperman GJ, Wang S, et al. Ten commandments for effective clinical decision support: making the practice of evidence-based medicine a reality. *J Am Med Inform Assoc*. 2003;10(6):523-530. doi:10.1197/jamia.M1370
3. Hripcsak G, Clayton PD, Jenders RA, Cimino JJ, Johnson SB. Design of a clinical event monitor. *Comput Biomed Res*. 1996;29(3):194-221. doi:10.1006/cbmr.1996.0016
4. Han YY, Carcillo JA, Venkataraman ST, et al. Unexpected increased mortality after implementation of a commercially sold computerized physician order entry system [published correction appears in *Pediatrics*. 2006 Feb;117(2):594]. *Pediatrics*. 2005;116(6):1506-1512. doi:10.1542/peds.2005-1287
5. Farley HL, Baumlin KM, Hamedani AG, et al. Quality and safety implications of emergency department information systems. *Ann Emerg Med*. 2013;62(4):399-407. doi:10.1016/j.annemergmed.2013.05.019
6. Melnick ER, Genes NG, Chawla NK, Akerman M, Baumlin KM, Jagoda A. Knowledge translation of the American College of Emergency Physicians' clinical policy on syncope using computerized clinical decision support. *Int J Emerg Med*. 2010;3(2):97-104. Published 2010 Jun 1. doi:10.1007/s12245-010-0168-x
7. Weingart SN, Simchowitz B, Padolsky H, et al. An empirical model to estimate the potential impact of medication safety alerts on patient safety, health care utilization, and cost in ambulatory care. *Arch Intern Med*. 2009;169(16):1465-1473. doi:10.1001/archinternmed.2009.252
8. Terrell KM, Perkins AJ, Hui SL, Callahan CM, Dexter PR, Miller DK. Computerized decision support for medication dosing in renal insufficiency: a randomized, controlled trial. *Ann Emerg Med*. 2010;56(6):623-629. doi:10.1016/j.annemergmed.2010.03.025
9. Powers EM, Shiffman RN, Melnick ER, Hickner A, Sharifi M. Efficacy and unintended consequences of hard-stop alerts in electronic health record systems: a systematic review. *J Am Med Inform Assoc*. 2018;25(11):1556-1566. doi:10.1093/jamia/ocy112
10. Strom BL, Schinnar R, Aberra F, et al. Unintended effects of a computerized physician order entry nearly hard-stop alert to prevent a drug interaction: a randomized controlled trial. *Arch Intern Med*. 2010;170(17):1578-1583. doi:10.1001/archinternmed.2010.324
11. Shapiro JS, Crowley D, Hoxhaj S, et al. Health Information Exchange in Emergency Medicine. *Ann Emerg Med*. 2016;67(2):216-226. doi:10.1016/j.annemergmed.2015.06.018
12. Cimino JJ. Desiderata for controlled medical vocabularies in the twenty-first century. *Methods Inf Med*. 1998;37(4-5):394-403.
13. Varkey P, Reller MK, Resar RK. Basics of quality improvement in health care. *Mayo Clin Proc*. 2007;82(6):735-739. doi:10.4065/82.6.735

Videos

1. Baker M, Slovis BH, Kring R. What is Clinical Informatics? ACEP.org. Published April 11, 2022. Accessed April 22, 2022. At: https://www.acep.org/administration/quality/health-information-technology/hit-articles/what-is-clinical-informatics/
2. Hersh WR. What is Biomedical and Health Informatics? (1). https://dmice.ohsu.edu/hersh/whatis/ Updated Jan 5, 2022. Accessed April 13, 2022. At: https://echo360.org/media/2c348b8a-fb1f-4689-a5fe-985faec1eebe/public

3. Hersh WR. What is Biomedical and Health Informatics? (2). https://dmice.ohsu.edu/hersh/whatis/ Updated Jan 5, 2022. Accessed April 13, 2022. At: https://echo360.org/media/66a38a82-9ad2-4391-90b5-9d1b3bc1db91/public
4. Hersh WR. A Short History of Biomedical and Health Informatics. https://dmice.ohsu.edu/hersh/whatis/ Updated Jan 5, 2022. Accessed April 13, 2022. At: https://echo360.org/media/cc1c9af1-94c5-4b62-be4d-6cf64ae6efa5/public
5. Hersh WR. Resources for Field: Organizations, Information, Education. https://dmice.ohsu.edu/hersh/whatis/ Updated Jan 5, 2022. Accessed April 13, 2022. At: https://echo360.org/media/6e2092b3-35b7-47f9-a0aa-40d3cba9cda8/public
6. Hersh WR. Clinical Data. https://dmice.ohsu.edu/hersh/whatis/ Updated Jan 5, 2022. Accessed April 13, 2022. At: https://echo360.org/media/630e4d75-0024-4753-b9f2-a7475fbeff4f/public
7. Genes N. Digital Medicine for the Emergency Physician. ACEP Section for Emergency Medicine Informatics. Published 2016. Accessed April 13, 2022. At: https://www.acep.org/administration/quality/health-information-technology/hit-articles/digital-medicine-for-the-emergency-physician/
8. McClay J. FHIR. ACEP Section for Emergency Medicine Informatics, Grand Rounds. Published Aug 2, 2016. Accessed April 12, 2022. At: https://www.acep.org/administration/quality/health-information-technology/hit-articles/fhir-fast-health-information-resources/
9. Sivers D. How to start a movement. Ted.com. Feb 2010. Accessed April 12, 2022. At: https://www.ted.com/talks/derek_sivers_how_to_start_a_movement?language=en#t-169239

Websites

1. Campbell RJ. The Five Rights of Clinical Decision Support: CDS Tools Helpful for Meeting Meaningful Use. Published online October 2013. Accessed April 1, 2022. At: https://library.ahima.org/doc?oid=300027#.YlXJ9t-M4uU
2. U.S. Department of Health and Human Services: Office for Civil Rights. Breach Portal: Notice to the Secretary of HHS Breach of Unsecured Protected Health Information. Accessed April 12, 2022. At: https://ocrportal.hhs.gov/ocr/breach/breach_report.jsf
3. U.S. Department of Health & Human Services: Health Information Privacy. Cybersecurity Guidance Material. Accessed April 12, 2022. At: https://www.hhs.gov/hipaa/for-professionals/security/guidance/cybersecurity/index.html
4. Office of the National Coordinator for Health IT: Health IT Privacy and Security for Providers. Top 10 Tips for Cybersecurity in Health Care. Accessed April 12, 2022. At: https://www.healthit.gov/sites/default/files/Top_10_Tips_for_Cybersecurity.pdf

Appendix E.1:
Small Group Discussion: Clinical Informatics Fundamentals

Pre-Session Preparation:
Clinical informatics fundamentals will be reviewed at the beginning of the first week of a four-week rotation. Faculty will review asynchronous materials, "Appendix E.1.a. CI Fundamentals PPT," and "Appendix E.1.b. CI Fundamentals Instructor Material."

Learners may review the readings and video content asynchronously for an estimated time commitment of 10 hours. The small group session consists of a 20-minute lecture using "Appendix E.1.a. CI Fundamentals PPT," and then a 40-minute small group question and answer sheet, "Appendix E.1.c. CI Fundamentals Learner Material."

Recommended Pre-Reading:

1. Hersh WR, ed. *Health Informatics: Practical Guide*. 8th ed
   a. Hersh WR. Introduction to Biomedical and Health Informatics. In: Hersh WR, ed. *Health Informatics: Practical Guide*. 8th ed. Informatics Education. 2022:1-18.
   b. Hersh WR. A Short History of Biomedical and Health Informatics. In: Hersh WR, ed. *Health Informatics: Practical Guide*. 8th ed. Informatics Education. 2022:19-26.
   c. Hersh WR. Evidence-Based Medicine. In: Hersh WR, ed. *Health Informatics: Practical Guide*. 8th ed. Informatics Education. 2022:377-397.
2. Schleyer T, Zappone S, Wells-Meyers C, Saxton T. Effective Interdisciplinary Teams. In: Finnell JT, Dixon BE, eds. *Clinical Informatics Study Guide.* 2nd ed. Springer; 2022: 285-306.
3. Hersh WR. What is Biomedical and Health Informatics? (1). https://dmice.ohsu.edu/hersh/whatis/ Updated Jan 5, 2022. Accessed April 13, 2022. At: https://echo360.org/media/2c348b8a-fb1f-4689-a5fe-985faec1eebe/public
4. Hersh WR. What is Biomedical and Health Informatics? (2). https://dmice.ohsu.edu/hersh/whatis/ Updated Jan 5, 2022. Accessed April 13, 2022. At: https://echo360.org/media/66a38a82-9ad2-4391-90b5-9d1b3bc1db91/public
5. Hersh WR. A Short History of Biomedical and Health Informatics. https://dmice.ohsu.edu/hersh/whatis/ Updated Jan 5, 2022. Accessed April 13, 2022. At: https://echo360.org/media/cc1c9af1-94c5-4b62-be4d-6cf64ae6efa5/public
6. Hersh WR. Resources for Field: Organizations, Information, Education. https://dmice.ohsu.edu/hersh/whatis/ Updated Jan 5, 2022. Accessed April 13, 2022. At: https://echo360.org/media/6e2092b3-35b7-47f9-a0aa-40d3cba9cda8/public
7. Baker M, Slovis BH, Kring R. What is Clinical Informatics? ACEP.org. Published April 11, 2022. Accessed April 22, 2022. At: https://www.acep.org/administration/quality/health-information-technology/hit-articles/what-is-clinical-informatics/

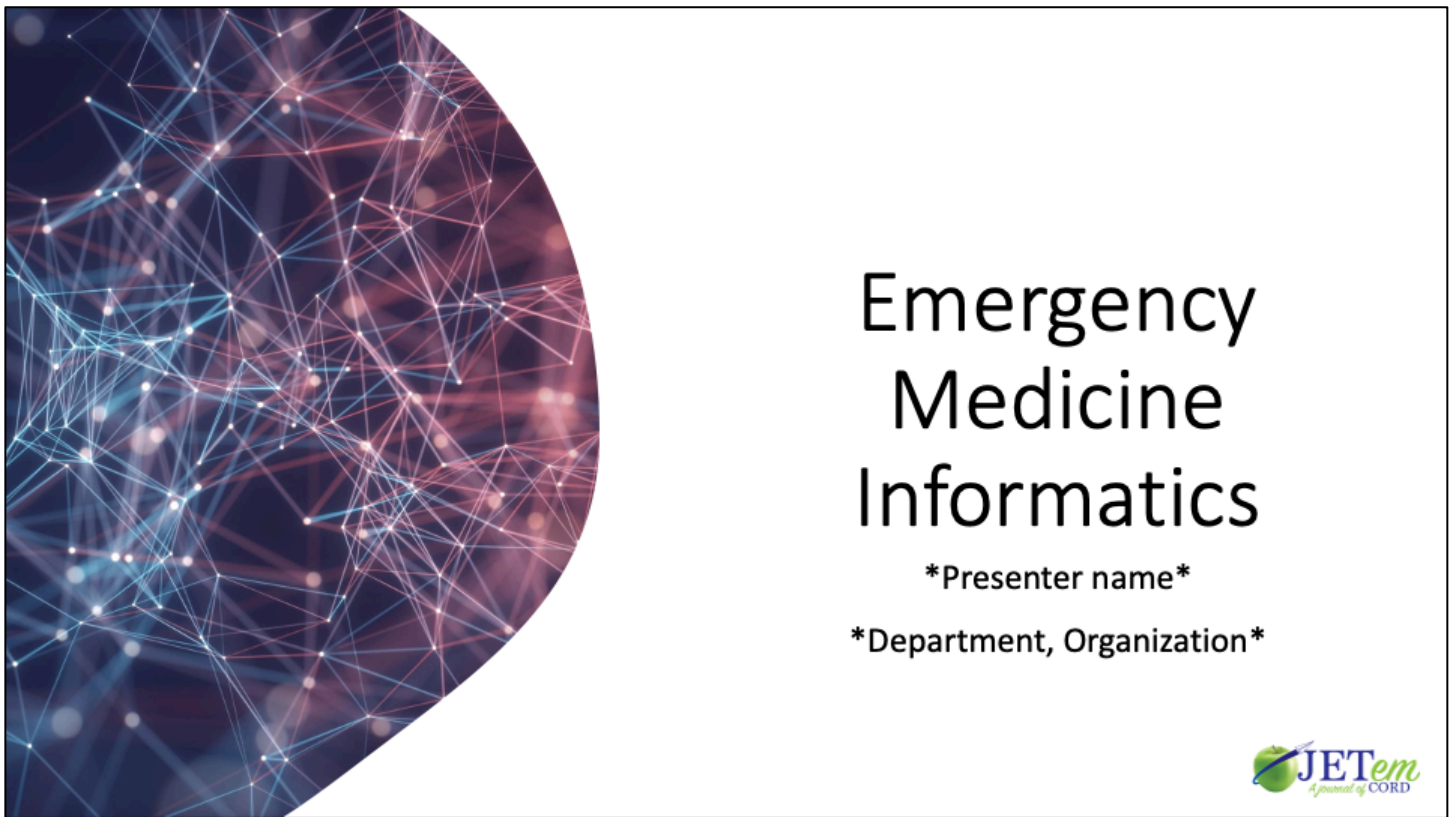
8. Friedman CP. A "fundamental theorem" of biomedical informatics. *J Am Med Inform Assoc*. 2009;16(2):169-170. doi:10.1197/jamia.M3092

Objectives:
Residents will gain an introduction of the broad field of clinical informatics, with a focus on the key applications of informatics in EM. By the end of this small group section, the learner will be able to:

1. State the value proposition of clinical informatics.
2. Describe the federal policies and legislation that influence the adoption of health information technology in the United States.

Linked objectives and methods:
Objectives are achieved through small group discussion with guidance from the small group instructor. This allows for knowledge translation in an informal setting. Learners discuss their experiences and ideas in an open format.

Appendix E.1.a:
CI Fundamentals PPT



Please see associated PowerPoint file

Appendix E.1.b:
CI Fundamentals Instructor Material

1. Define Informatics in your own words, being sure to identify what it is and what it is not. Define clinical informatics and explain in detail how it differs from other fields traditionally associated with Health Information Technology.
   a. An appropriate definition should include the themes of acquisition, storage, and use of information. While there is a current association with information technology this is not a critical part of the definition itself.
   b. Informatics is an association between informational science and a domain. It is not doctors "tinkering" with computers, nor large data analysis (though this can be part of the development of informatics interventions).
   c. It is not health information management, nor solely implementation science.
2. Using your own words, generate an example of Friedman's goal of informatics. Can you think of an example of how the rule can be applied in your clinical workflows?
   a. Friedman's "fundamental theorem" is the concept that a human plus an information system will perform superiorly to a human alone. In the context of clinical informatics, we generally assume this to be that despite some of their pitfalls, humans working with an associated clinical information system will be superior to one working without an information system. An important note is that the human element is critical to the interaction.
3. Take an example from your clinical work and demonstrate how data can progress to information, then knowledge, then wisdom.
   a. An example might be how the data point for a blood test can be used to generate information about the result if there is a trend (ie, serial elevated blood glucose levels). This information could result in knowledge via the diagnoses of a patient's condition (ie, a diagnosis of diabetes). The knowledge of the condition could contribute to wisdom and the appropriate interventions to manage the condition.
4. Describe the critical events leading up to the HITECH act and how it incentivized the use of electronic health records.
   a. The Great Recession of 2008 resulted in the passing of the American Recovery and Reinvestment Act (ARRA).
   b. A subset of ARRA was the Health Information Technology for Economic and Clinical Health (HITECH) act. The goal was to stimulate the economy and increase adoption of electronic health records (EHR) with improved quality and safety.
   c. Over $30B in incentives for the "meaningful use" of EHRs along with workforce development and research.
5. Define interoperability. Describe some of the past issues with it and how some policies are being developed to improve it. Describe an experience from your clinical work that demonstrated use of or a lack of interoperability.

a. Interoperability implies the ability for systems to share information, but an important distinction in clinical informatics is not just the ability to share but also make use of the information.
b. The HITECH act didn't adequately promote interoperability due to a lack of development of standards, thus leading to a world of EHRs that didn't talk to each other.
c. The 21st century Cures Act attempts to correct some of the issues with interoperability by prohibiting information blocking and setting a standard for information transfer (SMART on FHIR).

Appendix E.1.c:
CI Fundamentals Learner Material

1. Define Informatics in your own words, being sure to identify what it is and what it is not. Define clinical informatics and explain in detail how it differs from other fields traditionally associated with Health Information Technology.

2. Using your own words, generate an example of Friedman's goal of informatics. Can you think of an example of how the rule can be applied in your clinical workflows?

3. Take an example from your clinical work and demonstrate how data can progress to information, then knowledge, then wisdom.

4. Describe the critical events leading up to the HITECH act and how it incentivized the use of electronic health records.

5. Define interoperability. Describe some of the past issues with it and how some policies are being developed to improve it. Describe an experience from your clinical work that demonstrated use of or a lack of interoperability.

Appendix E.2:
Small Group Discussion: Improving Care Delivery and Outcomes

Pre-Session Preparation:
This small group session is to be held at the end of the second week of the rotation. See the proposed calendar for details. Learners will have completed pre-readings during their asynchronous learning sessions. The instructor will be familiar with the presentation and will be familiar with the studies cited. Depending on the instructor's baseline understanding, they may need to spend up to 6 hours becoming familiar with the published studies. The lecture will require about an hour to present depending on how much emphasis is placed on discussion, which we encourage. The CDS development worksheet will require another 45 minutes to an hour.

Recommended Pre-Reading:
Note: Items 1-6 are general background, and items 7-13 are for specific discussion during the PowerPoint lecture.

1. Ozkaynak M, Unertl KM, Johnson SA, Brixey JJ, Haque SN. Clinical Workflow Analysis, Process Redesign and Quality Improvement. In: Finnell JT, Dixon BE, eds. *Clinical Informatics Study Guide.* 2nd ed. Springer; 2022:103-118.
2. Jenders RA. Clinical Decision Support. In: Hersh WR, ed. *Health Informatics: Practical* Guide. 8th ed. Informatics Education. 2022:117-130.
3. Genes N. Digital Medicine for the Emergency Physician. ACEP Section for Emergency Medicine Informatics. Published 2016. Accessed April 13, 2022. At: https://www.acep.org/administration/quality/health-information-technology/hit-articles/digital-medicine-for-the-emergency-physician/
4. Hripcsak G, Clayton PD, Jenders RA, Cimino JJ, Johnson SB. Design of a clinical event monitor. *Comput Biomed Res*. 1996;29(3):194-221. doi:10.1006/cbmr.1996.0016
5. Han YY, Carcillo JA, Venkataraman ST, et al. Unexpected increased mortality after implementation of a commercially sold computerized physician order entry system [published correction appears in *Pediatrics*. 2006 Feb;117(2):594]. *Pediatrics*. 2005;116(6):1506-1512. doi:10.1542/peds.2005-1287
6. Farley HL, Baumlin KM, Hamedani AG, et al. Quality and safety implications of emergency department information systems. *Ann Emerg Med*. 2013;62(4):399-407. doi:10.1016/j.annemergmed.2013.05.019
7. Weingart SN, Simchowitz B, Padolsky H, et al. An empirical model to estimate the potential impact of medication safety alerts on patient safety, health care utilization, and cost in ambulatory care. *Arch Intern Med*. 2009;169(16):1465-1473. doi:10.1001/archinternmed.2009.252
8. Terrell KM, Perkins AJ, Hui SL, Callahan CM, Dexter PR, Miller DK. Computerized decision support for medication dosing in renal insufficiency: a randomized, controlled trial. *Ann Emerg Med*. 2010;56(6):623-629. doi:10.1016/j.annemergmed.2010.03.025

9. Powers EM, Shiffman RN, Melnick ER, Hickner A, Sharifi M. Efficacy and unintended consequences of hard-stop alerts in electronic health record systems: a systematic review. *J Am Med Inform Assoc*. 2018;25(11):1556-1566. doi:10.1093/jamia/ocy112
10. Levick D, Saldana L, Osheroff JA, eds. Healthcare Information and Management Systems Society, eds. *Improving Outcomes with Clinical Decision Support: An Implementer's Guide*. 2nd ed. HIMSS; 2012.
11. Melnick ER, Genes NG, Chawla NK, Akerman M, Baumlin KM, Jagoda A. Knowledge translation of the American College of Emergency Physicians' clinical policy on syncope using computerized clinical decision support. *Int J Emerg Med*. 2010;3(2):97-104. Published 2010 Jun 1. doi:10.1007/s12245-010-0168-x
12. Bates DW, Kuperman GJ, Wang S, et al. Ten commandments for effective clinical decision support: making the practice of evidence-based medicine a reality. *J Am Med Inform Assoc*. 2003;10(6):523-530. doi:10.1197/jamia.M1370
13. Campbell RJ. The Five Rights of Clinical Decision Support: CDS Tools Helpful for Meeting Meaningful Use. Published online October 2013. Accessed April 1, 2022. At: https://library.ahima.org/doc?oid=300027#.YlXJ9t-M4uU
14. Strom BL, Schinnar R, Aberra F, et al. Unintended effects of a computerized physician order entry nearly hard-stop alert to prevent a drug interaction: a randomized controlled trial. *Arch Intern Med*. 2010;170(17):1578-1583. doi:10.1001/archinternmed.2010.324

Objectives:

By the end of this small group session, the learner will be able to:

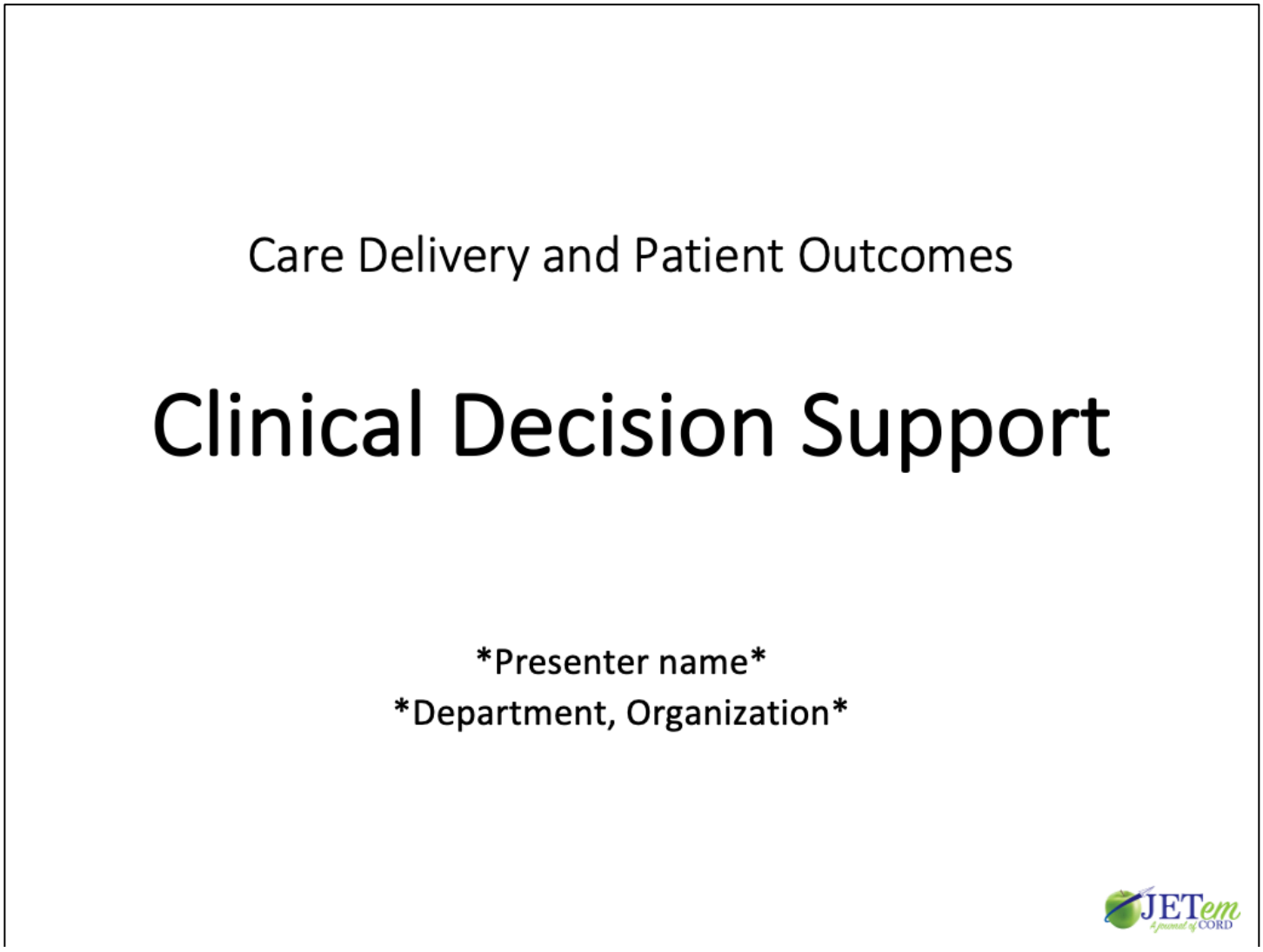
1. Explain the relationship between physical workflow and the EHR workflow.
2. List the types of CDS.
3. Describe potential side effects of CDS.
4. Cite scientific evaluations of CDS.
5. Develop a short CDS proposal.

Linked objectives and methods:

This small group exercise begins with a slide presentation and discussion of CDS types and CDS evaluation, with guidance from the small group instructor. This is found in "Appendix E.2.a. Care Delivery Outcomes CDS PPT." This presentation covers the first four objectives listed. As described above, the instructor will need to become familiar with the cited studies so that they can be discussed as a group. The slides take about 60 minutes to cover but are much more interesting if they include discussion about how their current EHR setup and prior experiences correspond to the study outcomes.

The fifth objective is "Develop a short CDS proposal." This requires dividing the group into small teams of 2-5 individuals. Smaller groups are usually better so that everyone has a chance to contribute. Each learner is given a copy of "Appendix E.2.b. Care Delivery Outcomes CDS Development Form." They are asked to consider a way that EHR might support their workflow, correct an error, or somehow make it easier to do the right thing. In their group they should discuss how it might be implemented and answer the questions on the sheet. After about 20 minutes of discussion in small groups, they should present their CDS suggestion to the larger group and discuss their design rationale.

Appendix E.2.a:
Care Delivery Outcomes CDS PPT



Please see associated PowerPoint file

Appendix E.2.b:
Care Delivery Outcomes CDS Form

Select a topic:

List Stakeholders:

Define the right information:

1. What should the alert or change be?

2. What should the suggested outcome be?

3. What science/recommendation is CDS based on?

Define the Right Intervention format: (soft stop/hard stop/notification/precheck/order set/protocol/ info buttons):

Define the Right Channel (EHR/flowsheet/Order Entry)

Define the Right Person to receive CDS:

Define the Right Time in the Workflow (what is the trigger):

Write the clinical scenario:

Describe possible unintended consequences:

DIDACTICS AND HANDS-ON CURRICULUM

Using the following framework, begin drafting a Team Charter: from Schleyer T, Zappone S, Wells-Meyers C, Saxton T. Effective Interdisciplinary Teams. In: Finnell JT, Dixon BE, eds. *Clinical Informatics Study Guide.* 2nd ed. Springer; 2022: 285-306. You will present this at the end of the final session.

Team Charter	
Purpose: Why does a team exist? What is it expected to accomplish?	
1. Statement of Work: Accomplish, Expected outcomes	
2. Duration: Timeline	
3. Scope: In/Out	
4. End result:	
Members:	
5: Team, Team Leads, Members	
6. External stakeholders: Who else might benefit or be affected by this?	
Structure and Process:	
7. Roles and responsibilities:	
8. Meeting plan:	
9. Reporting plan:	
10. Deliverables and Timetable:	
Resources:	
11. Financial Resources:	
12. Technological Resources:	
13. Support Resources:	

Appendix E.3:
Small Group Discussion: Data Analytics and Governance

Pre-Session Preparation:
Data Analytics and Governance content will be reviewed during the third week of the rotation. The small group discussion will be held at the end of the week. It begins with a slide presentation and follows with discussion of four scenarios covering issues in data analytics and data governance. The 20-minute presentation is found in "Appendix E.3.a. Data Analytics Governance PPT." A framework for a 40-minute small group discussion and answers are included in the documents, "Appendix E.3.b. Data Analytics Governance Instructor Material" and "Appendix E.3.c. Data Analytics Governance Learner Material."

Recommended Pre-Reading:

1. Finnell JT, Dixon BE, eds. *Clinical Informatics Study Guide.* Springer; 2022.
   a. Kasthurirathne SN, Grannis SJ. Analytics. In: Finnell JT, Dixon BE, eds. *Clinical Informatics Study Guide.* Springer; 2022: 227-239.
   b. Dixon BE, Holmgren AJ, Adler-Milstein J, Grannis SJ. Health Information Exchange and Interoperability. In: Finnell JT, Dixon BE, eds. *Clinical Informatics Study Guide.* Springer; 2022:203-219.
2. Hersh WR. Data Science, Machine Learning, and Artificial Intelligence. In: Hersh WR, ed. *Health Informatics: Practical Guide*. 8th ed. Informatics Education. 2022;89-115.
3. Rasmussen J. Health Information Privacy and Security. In: Hersh WR, ed. *Health Informatics: Practical Guide*. 8th ed. Informatics Education. 2022:233-252.
4. Shapiro JS, Crowley D, Hoxhaj S, et al. Health Information Exchange in Emergency Medicine. *Ann Emerg Med*. 2016 Feb;67(2):216-26. Epub 2015 Jul 28. PMID: 26233924. doi: 10.1016/j.annemergmed.2015.06.018
5. Cimino JJ. Desiderata for controlled medical vocabularies in the twenty-first century. *Methods Inf Med*. 1998;37(4-5):394-403.
6. Hersh WR. Clinical Data. https://dmice.ohsu.edu/hersh/whatis/ Updated Jan 5, 2022. Accessed April 13, 2022. At: https://echo360.org/media/630e4d75-0024-4753-b9f2-a7475fbeff4f/public
7. McClay J. FHIR. ACEP Emergency Medicine Informatics Grand Rounds. Published Aug 2, 2016. Accessed April 12, 2022. At: https://www.acep.org/administration/quality/health-information-technology/hit-tarticles/fhir-fast-health-information-resources/
8. US Department of Health and Human Services, Office for Civil Rights. Breach Portal: Notice to the Secretary of HHS Breach of Unsecured Protected Health Information. Accessed April 12, 2022. At: https://ocrportal.hhs.gov/ocr/breach/breach_report.jsf
9. U.S. Department of Health & Human Services, Health Information Privacy. Cybersecurity Guidance Material. Accessed April 12, 2022. At: https://www.hhs.gov/hipaa/for-professionals/security/guidance/cybersecurity/index.html

10. Office of the National Coordinator for Health IT: Health IT Privacy and Security for Providers. Top 10 Tips for Cybersecurity in Health Care. Accessed April 12, 2022. At: https://www.healthit.gov/sites/default/files/Top_10_Tips_for_Cybersecurity.pdf

Objectives:

Residents will gain an introduction of the broad field of clinical informatics, with a focus on the key applications of informatics in emergency medicine. By the end of this rotation, the learner will be able to:

1. Understand the need for standards, clinical terminologies, and ontologies.
2. Recognize the need for data governance and analytics.

Linked objectives and methods:

Objectives are achieved through small group discussion with guidance from the small group instructor. This allows for knowledge translation in an informal setting. Learners can discuss their experiences and ideas in an open format. This presentation covers three objectives. Grounded in examples and discussion using the documents, "Appendix E.3.b. Data Analytics Governance Instructor Material," and "Appendix E.3.c. Data Analytics Governance Learner Material," learners will:

1. Develop a basic understanding of the concepts of data analytics for ED needs, including techniques of "AI"/machine learning and natural language processing.
2. Understand strategies for data warehouse access and methods of conducting research and quality projects to improve ED care and operations.
3. Appreciate the utility of health information exchange in the ED, as well as some of the challenges of interoperability, necessity of data standards, and tradeoffs involved with different consent models.

As described above, the instructor should be familiar with the cited studies and aspects of running queries and sharing data to facilitate discussion. The documents, "Appendix E.3.b. Data Analytics Governance Instructor Material," and "Appendix E.3.c. Data Analytics Governance Learner Material," serve as a discussion guide for the small group.

Appendix E.3.a:
Data Analytics Governance PPT

Please see associated PowerPoint file

Appendix E.3.b:
Data Analytics Governance Instructor Material

Objectives:
Grounded in examples and discussion, learners will

1. Develop a basic understanding of the concepts of data analytics for ED needs, including techniques of "AI"/machine learning and natural language processing.
2. Understand strategies for data warehouse access and methods of conducting research and quality projects to improve ED care and operations.
3. Appreciate the utility of health information exchange in the ED, as well as some of the challenges of interoperability, necessity of data standards, and tradeoffs involved with different consent models.

1. A quality administrator asks the ED Clinical Informaticist for help for reducing "bouncebacks." They are looking to flag appropriate ED patients as "high risk for 72 hour return," and staff a callback center to communicate with those at highest risk for unscheduled return visits, to help arrange ambulatory clinic follow-up, and to ensure prescriptions have been filled and needs met. This administrator is looking at a combination of demographics, complaints/diagnoses, PMHx (past medical history), vitals and lab results, and clinical documentation that may play a role in 72-hour returns. As the informaticist, you will work with analysts to compose a query on ED discharges and help interpret the results.

   1Q1: What challenges do you foresee in collecting and analyzing the discrete data?
   1A1: Social Determinants of Health will play a significant factor in 72 hour returns and are not (yet, routinely) captured in EHR data.

   1Q2: What approach would you take to analyzing clinical documentation?
   1A2: Clinical Documentation is largely unstructured. Natural Language Processing techniques may be suitable for discovering words and phrases associated with higher-risk patients for 72 hour returns.

   1Q3: Discuss advantages and disadvantages of methods to identifying future high-risk patients in the ED:
   1. Running a daily report of patients that meet predefined high-risk criteria, and sharing it with the callback center.
   2. Automatically flagging the charts in the EHR and having the callback center review flagged visits.
   3. Asking the clinical staff to manually flag patients they think are at risk for unscheduled returns within 72 hours and having each flag event send a message with patient information to the callback center.

   1A3: Method #1 is relatively easy to build and automate and provides the callback center with a daily work list, though it fails to capture any particular patients the ED staff were concerned about.

Method #2 is also relatively easy to build, but requires more work of the callback center.
Method #3 is the most labor-intensive, relying on both human curation of the list and interruptive notifications to the callback center.

1Q4: What challenges do you think the callback center will have, in contacting these patients and preventing unscheduled 72-hour returns?
1A4: Patients at higher risk for return visits may be the hardest to reach (undomiciled or inconsistent address, no mobile phone). Also, patients today may prefer messaging – either SMS or through the EHR patient portal – to phone calls.

2. A few residents are interested in a research project on the use of pain medications in the ED. The hypothesis is that decreasing the default adult dose of ibuprofen from 600mg to 400mg across all order sets and preference lists in the ED will lead to greater use of the safer adult dosage without a significant change in the delta for pain scores. They'd like to be able to log into the identified hospital data warehouse self-service query tool to look at historical pain score trends across ED visits for all chief complaints and prospectively assess the impact of the intervention.

   2Q1: What retrospective data may be possible to analyze first, to help answer the study question, before any prospective changes are made to ibuprofen dosing in the ED preference lists?
   2A1: Despite default values, ED providers may choose different initial doses of ibuprofen. So, it might be possible to retrospectively assess the delta for pain scores retrospectively across different initial doses of ibuprofen, if steps are taken to match patient characteristics and diagnoses.

   2Q2: What steps should the residents take before conducting this research?
   2A2: The residents should demonstrate an understanding of research ethics. They should submit an internal review board application stating the scope of the research and describing the need for their data and their plans to access and secure it. Finally, they should demonstrate proficiency in safely and efficiently running queries using the self-service tools.

   2Q3: Name several alternatives to providing the residents with data warehouse access.
   2A3: An honest broker can run (or receive) the report for the relevant fields of interest, and de-identify it, giving the residents data they need for the research without risking PHI (protected health information) loss. Or a datamart could be developed, so the residents can't access data out of scope of their project. The residents could access a de-identified self-service query tool, if available.

3. A vendor claims they've developed an "AI" algorithm that is more sensitive and specific at identifying patients with sepsis in the ED. The algorithm depends on so many dynamic patient variables to function, it cannot be properly evaluated just by inspection.

   3Q1: Describe several approaches to evaluating the vendor's claim and potentially partnering with the vendor to improve clinical care.
   3A1: Approaches include

- Review the algorithm's performance on the vendor's training and evaluation data set. Determine what different characteristics those patients had with your hospitals' patients, and whether those are likely to be significant.
- Partner with the vendor on researching and developing the sepsis algorithm, tailored to your ED patient population, through use of historical data in the data warehouse.
- Sign a non-disclosure agreement with the vendor, build a secure interface between your institution and the vendor, and test their algorithm on a sandboxed version of your EHR. This EHR can be populated by "synthetic" patients, or de-identified reflections of patients, or if a business agreement is in place, real patients whose demographic data and workup decisions are mirrored from the production environment. These approaches can be time-consuming and expensive, so if the algorithm doesn't perform well, there will be sunk costs.

3Q2: What are some risks of using AI algorithms for clinical care?
3A2: The biggest risk comes from the algorithm's complexity masking bias. There are already many examples in healthcare where AI recommendations thought to be based entirely on clinical details were actually found to be based on race, socioeconomic status, or other factors. Because the recommendations often appear as a "black box" to clinicians, some time may pass before these biases can be detected and properly interpreted.

4. Your hospital wants to participate in the local HIE (health information exchange).

4Q1: As an ED physician, do you expect ED patients would benefit from health information exchange?
4A1: Access to HIE has been shown to reduce redundant testing in the ED and reduce costs, and many cases have been described where the HIE provided helpful data for reaching a diagnosis and treatment faster.

4Q2: What ED presentations are least likely to benefit from HIE?
4A2: HIE could potentially make a difference in any ED presentation, if there's a history of allergy or a potential for drug interactions that would otherwise be missed (particularly if patients are unable to share their allergies or medication lists). However, ED visits concerning minor traumas resulting in sprains, fractures, or lacerations seem less likely to benefit from the data in an HIE than, for example, a patient with recent surgery, or on chemotherapy, or managing complex chronic conditions.

4Q3: The hospitals participating in the HIE are on different EHRs. How will data about patients from different facilities be shared and accessible?
4A3: Most discrete data today – diagnoses, medications, vital signs, lab results, etc – are captured through standard terminologies (like ICD-10, RxNorm, LOINC, etc). Messages between facilities and HIE are also sent according to a common standard. Patients are matched with algorithms that permit some small degree of "fuzziness" so records from two facilities can be recognized as belonging to the same patient so long as there are very closes matches with name, birthday, address, and potentially other criteria. However, idiosyncrasies in how notes are categorized and described, and particular aspects of

each EHR, mean that browsing patient data supplied by an HIE is not as seamless as viewing a chart compiled within a single institution.

4Q4: For this new HIE, your hospital wants to require a separate consent for patient data, so that neighboring facilities must document their own consent from the patient to access your hospital's data. Is this feasible? Why would the hospital pursue this? How does this balance patient privacy vs patient care needs?
4A4: This arrangement is technically possible (attempts at downloading HIE data from your hospital's institution can be met with a specialized consent form) and may be viewed by the hospital as patient-centric (if they have data at the hospital they'd rather not disclose to outside parties). However, this extra consent introduces an additional step for obtaining access, making routine use of HIE data less likely in the ED, and possibly jeopardizing care if critical details are missed or overlooked (or more difficult to collect, such as if patient arrives unconscious at the other facility).

Appendix E.3.c:
Data Analytics Governance Learner Material

Objectives:
Grounded in examples and discussion, learners will

1. Develop a basic understanding of the concepts of data analytics for ED needs, including techniques of "AI"/machine learning and natural language processing.
2. Understand strategies for data warehouse access and methods of conducting research and quality projects to improve ED care and operations.
3. Appreciate the utility of health information exchange in the ED, as well as some of the challenges of interoperability, necessity of data standards, and tradeoffs involved with different consent models.

1. A quality administrator asks the ED Clinical Informaticist for help for reducing "bouncebacks." They are looking to flag appropriate ED patients as "high risk for 72 hour return," and staff a callback center to communicate with those at highest risk for unscheduled return visits, to help arrange ambulatory clinic follow-up, and to ensure prescriptions have been filled and needs met. This administrator is looking at a combination of demographics, complaints/diagnoses, PMHx (past medical history), vitals and lab results, and clinical documentation that may play a role in 72-hour returns. As the informaticist, you will work with analysts to compose a query on ED discharges and help interpret the results.

   1Q1: What challenges do you foresee in collecting and analyzing the discrete data?

   1Q2: What approach would you take to analyzing clinical documentation?

   1Q3: Discuss advantages and disadvantages of methods to identifying future high-risk patients in the ED:

   1. Running a daily report of patients that meet predefined high-risk criteria, and sharing it with the callback center.

   2. Automatically flagging the charts in the EHR and having the callback center review flagged visits.

3. Asking the clinical staff to manually flag patients they think are at risk for unscheduled returns within 72 hours and having each flag event send a message with patient information to the callback center.

1Q4: What challenges do you think the callback center will have, in contacting these patients and preventing unscheduled 72-hour returns?

2. A few residents are interested in a research project on the use of pain medications in the ED. The hypothesis is that decreasing the default adult dose of ibuprofen from 600mg to 400mg across all order sets and preference lists in the ED will lead to greater use of the safer adult dosage without a significant change in the delta for pain scores. They'd like to be able to log into the identified hospital data warehouse self-service query tool to look at historical pain score trends across ED visits for all chief complaints and prospectively assess the impact of the intervention.

   2Q1: What retrospective data may be possible to analyze first, to help answer the study question, before any prospective changes are made to ibuprofen dosing in the ED preference lists?

   2Q2: What steps should the residents take before conducting this research?

   2Q3: Name several alternatives to providing the residents with data warehouse access.

3. A vendor claims they've developed an "AI" algorithm that is more sensitive and specific at identifying patients with sepsis in the ED. The algorithm depends on so many dynamic patient variables to function, it cannot be properly evaluated just by inspection.

   3Q1: Describe several approaches to evaluating the vendor's claim and potentially partnering with the vendor to improve clinical care.

   3Q2: What are some risks of using AI algorithms for clinical care?

4. Your hospital wants to participate in the local HIE (health information exchange).

   4Q1: As an ED physician, do you expect ED patients would benefit from health information exchange?

   4Q2: What ED presentations are least likely to benefit from HIE?

   4Q3: The hospitals participating in the HIE are on different EHRs. How will data about patients from different facilities be shared and accessible?

   4Q4: For this new HIE, your hospital wants to require a separate consent for patient data, so that neighboring facilities must document their own consent from the patient to access your hospital's data. Is this feasible? Why would the hospital pursue this? How does this balance patient privacy vs patient care needs?

Appendix E.4:
Small Group Discussion: Leadership and Professionalism

Pre-Session Preparation:
This small group session is to be held during the fourth week of the rotation. See the proposed calendar for details. Faculty and learners will have completed pre-readings during their asynchronous learning sessions. Instructor preparation: 45 minutes, Learner Responsible Content: 30 minutes, In Class Exercise: 90 minutes

Recommended Pre-Reading:

1. Schleyer T, Zappone S, Wells-Meyers C, Saxton T. Effective Interdisciplinary Teams. In. Finnell JT, Dixon BE, eds. *Clinical Informatics Study Guide.* 2nd ed. Springer; 2022: 285-306.
2. Sivers D. How to start a movement. Ted.com. Feb 2010. Accessed April 12, 2022. https://www.ted.com/talks/derek_sivers_how_to_start_a_movement?language=en#t-169239
3. Varkey P, Reller MK, Resar RK. Basics of quality improvement in health care. *Mayo Clin Proc*. 2007 Jun;82(6):735-9.
4. McMillan SS, King M, Tully MP. How to use the nominal group and Delphi techniques. *Int J Clin Pharm*. 2016;38(3):655-662.

Objectives:
Residents will learn leadership skills that can be applied to improve patient care.

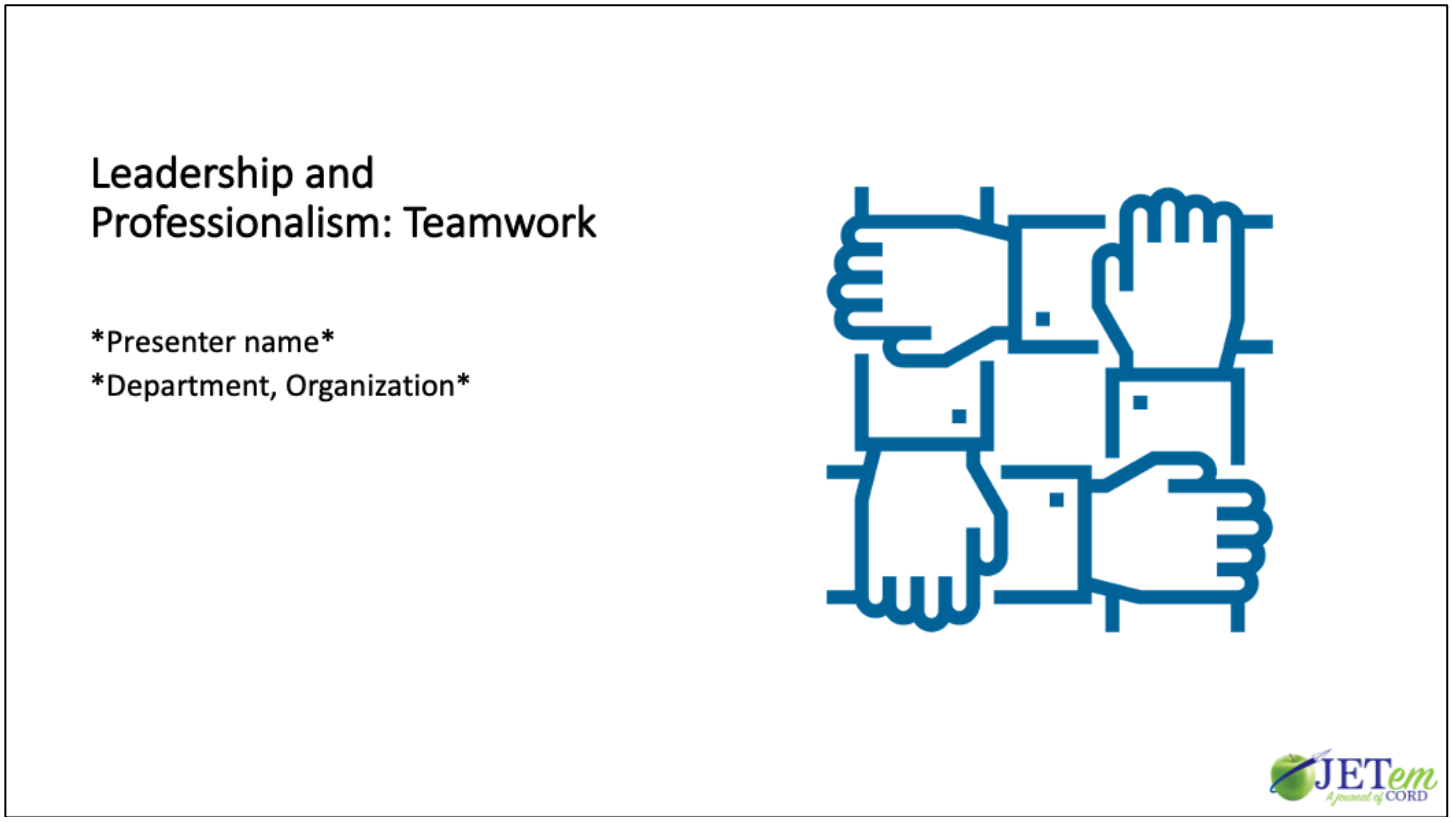
1. Utilize informatics techniques to perform research and quality improvement projects.
2. Develop and present a realistic informatics-based project plan for a problem in their clinical environment with the option to pursue further research or quality improvement.
3. Appreciate the role and need for project management, change management, and stakeholder engagement.
4. Learn the basics of team management and effective communication skills including developing a team charter, creating a meeting agenda, identifying stakeholders, and making group decisions using nominal group techniques.
5. Appreciate the role EM physicians can play in departmental and hospital leadership.

Linked objectives and methods:
Objectives are achieved through small group discussion with guidance from the small group instructor. The faculty will use the provided PowerPoint, "Appendix E.4.a. Leadership PPT," to guide the group discussion. An electronic or printed document, "Appendix E.4.b. Leadership Form," will be given to each participant to use during the small group the session.

DIDACTICS AND HANDS-ON CURRICULUM

Each person will have the opportunity to learn through listening, reflecting, committing to a decision, brainstorming ideas, discussion, and voting. This allows for knowledge translation in an informal setting. Learners discuss their experiences and ideas in an open format.

Appendix E.4.a:
Leadership PPT



Please see associated PowerPoint file

Appendix E.4.b: Leadership Form

Leadership Agenda

Date:		
Time:		
Topic:		Clinical Informatics Leadership
Attendees:		
Absent:		

	Meeting Objectives:		
	1. Develop Team Charter to Solve a Problem 2. Make Decisions Using Nominal Group Technique		
	Agenda		
	Name	**Topic**	**Time**
	Faculty	Introduction Presentation	10 minutes
	Learners	Silently Write Reflections using the Team Charter	15 minutes
	Learners	Round Robin	20 minutes
	Faculty/Learners	Facilitated discussion, including grouping similar ideas and unique ideas for voting	25 minutes
	Learners	Silent Voting	5 minutes
	Faculty	Announce Results	10 minutes
	Faculty	Conclude	5 minutes
	Notes:		
	Next Steps:		

DIDACTICS AND HANDS-ON CURRICULUM

Team Charter	
Purpose: Why does a team exist? What is it expected to accomplish?	
1. Statement of Work: Accomplish, Expected outcomes	
2. Duration: Timeline	
3. Scope: In/Out	
4. End result:	
Members:	
5: Team, Team Leads, Members	
6. External stakeholders: Who else might benefit or be affected by this?	
Structure and Process:	
7. Roles and responsibilities:	
8. Meeting plan:	
9. Reporting plan:	
10. Deliverables and Timetable:	
Resources:	
11. Financial Resources:	
12. Technological Resources:	
13. Support Resources:	

Nominal Group Technique

Individual Reflection:

A problem was proposed by your leader. Using the team charter, silently reflect and write down possible ideas to solve the problem.

Each person verbally states his/her/their reflections which are compiled by the facilitator into one document by going around the room **without** discussion. Related items are grouped. Unique ideas are listed separately.

Round Robin:

After **ALL** ideas are added to the document, the facilitator leads a group discussion. A list of voting will be made for each section.

Silent Voting:

Each section should have a list of ideas with similar ones grouped and unique ones separated out. For voting purposes, label each idea per box alphabetically, for example: Duration: 3.a. one week, 3.b. one month, 3.c. one year

Use electronic poll to vote (MS Teams, Zoom, etc.) or have the facilitator tally votes manually by having the learners turn in their papers.

Facilitator Announces Results

Appendix F:
Sample Schedule

	Monday	Tuesday	Wednesday	Thursday	Friday
Week 1 Clinical Informatics Fundamentals	Rotation Introduction Asynchronous Learning: Clinical Informatics Fundamentals	Administrative Session: Clinical Decision Support Asynchronous Learning Work on Appendix E.1.c. CI Fundamentals Learner Materials	Asynchronous Learning Work on Appendix E.1.c. CI Fundamentals Learner Materials	Administrative Session: Computerized Provider Order Management Asynchronous Learning Work on Appendix E.1.c. CI Fundamentals Learner Materials	Small Group Discussion: Clinical Informatics Fundamentals Submit and discuss Appendix E.1.c. CI Fundamentals Learner Materials
Week 2 Improving Care Delivery and Outcomes	Asynchronous Learning: Improving Care Delivery and Outcomes Review Appendix E.2.b. Care Delivery Outcomes CDS Form Review Appendix B Project Proposal Assignment	Administrative Session: Quality & Utilization Work on Appendix E.2.b. Care Delivery Outcomes CDS Form Work on Appendix B Project Proposal Assignment	Administrative Session: Medical Informatics Work on Appendix E.2.b. Care Delivery Outcomes CDS Form Work on Appendix B Project Proposal Assignment	Asynchronous Learning Work on Appendix E.2.b. Care Delivery Outcomes CDS Form Work on Appendix B Project Proposal Assignment	Small Group Discussion: Improving Care Delivery and Outcomes. Submit and discuss Appendix E.2.b. Care Delivery Outcomes CDS Form Discuss and submit drafts of Appendix B Project Proposal Assignment

DIDACTICS AND HANDS-ON CURRICULUM

	Monday	Tuesday	Wednesday	Thursday	Friday
Week 3 Health Information Systems, Data Governance, and Data Analytics	Asynchronous Learning: Health Information Systems, Data Governance, and Data Analytics Review Appendix E.3c. Data Analytics Governance Learner Material	Administrative Session: Physician Advisory Council Work on Appendix E.3c. Data Analytics Governance Learner Material Work on Appendix B. Project Proposal Assignment	Administrative Session: Analytics Council Work on Appendix E.3c. Data Analytics Governance Learner Material Work on Appendix B. Project Proposal Assignment	Asynchronous Learning Work on Appendix E.3c. Data Analytics Governance Learner Material Work on Appendix B. Project Proposal Assignment	Small Group Discussion: Health Information Systems, Data Governance, and Data Analytics Submit and discuss Appendix E.3c. Data Analytics Governance Learner Material Discuss and submit updated drafts of Appendix B Project Proposal Assignment
Week 4 Leadership & Professionalism	Asynchronous Learning: Leadership & Professionalism Review Appendix E.4.b. Leadership Form Work on Appendix B Project Proposal Assignment	Asynchronous Learning: Leadership & Professionalism Work on Appendix B Project Proposal Assignment	Administrative Session: Process Excellence Small Group Discussion: Leadership & Professionalism Discuss and submit updated drafts of Appendix B Project Proposal Assignment	Administrative Session: Clinical Pathways Work on Appendix B Project Proposal Assignment	Present Work on Appendix B Project Proposal Assignment to Leadership and other Learners

Appendix G:
Sample Survey

Clinical Informatics Rotation Evaluation

Resident Name: _____ CI Rotation Faculty: _____
Resident Program: _____ Rotation Dates: _____
Resident Level: _____

This course was a valuable use of my elective time:

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

Comments:

I achieved the learning objectives:

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

Comments:

This rotation helped me understand Clinical Informatics:

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

Comments:

Thank you to JT Finnell for his feedback on a revision of this document. Thank you to William Hersh for his educational materials. The corresponding authors would like to be contacted for further collaboration if you use this curriculum. Carrie.Baker@ketteringhealth.org *and* Benjamin.Slovis@jefferson.edu *Please include the subject: "JET EM Resident Clinical Informatics." Thank you!*