

What Competencies in Clinical Informatics Are Required of 21st Century Clinicians and Informaticians?

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Outline

- Background
- Competencies for clinical informaticians
- Competencies in clinical informatics for healthcare professionals
- Educational activities and programs to achieve competence

2



Many problems in healthcare have information-related solutions

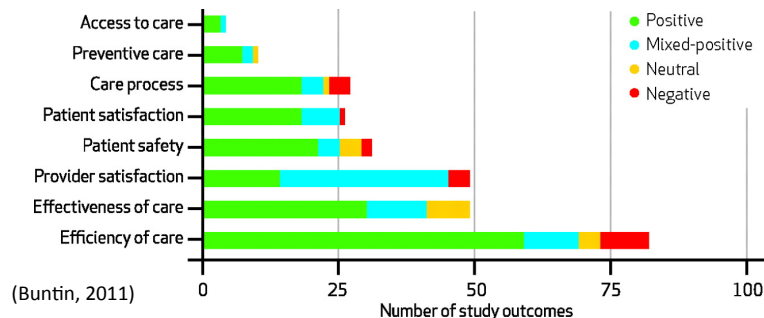
- Quality – not as good as it could be (McGlynn, 2003; Schoen, 2009; NCQA, 2010)
- Safety – errors cause morbidity and mortality; many preventable (Kohn, 2000; Classen, 2011; van den Bos, 2011; Smith 2012)
- Cost – rising costs not sustainable; US spends more but gets less (Angrisano, 2007; Brill, 2013)
- Inaccessible information – missing information frequent in primary care (Smith, 2005)

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Substantial evidence that information interventions are part of solution

- Systematic reviews (Chaudhry, 2006; Goldzweig, 2009; Buntin, 2011; Jones, 2014) have identified benefits in a variety of areas, although
 - Quality of many studies could be better
 - Large number of early studies came from a small number of “health IT leader” institutions



These problems and solutions led to the HITECH Act and “meaningful use”



“To improve the quality of our health care while lowering its cost, we will make the immediate investments necessary to ensure that within five years, all of America’s medical records are computerized ... It just won’t save billions of dollars and thousands of jobs – it will save lives by reducing the deadly but preventable medical errors that pervade our health care system.”

January 5, 2009

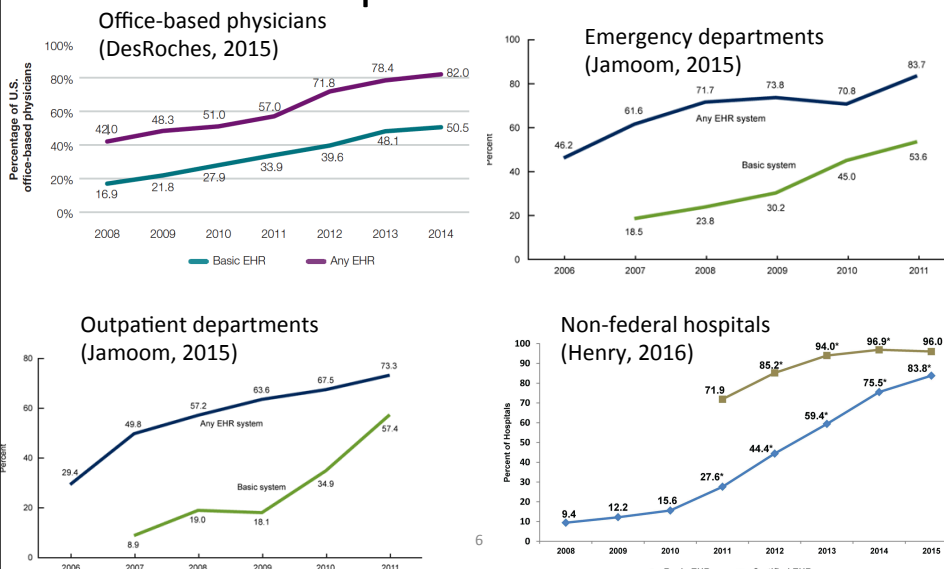
Health Information Technology for Economic and Clinical Health (HITECH) Act of the American Recovery and Reinvestment Act (ARRA) (Blumenthal, 2011)

- Incentives for electronic health record (EHR) adoption by physicians and hospitals (up to \$27B)
- Direct grants administered by federal agencies (\$2B, including \$118M for workforce development)



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Which has led to significant EHR adoption in the US



But there are still major challenges (Hersh, 2004)

Health Care Information Technology Progress and Barriers

William Hersh, MD

IN THE 3 DECADES SINCE THE TERM "MEDICAL INFORMATICS" was first used, individuals working at the intersection of information technology (IT) and medicine have developed and evaluated computer applications aimed at improving health and health care. The goal of these

in this issue of JAMA, Slack demonstrates the value that patient-physician e-mail can have in improving patient care, and also catalogs the incomplete but encouraging underlying evidence.¹¹ As with many applications of IT, the technology can improve the existing situation but also empower clinicians and patients to think more fundamentally about how innovation can lead to changes in the way medicine is practiced.

- Cost
- Technical challenges
- Interoperability
- Privacy and confidentiality
- Workforce

care IT.¹² It is no exaggeration to declare that the years ahead portend the "decade of health information technology."¹³ Informatics is poised to have a major impact in patient-clinician communication. In the Clinical Crossroads article

See also p 2255.

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ment. The rest goes to those who typically do not pay for
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(Reprinted) JAMA, November 10, 2004—Vol 292, No. 18 2273



Biomedical and health informatics underlies the solutions

- *Biomedical and health informatics* (BMHI) is the science of using data and information, often aided by technology, to improve individual health, health care, public health, and biomedical research (Hersh, 2009)
 - It is about information, not technology
 - Area of field focused on informatics for healthcare called *clinical informatics*
- Practitioners in BMHI are usually called *informaticians* (sometimes *informaticists*)
- Overview textbooks: Shortliffe, 2014; Hoyt, 2014



Definition of clinical informatics (ACGME)

- Clinical informatics ... transforms health care by analyzing, designing, implementing, and evaluating information and communication systems to improve patient care, enhance access to care, advance individual and population health outcomes, and strengthen the clinician-patient relationship

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Growth of field has led to increased job opportunities and shortages

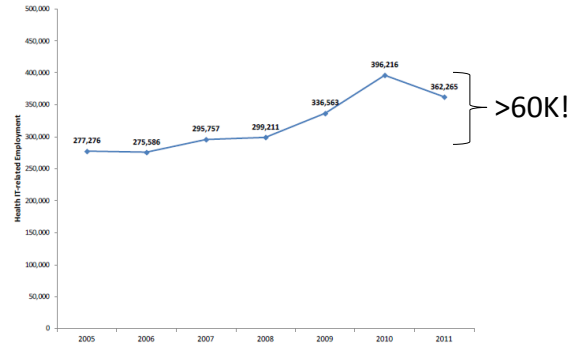
- Opportunities
 - Estimated need for 41,000 additional HIT professionals as we moved to more advanced clinical systems (Hersh, 2008)
 - Actual numbers hired were even higher (Furukawa, 2012; Schwartz, 2013)
- Shortages
 - 71% of healthcare CIOs said IT staff shortages could jeopardize an enterprise IT project, while 58% said they would affect meeting meaningful use (CHIME, 2012)
 - More recent surveys paint continued picture of healthcare organizations and vendors having challenges recruiting and maintaining staff (HIMSS, 2014)

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Job growth and salaries are high

Employment in health IT-related occupations in the health delivery system:
2005-2011 (Furukawa, 2012)



www.healthitjobs.com



AVERAGE SALARY BY JOB FUNCTION



PROJECT
MANAGER
\$107,674.00



IT
MANAGEMENT
\$94,275.05



BUSINESS
INTELLIGENCE
\$81,574.31



HEALTHCARE
INFORMATICS
\$80,907.41



IMPLEMENTATION
CONSULTANT
\$78,147.27

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A skilled workforce requires “competence”

- Competency-based education (Frank, 2010)
 - “An approach to preparing physicians for practice that is fundamentally oriented to graduate outcome abilities and organized around competencies derived from an analysis of societal and patient needs. It de-emphasizes time-based training.”
- Growing adoption in medical education (Holmboe, 2014)
 - Aiming to create milestones for education achievement and development of entrustable professional activities (EPAs) for physicians in training (TenCate, 2013)
- Also being adopted in informatics education

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Important topic for those entering the medical school business

Opinion & EditorialResearch & Data

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Geisinger Health acquires Pa. medical school

By Maria Castellucci | September 28, 2016

Danville, Pa.-based Geisinger Health System announced Wednesday that it has acquired the **Commonwealth Medical College**, based in **Scranton, Pa.** The school will give Geisinger a pipeline of future doctors.

Geisinger, which currently employs 30,000, will retain all 1,200 faculty members at Commonwealth Medical and its approximately 200 students. The system will also support operating costs and expansion at the institution.



Inventory of competencies for various groups (Hersh, 2010)

- Competencies differ by group
 - Informaticians
 - Developing, implementing, and evaluating systems
 - Making optimal use of information
 - Recent elucidation of core competencies by AMIA (Kulikowski, 2012)
 - Clinicians
 - Applying informatics in delivery of care
 - Recent publication of competencies for medical students (Hersh, 2014)
 - Patients
 - Health information literacy

Review

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Table 2 Inventory of competencies in biomedical and health informatics.

Organization or Journal [Reference]	Year	Discipline	Title
Association for Computing Machinery [49]	1978	Computer science	Health Computing: Curriculum for an Emerging Profession
[50]	1992	Informatics	Recommendations of the German Association for Medical Informatics, Biometry and Epidemiology
Association of American Medical Colleges [51]	1999	Medical students	Medical School Objectives Project: Medical Informatics
International Medical Informatics Association [52]	2000	Informatics	Recommendations of the International Medical Informatics Association (IMIA) on education in health and medical informatics (updated in 2010)
UK National Health Service [53]	2001	Informatics	Health Informatics Competency Profiles for the NHS
American Nurses Association [54]	2001	Nursing	A Delphi Study to Determine Informatics Competencies for Nurses at Four Levels of Practice
...			
Nursing Clinics of North America [68]	2008	Nursing	Technology and Informatics competencies
AMIA-OHSU 10x10 Course [69]	2009	Informatics	AMIA-OHSU 10x10 Program - Detailed Curriculum, Learning Objectives
AMIA Core Content for Clinical Informatics [35]	2009	Informatics	Core content for certification of physicians (with others to follow later)
TIGER Nursing Informatics [70]	2009	Nursing Informatics	TIGER Informatics Competencies Collaborative (TICC) Final Report
Office of the National Coordinator for Health IT [71]	2009	Electronic health record adoption	HIT Workforce Competencies by Role
Centers for Disease Control and Prevention, [72]	2009	Informatics	Public Health Informatics Competencies
International Medical Informatics Association [73]	2010	Informatics	Recommendations of the International Medical Informatics Association (IMIA) on education in biomedical and health informatics

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Competencies of clinical informaticians (Safran, 2009)

- Search and appraise the literature relevant to clinical informatics
- Demonstrate fundamental programming, database design, and user interface design skills
- Develop and evaluate evidence-based clinical guidelines and represent them in an actionable way
- Identify changes needed in organizational processes and clinician practices to optimize health system operational effectiveness
- Analyze patient care workflow and processes to identify information system features that would support improved quality, efficiency, effectiveness, and safety of clinical services
- Assess user needs for a clinical information or telecommunication system or application and produce a requirements specification document
- Design or develop a clinical or telecommunication application or system
- Evaluate vendor proposals from the perspectives of meeting clinical needs and the costs of the proposed information solutions
- Develop an implementation plan that addresses the sociotechnical components of system adoption for a clinical or telecommunication system or application
- Evaluate the impact of information system implementation and use on patient care and users
- Develop, analyze, and report effectively (verbally and in writing) about key informatics processes

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Core content for clinical informatics (Gardner, 2009)

- | | | |
|---|--|--|
| 1. Fundamentals
1.1. Clinical Informatics
1.1.1. The discipline of informatics
1.1.2. Key informatics concepts, models, theories
1.1.3. Clinical informatics literature
1.1.4. International clinical informatics practices
1.1.5. Ethics and professionalism
1.1.6. Legal and regulatory issues
1.2. The Health System
1.2.1. Determinants of individual and population health
1.2.2. Primary domains, organizational structures, cultures, and processes
1.2.3. The flow of data, information, and knowledge within the health system
1.2.4. Policy & regulatory framework
1.2.5. Health economics and financing
1.2.6. Forces shaping health care delivery
1.2.7. Institute of Medicine quality components

2. Clinical Decision Making and Care Process Improvement
2.1. Clinical Decision Support
2.1.1. The nature and cognitive aspects of human decision making
2.1.2. Decision science
2.1.3. Application of clinical decision support
2.1.4. Transformation of knowledge into clinical decision support tools
2.1.5. Legal, ethical, and regulatory issues
2.1.6. Quality and safety issues
2.1.7. Supporting decisions for populations of patients
2.2. Evidence-based Patient Care
2.2.1. Evidence sources
2.2.2. Evidence grading
2.2.3. Clinical guidelines
2.2.4. Implementation of guidelines as clinical algorithms
2.2.5. Information retrieval and analysis
2.3. Clinical Workflow Analysis, Process Redesign, and Quality Improvement
2.3.1. Methods of workflow analysis
2.3.2. Principles of workflow re-engineering
2.3.3. Quality improvement principles and practices | 3. Health Information Systems
3.1. Information Technology Systems
3.1.1. Computer Systems
3.1.2. Architecture
3.1.3. Networks
3.1.4. Security
3.1.5. Data
3.1.6. Technical approaches that enable sharing data
3.2. Human Factors Engineering
3.2.1. Models, theories, and practices of human-computer (machine) interaction (HCI)
3.2.2. HCI Evaluation, usability testing, study design and methods
3.2.3. Interface design standards and design principles
3.2.4. Usability engineering
3.3. Health Information Systems and Applications
3.3.1. Types of functions offered by systems
3.3.2. Types of settings where systems are used
3.3.3. Electronic health/medical records systems as the foundational tool
3.3.4. Telemedicine
3.4. Clinical Data Standards
3.4.1. Standards development history and current process
3.4.2. Data standards and data sharing
3.4.3. Transaction standards
3.4.4. Messaging standards
3.4.5. Nomenclatures, vocabularies, and terminologies
3.4.6. Ontologies and taxonomies
3.4.7. Interoperability standards
3.5. Information System Lifecycle
3.5.1. Institutional governance of clinical information systems
3.5.2. Clinical information needs analysis and system selection
3.5.3. Clinical information system implementation
3.5.4. Clinical information system testing, before, during and after implementation
3.5.5. Clinical information system maintenance
3.5.6. Clinical information system evaluation | 4. Leading and Managing Change
4.1. Leadership Models, Processes, and Practices
4.1.1. Dimensions of effective leadership
4.1.2. Governance
4.1.3. Negotiation
4.1.4. Conflict management
4.1.5. Collaboration
4.1.6. Motivation
4.1.7. Decision making
4.2. Effective Interdisciplinary Teams
4.2.1. Human resources management
4.2.2. Team productivity and effectiveness
4.2.3. Group management processes
4.2.4. Managing meetings
4.2.5. Managing group deliberations
4.3. Effective Communications
4.3.1. Effective presentations to groups
4.3.2. Effective one-on-one communication
4.3.3. Writing effectively for various audiences and goals
4.3.4. Developing effective communications program to support system implementation
4.4. Project Management
4.4.1. Basic principles
4.4.2. Identifying resources
4.4.3. Resource allocation
4.4.4. Project management tools (non-software specific)
4.4.5. Informatics project challenges
4.5. Strategic and Financial Planning for Clinical Information Systems
4.5.1. Establishing mission and objectives
4.5.2. Environmental scanning
4.5.3. Strategy formulation
4.5.4. Action planning and strategy implementation
4.5.5. Capital and operating budgeting
4.5.6. Principles of managerial accounting
4.5.7. Evaluation of planning process
4.6. Change Management
4.6.1. Assessment of organizational culture and behavior
4.6.2. Change theories
4.6.3. Change management strategies
4.6.4. Strategies for promoting adoption and effective use of clinical information systems |
|---|--|--|

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Beyond information retrieval and electronic health record use: competencies in clinical informatics for medical education

This article was published in the following Dove Press journal:
Advances in Medical Education and Practice
1 July 2014
Number of times this article has been viewed

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Abstract: Physicians in the 21st century will increasingly interact in diverse ways with information systems, requiring competence in many aspects of clinical informatics. In recent years, many medical school curricula have added content in information retrieval (search) as a basic use of the electronic health record. However, this omits the growing number of other ways that physicians are interacting with information that includes activities such as clinical decision support, quality measurement and improvement, personal health records, telemedicine, and personalized medicine. We describe a process whereby six faculty members representing different perspectives came together to define competencies in clinical informatics for a curriculum transformation project occurring at Oregon Health & Science University. From the broad competencies, we also developed specific learning objectives and milestones, an implementation schedule, and mapping to general competency domains. We present our work to encourage debate and refinement as well as facilitate evaluation in this area.

In reality, applicable to all healthcare professionals and students.

Part of larger health systems science
(Skochelak, 2016)

Table 1 Competencies in clinical informatics and specific learning objective/milestone within each

Competency	Learning objectives/milestones
Find, search, and apply knowledge-based information to patients care and other clinical tasks	Information retrieval/search: choose correct source for specific task; search using advanced features; apply results Evaluate information resources (textbooks, databases, etc.) for their quality, funding sources, biases Identify tools to assess patient safety (e.g. medication interactions) Utilize knowledge-based tools to answer clinical questions at the point of care (e.g. textbooks, calculators, etc.) Formulate an answerable clinical question Determine the costs/benefits of medications and tests Identify when to consult a laboratory (e.g. myelogram) and develop a list of causes of the deviation
Effectively read and write from the electronic health record for patient care and other clinical activities	Graph, display, and trend vital signs and laboratory values over time Adopt a uniform method of recording patient information in the record Create and maintain an accurate problem list Recognize medical history issues related to poor chart maintenance Identify a normal range of results for a specific patient Access and compare radiographs over time Identify inaccuracies in the problem list/history/medication/allergies Create usable notes Write orders and prescriptions List common errors with data entry (drop down lists, copy and paste, etc.) Recognize different types of records Be able to use different types of CDS Work with clinical and informatics colleagues to guide CDS use in clinical settings Use the electronic record (data collection and data entry) to assist with disease management approaches
Use and guide implementation of CDS	Create reports for populations in different health care delivery systems Use and apply data in accounting, billing, care coordination, and the primary care medical home settings Use security features of information systems Adhere to HIPAA privacy and security regulations Describe and manage ethical issues in privacy and security Perform a root-cause analysis to uncover patient safety problems Familiarity with safety issues Use resources to solve safety issues Recognize the types and limitations of different types of quality measures Identify the pros and cons of a quality measure, how to measure it, and how to use it to change care Recognize issues of dispersed patient information across clinical locations Participate in the use of HIE to improve clinical care
Protect patient privacy and security	Identify patients in proper use of a personal health record Write an e-message to a patient using a patient portal Demonstrate appropriate written communication with all members of the health care team Integrate technology into online medical history (e.g. decision making tools, diagrams, etc.) Evaluate patients to discern quality of patient information resources (Web sites, applications, patient support groups, social media, etc.) Monitor patient engagement and use in electronic health record (eye contact, body language, etc.) Identify and monitor clinical data in the cloud (storage issues, texting, cell phones, social media professionalism) Be able to function clinically in telemedicine/teletouch environments
Use information technology to improve patient safety	Recognize growing role of genomics and personalized medicine in care Identify resources enabling access to accessible information related to precision medicine Use electronic health record alerts and other tools to identify patients and populations for offering clinical trial participation Participate in precision-based research to advance medical knowledge
Maintain professionalism through use of information technology tools	
Provide clinical care as a telemedicine, and refer those for whom it is necessary	
Apply personalized/precision medicine	
Participate in practice-based clinical and translational research	

Educational programs for achieving competence

- Informaticians
- Clinicians

Academic programs for informaticians

- An ever-growing number of programs – list of US informatics programs on AMIA Web site
 - <http://www.amia.org/education/programs-and-courses>
- Programs come in many flavors: medical, clinical, biomedical, health, bio-, nursing, etc. informatics
- Funding available for research programs from National Library of Medicine (NLM), which funds fellowships to train future researchers at doctoral and postdoctoral levels at 14 universities
 - <http://www.nlm.nih.gov/ep/GrantTrainInstitute.html>
 - Also others from Veteran's Administration, Kaiser-Permanente, and other institutes of the National Institutes of Health (NIH)
- New fellowships for clinical informatics subspecialists accredited by Accreditation Council for Graduate Medical Education (ACGME)

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OHSU Biomedical Informatics Graduate Program

- Aims to train future professionals, leaders, and researchers
- Graduate level programs
 - Graduate Certificate
 - Master's – research, professional
 - PhD
- Graduate Certificate and Master's available online
- Innovations in online learning, including AMIA 10x10 Program

Track	Clinical Informatics*	Bioinformatics & Computational Biology	Total
Certificate/Degree			
Graduate Certificate	406	N/A	406
Master of Biomedical Informatics**	190	8	198
Master of Science	72	16	88
PhD	18	6	24
Total	686	30	716

Number of students receiving degrees and certificates: 653

* includes former Health Information Management Track

** includes former Master of Medical Informatics degree



<http://www.ohsu.edu/informatics>

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How have OHSU students and graduates done?

- Now have nearly 20 years of experience...
- General observation: What people do when they graduate is partially dependent on what they did when they entered, e.g.,
 - Physicians, nurses, public health, etc. draw on their clinical/professional background
 - Information technology professionals draw on their unique background and experience
- Graduates have obtained jobs in a variety of settings, e.g., clinical, academic, and industry
- Some have obtained jobs before finishing the program; a few before starting

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Clinical informatics subspecialty

- Following usual path of five years of “grandfathering” training requirements to take certification exam before formal fellowships required
- Two paths to eligibility for exam in first five years
 - Practice pathway – practicing 25% time for at least three years within last five years (education counts at half time of practice)
 - Non-traditional fellowships – qualifying educational or training experience, e.g., NLM, VA, or other fellowship or educational program (e.g., master’s degree)

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Clinical informatics subspecialty for physicians – history

- 2009
 - American Medical Informatics Association (AMIA) develops and publishes plans for curriculum and training requirements (Gardner, 2009; Safran, 2009)
- 2011
 - American Board of Medical Specialties (ABMS) approves
 - American Board of Preventive Medicine (ABPM) becomes administrative home
- 2013
 - AMIA board review course launched
 - First certification exam administered, with 456 physicians certified, including seven from OHSU

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Clinical informatics subspecialty for physicians – history

- 2014
 - ACGME rules for fellowship accreditation released, with first three programs accredited (including OHSU)
 - Another 331 physicians certified
- 2015
 - OHSU fellowship launched
 - Another 320 physicians certified (total of 1107)
- 2016
 - 20th program achieves ACGME accreditation
 - Second year of OHSU fellowship
- 2017
 - Last year of “grandfathering” period – although proposal under review at ABPM to extend for five additional years

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Clinical training model presents some challenges

- Fragmentation and funding challenges (Detmer, 2014)
- Clinical fellowship model has some aspects of “fitting square pegs into round holes” (Hersh, 2014)
- Requirement of two-year, full-time fellowship for board certification may limit career paths
 - Many clinicians pursue informatics in mid-career
- Concerns about sustainability of funding
 - Fellows may practice but CMS rules do not allow them to bill
- Informatics is not only for physicians – AMIA developing Advanced Health Informatics Certification for others, including non-boarded physicians (Gadd, 2016)
 - <https://www.amia.org/advanced-health-informatics-certification>

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After 2018 (2023?), only pathway will be clinical (ACGME) fellowships

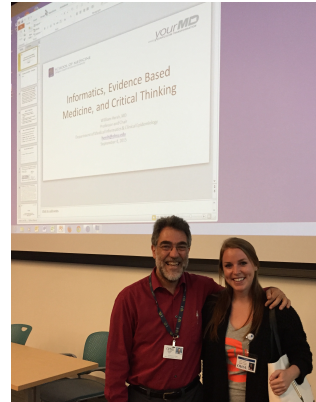
- One of 9 specialties must serve as administrative home
 - Accreditation tied to specialty RRC
- Fellow must stay clinically active in their primary specialty
- Many hope over time that ACGME will allow flexibility and innovation, e.g.,
 - Blended with residencies or other fellowships
 - Training not limited by time or place – especially if we aim for competency-based training

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Also need informatics education for clinicians

- OHSU developing curricula around our competencies (Hersh, 2014)
 - Interactive lectures and series, e.g.,
 - “Information is Different Now That You’re a Doctor”
 - “Informatics, EBM, and Critical Thinking”
 - Pearls – weekly 7-10 minute recording on various topics
 - Clinical skills – e.g.,
 - Using EHR
 - Applying quality measures
- Assessments key, including being part of board exams, e.g., USMLE



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Conclusions

- Some problems in healthcare have informatics solutions
- Competence in clinical informatics is essential for 21st century healthcare professionals
- Many opportunities for clinical informatics professionals who will lead the way

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For more information

- Bill Hersh
 - <http://www.billhersh.info>
- Informatics Professor blog
 - <http://informaticsprofessor.blogspot.com>
- OHSU Department of Medical Informatics & Clinical Epidemiology (DMICE)
 - <http://www.ohsu.edu/informatics>
 - <http://www.youtube.com/watch?v=T-74duDDvwU>
 - <http://oninformatics.com>
- What is Biomedical and Health Informatics?
 - <http://www.billhersh.info/whatis>
- Office of the National Coordinator for Health IT (ONC)
 - <http://healthit.hhs.gov>
- American Medical Informatics Association (AMIA)
 - <http://www.amia.org>
- National Library of Medicine (NLM)
 - <http://www.nlm.nih.gov>

