Update in Clinical Informatics: The Newest Subspecialty

William Hersh, MD
Professor and Chair
Department of Medical Informatics & Clinical Epidemiology
Oregon Health & Science University
Portland, OR, USA
Email: hersh@ohsu.edu
Web: www.billhersh.info
Blog: http://informaticsprofessor.blogspot.com

References

Angrisano, C, Farrell, D, et al. (2007). Accounting for the Cost of Health Care in the United States. Washington, DC, McKinsey & Company. http://www.mckinsey.com/mgi/rp/healthcare/accounting_cost_healthcare.asp

Anonymous (2010). The State of Health Care Quality: 2010. Washington, DC, National Committee for Quality Assurance. http://www.ncqa.org/tabid/836/Default.aspx

Anonymous (2012). Demand Persists for Experienced Health IT Staff. Ann Arbor, MI, College of Healthcare Information Management Executives. http://www.cio-chime.org/chime/press/surveys/pdf/CHIME_Workforce _survey_report.pdf

Anonymous (2014). 2014 HIMSS Workforce Survey. Chicago, IL, HIMSS Analytics. http://www.himssanalytics.org/research/AssetDetail.aspx?pubid=82173

Blumenthal, D (2011). Implementation of the federal health information technology initiative. *New England Journal of Medicine*. 365: 2426-2431.

Blumenthal, D (2011). Wiring the health system--origins and provisions of a new federal program. *New England Journal of Medicine*. 365: 2323-2329.

Brill, S (2013). Bitter Pill: Why Medical Bills Are Killing Us. Time, April 4, 2013. http://healthland.time.com/2013/02/20/bitter-pill-why-medical-bills-are-killing-us/

Buntin, MB, Burke, MF, et al. (2011). The benefits of health information technology: a review of the recent literature shows predominantly positive results. *Health Affairs*. 30: 464-471.

Charles, D, Gabriel, M, et al. (2014). Adoption of Electronic Health Record Systems among U.S. Non-federal Acute Care Hospitals: 2008-2013. Washington, DC, Department of Health and Human Services. http://www.healthit.gov/sites/default/files/oncdatabrief16.pdf

Chaudhry, B, Wang, J, et al. (2006). Systematic review: impact of health information technology on quality, efficiency, and costs of medical care. *Annals of Internal Medicine*. 144: 742-752.

Classen, DC, Resar, R, et al. (2011). 'Global trigger tool' shows that adverse events in hospitals may be ten times greater than previously measured. *Health Affairs*. 30: 4581-4589.

Fleurence, RL, Curtis, LH, et al. (2014). Launching PCORnet, a national patient-centered clinical research network. *Journal of the American Medical Informatics Association*: Epub ahead of print.

Furukawa, MF, Vibbert, D, et al. (2012). HITECH and Health IT Jobs: Evidence from Online Job Postings. Washington, DC, Office of the National Coordinator for Health Information Technology. http://www.healthit.gov/sites/default/files/pdf/0512_ONCDataBrief2_JobPostings.pdf

Gardner, RM, Overhage, JM, et al. (2009). Core content for the subspecialty of clinical informatics. *Journal of the American Medical Informatics Association*. 16: 153-157.

Goldzweig, CL, Towfigh, A, et al. (2009). Costs and benefits of health information technology: new trends from the literature. *Health Affairs*. 28: w282-w293.

Greene, SM, Reid, RJ, et al. (2012). Implementing the learning health system: from concept to action. *Annals of Internal Medicine*. 157: 207-210.

Hersh, W (2004). Health care information technology: progress and barriers. *Journal of the American Medical Association*. 292: 2273-2274.
Hersh, W (2009). A stimulus to define informatics and health information technology. *BMC Medical Informatics & Decision Making*. 9: 24. http://www.biomedcentral.com/1472-6947/9/24/
Hersh, WR, Gorman, PN, et al. (2014). Beyond information retrieval and EHR use: competencies in clinical informatics for medical education. *Advances in Medical Education and Practice*. 5: 205-212. http://www.dovepress.com/beyond-information-retrieval-and-electronic-health-record-use-competen-peer-reviewed-article-AMEP
Hersh, WR, Weiner, MG, et al. (2013). Caveats for the use of operational electronic health record data in comparative effectiveness research. *Medical Care*. 51(Suppl 3): S30-S37.
Hersh, WR and Wright, A (2008). What workforce is needed to implement the health information technology agenda? An analysis from the HIMSS Analytics™ Database. *AMIA Annual Symposium Proceedings*, Washington, DC. American Medical Informatics Association. 303-307.
Hoyt, RE and Yoshihashi, A, Eds. (2014). Health Informatics: Practical Guide for Healthcare and Information Technology Professionals, Sixth Edition. Pensacola, FL, Lulu.com.
Hsiao, CJ and Hing, E (2014). Use and Characteristics of Electronic Health Record Systems Among Office-based Physician Practices: United States, 2001–2013. Hyattsville, MD, National Center for Health Statistics. http://www.cdc.gov/nchs/data/databriefs/db143.htm
Jones, SS, Rudin, RS, et al. (2014). Health information technology: an updated systematic review with a focus on meaningful use. *Annals of Internal Medicine*. 160: 48-54.
Kohn, LT, Corrigan, JM, et al., Eds. (2000). To Err Is Human: Building a Safer Health System. Washington, DC, National Academies Press.
McGlynn, EA, Asch, SM, et al. (2003). The quality of health care delivered to adults in the United States. *New England Journal of Medicine*. 348: 2635-2645.
Richesson, RL and Andrews, JE, Eds. (2012). Clinical Research Informatics. New York, NY, Springer.
Safran, C, Bloomrosen, M, et al. (2007). Toward a national framework for the secondary use of health data: an American Medical Informatics Association white paper. *Journal of the American Medical Informatics Association*. 14: 1-9.
Safran, C, Shabot, MM, et al. (2009). ACGME program requirements for fellowship education in the subspecialty of clinical informatics. *Journal of the American Medical Informatics Association*. 16: 158-166.
Schoen, C, Osborn, R, et al. (2009). A survey of primary care physicians in eleven countries, 2009: perspectives on care, costs, and experiences. *Health Affairs*. 28: w1171-1183.
Schwartz, A, Magoulas, R, et al. (2013). Tracking labor demand with online job postings: the case of health IT workers and the HITECH Act. *Industrial Relations: A Journal of Economy and Society*. 52: 941–968.
Shortliffe, EH and Cimino, JJ, Eds. (2014). Biomedical Informatics: Computer Applications in Health Care and Biomedicine (Fourth Edition). London, England, Springer.
Smith, M, Saunders, R, et al. (2012). Best Care at Lower Cost: The Path to Continuously Learning Health Care in America. Washington, DC, National Academies Press.
Smith, PC, Araya-Guerra, R, et al. (2005). Missing clinical information during primary care visits. *Journal of the American Medical Association*. 293: 565-571.
VanDenBos, J, Rustagi, K, et al. (2011). The $17.1 billion problem: the annual cost of measurable medical errors. *Health Affairs*. 30: 596-603.

Update in Clinical Informatics: The Newest Medical Subspecialty

William Hersh, MD, FACP, FACMI
Diplomate, Clinical Informatics, ABPM
Professor and Chair
Department of Medical Informatics & Clinical Epidemiology
Oregon Health & Science University
Portland, OR, USA
Email: hersh@ohsu.edu
Web: www.billhersh.info
Blog: http://informaticsprofessor.blogspot.com

OREGON HEALTH & SCIENCE UNIVERSITY

Outline

- Problems in healthcare that have informatics solutions
- The new subspecialty of clinical informatics
- Important issues in clinical informatics for all physicians

OREGON HEALTH & SCIENCE UNIVERSITY

Many problems in healthcare have information-related solutions

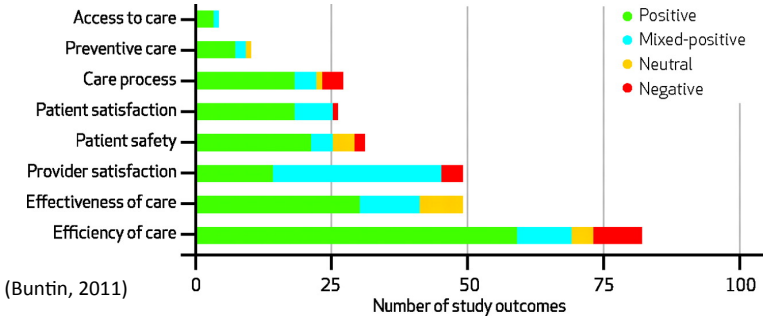
- Quality – not as good as it could be (McGlynn, 2003; Schoen, 2009; NCQA, 2010)
- Safety – errors cause morbidity and mortality; many preventable (Kohn, 2000; Classen, 2011; van den Bos, 2011; Smith 2012)
- Cost – rising costs not sustainable; US spends more but gets less (Angrisano, 2007; Brill, 2013)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

3

OREGON HEALTH & SCIENCE UNIVERSITY

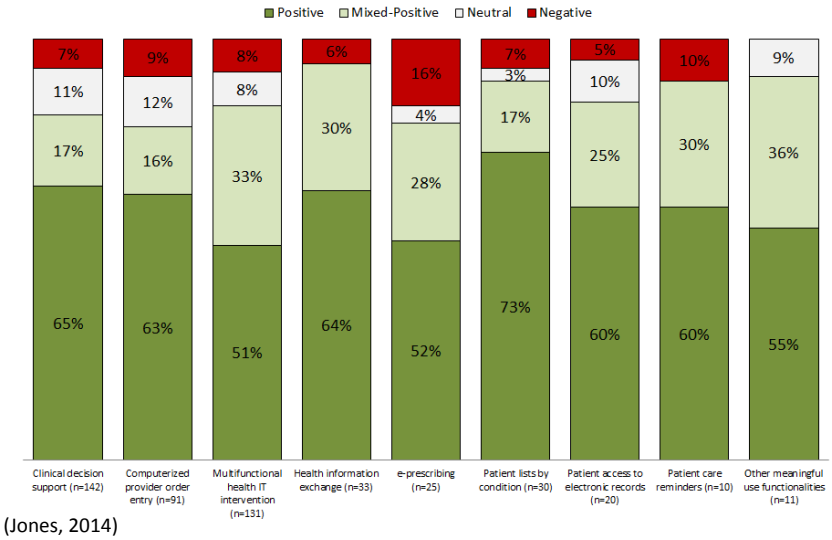
Growing evidence that information interventions are part of solution

- 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



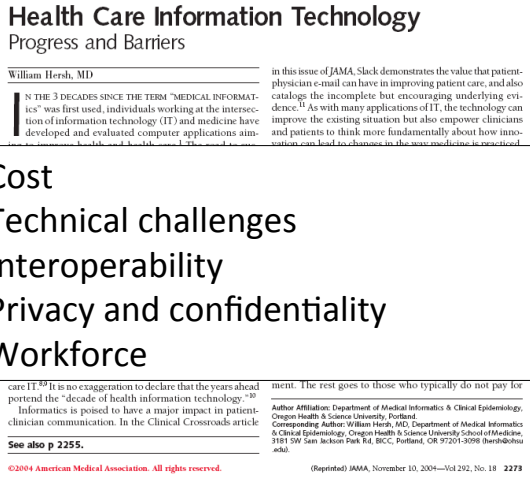
(Buntin, 2011)

Updated evidence organized by "meaningful use"



(Jones, 2014)

What are the major challenges in getting where we want? (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 aim-

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

care IT.[8,9] It is no exaggeration to declare that the years ahead portend the "decade of health information technology."[10]

Informatics is poised to have a major impact in patient-clinician communication. In the Clinical Crossroads article

ment. The rest goes to those who typically do not pay for

Author Affiliation: Department of Medical Informatics & Clinical Epidemiology, Oregon Health & Science University, Portland.
Corresponding Author: William Hersh, MD, Department of Medical Informatics & Clinical Epidemiology, Oregon Health & Science University School of Medicine, 3181 SW Sam Jackson Park Rd, BICC, Portland, OR 97201-3098 (hersh@ohsu.edu).

See also p 2255.

(Reprinted) JAMA, November 10, 2004—Vol 292, No. 18 2273

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

OREGON HEALTH & SCIENCE UNIVERSITY

These problems and solutions led to the HITECH Act and "meaningful use"

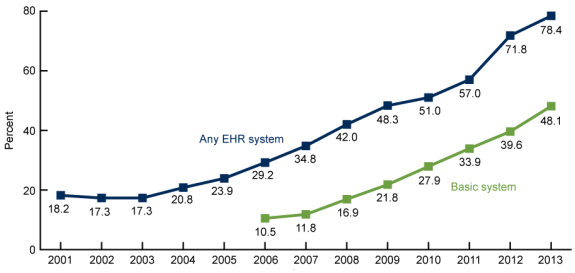
"To improve the quality of our health care while lowering its cost, we will make the immediate investments necessary to ensure that within five years, all of America's medical records are computerized … It just won't save billions of dollars and thousands of jobs – it will save lives by reducing the 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)

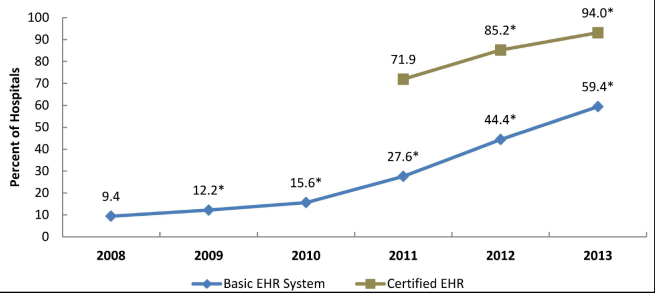
7

Has led to significant EHR adoption in the US



(Hsiao, 2014)

(Charles, 2014)



Providing opportunities for "secondary use" of clinical data

- In addition to documentation using the electronic health record (EHR), "secondary" uses of data (Safran, 2007) include
  - Health information exchange
  - Personal health records
  - Quality measurement and improvement
  - Predictive analytics to identify and act upon outliers
  - Clinical and translational research
  - Public health surveillance

9

OREGON HEALTH & SCIENCE UNIVERSITY

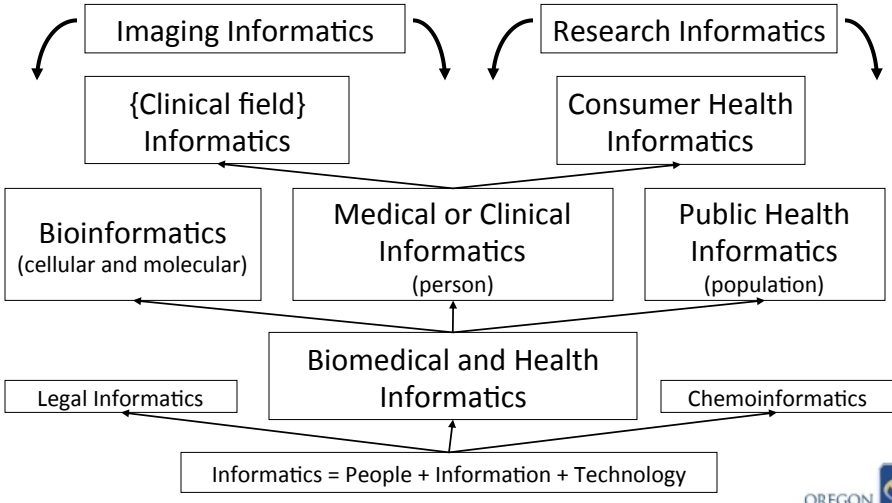
Biomedical and health informatics underlies the solutions

- *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
  - http://www.billhersh.info/whatis
- Practitioners are BMHI are usually called *informaticians* (sometimes *informaticists*)
- Overview textbooks: Shortliffe, 2014; Hoyt, 2014

10

OREGON HEALTH & SCIENCE UNIVERSITY

Informatics has many sub-areas



11

OREGON HEALTH & SCIENCE UNIVERSITY

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)

12

OREGON HEALTH & SCIENCE UNIVERSITY

Clinical informatics subspecialty for physicians

- History
  - 2009 – American Medical Informatics Association (AMIA) develops and publishes plans for curriculum and training requirements
  - 2011 – American Board of Medical Specialties (ABMS) approves; American Board of Preventive Medicine (ABPM) becomes administrative home
    - Subspecialty open to physicians of all primary specialties but not those without a specialty or whose specialty certification has lapsed
  - 2013 – First certification exam offered by ABPM
    - 455 physicians pass (91%)
  - 2014 – ACGME fellowship accreditation rules released
    - OHSU program third to be accredited nationwide

13

OREGON HEALTH & SCIENCE UNIVERSITY

Definition of clinical informatics (ACGME)

- Clinical informatics is the subspecialty of all medical specialties that 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

14

OREGON HEALTH & SCIENCE UNIVERSITY

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

15

OREGON HEALTH & SCIENCE UNIVERSITY

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

16

OREGON HEALTH & SCIENCE UNIVERSITY

Clinical informatics subspecialty (cont.)

- 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)

17

OREGON HEALTH & SCIENCE UNIVERSITY

Clinical fellowship (ACGME) model presents some challenges

- One of 9 specialties must serve as administrative home
  - Accreditation tied to specialty RRC
- Fellow must stay clinically active in their primary specialty
  - But because they are a "fellow," CMS rules do not allow them to bill
- Fellowship duration is to be 2 years, regardless of experience, mastery of competencies, etc.
  - Can be done over 4-year period

18

OREGON HEALTH & SCIENCE UNIVERSITY

Clinical informatics education goes beyond physicians, fellowships, etc.

Graduates	CI	BCB	HIM	Total
GC	321	0	37	358
MBI	146	6	2	154
MS	68	9	0	77
PhD	10	6	0	16
Total	545	21	39	605

International students from: Argentina, Singapore, Egypt, Israel, Thailand, Zimbabwe, Saudi Arabia, China, etc.

http://www.ohsu.edu/informatics-education

19

OREGON HEALTH & SCIENCE UNIVERSITY

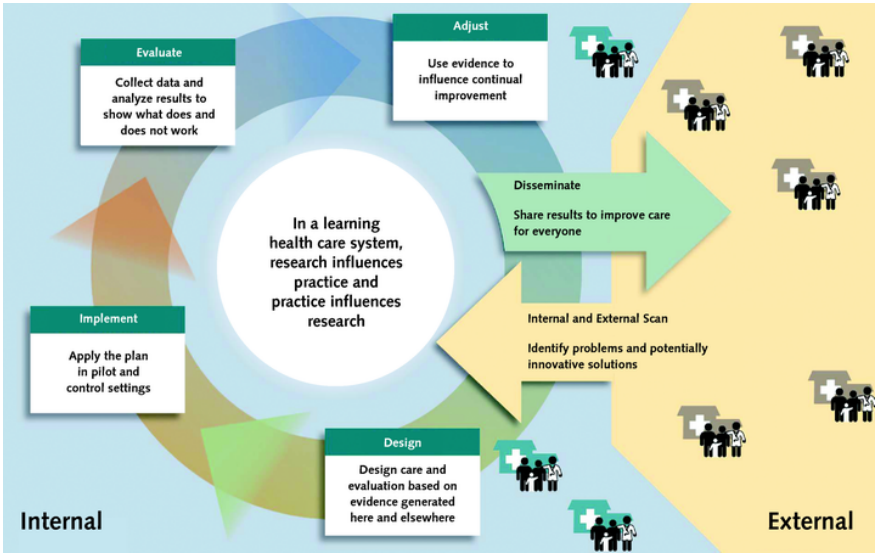
Important developments in clinical informatics

- Optimizing the electronic health record (EHR)
  - Getting to the "meaningful" part of meaningful use
  - Analytics of EHR and other clinical data for increasing quality, efficiency, and coordination of healthcare
  - Standards, interoperability, and health information exchange (HIE)
  - Will expand to "big data" when we add in data from genomics, imaging, personal health devices, etc.
- Patient engagement
  - Use of personal health record (PHR) for engaging consumers and patients in their health and healthcare
- Precision/personalized medicine
  - Based in part on bioinformatics and computational biology, with potential to revolutionize diagnosis and treatment of disease

20

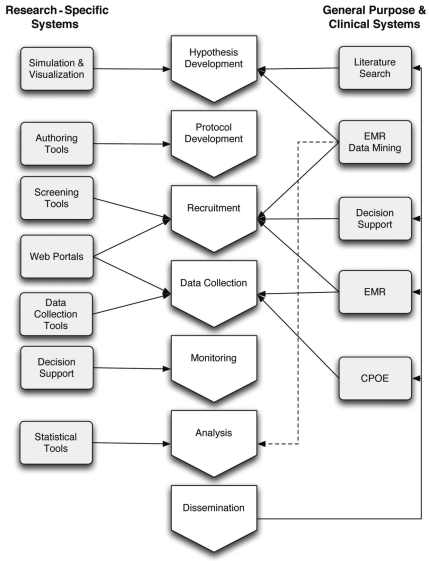
OREGON HEALTH & SCIENCE UNIVERSITY

Many roles for informatics in learning healthcare system (Greene, 2012)



Important for research too

- Clinical & Translational Science Award (CTSA) Program
  - Has galvanized related area of clinical research informatics (Richesson, 2013)
- Patient-Centered Outcomes Institute (PCORI)
  - Clinical Data Research Networks – www.pcornet.org (Fleurence, 2014)
- NIH Big Data to Knowledge (BD2K)
  - Training the next generation of scientists in data and related techniques



22

Caveats for the Use of Operational Electronic Health Record Data in Comparative Effectiveness Research

William R. Hersh, MD, Mark G. Weiner, MD,† Peter J. Embi, MD, MS,‡ Judith R. Logan, MD, MS,* Philip R.O. Payne, PhD,‡ Elmer V. Bernstam, MD, MSE,§ Harold P. Lehmann, MD, PhD,‖ George Hripcsak, MD, MS,¶ Timothy H. Hartzog, MD, MS,# James J. Cimino, MD,** and Joel H. Saltz, MD, PhD††*

But there are caveats for use of operational clinical data (Medical Care, 2013):

- Inaccurate
- Incomplete
- Transformed in ways that undermine meaning
- Unrecoverable for research
- Of unknown provenance
- Of insufficient granularity
- Incompatible with research protocols

23

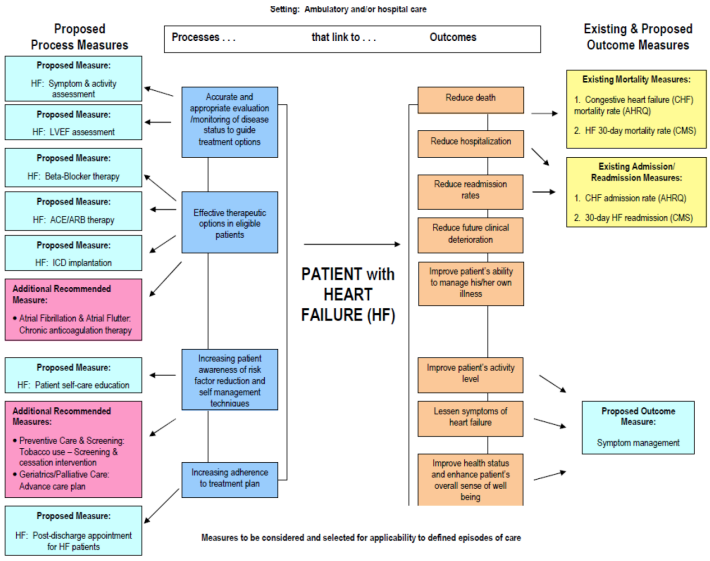
Example at OHSU: Knight Cardiovascular Institute (KCVI)

- From SOM Blog (June, 2014): "Elevate the institute's capabilities to analyze data and information essential to improving cardiovascular health outcomes and reducing cardiovascular healthcare costs."
- Plans
  - Automated, easy-to-use system for evaluating measures KCVI selects
  - Reporting interface that's intuitive and easy to use by clinicians and administrators
  - Clear documentation that supports maintenance and extension of the system
  - Alignment with OHSU's evolving long-term analytics strategy

24

OREGON HEALTH & SCIENCE UNIVERSITY

Initial focus on CHF, first measure reliable assessment of LVEF – Simple?



Informatics competence is also fundamental to clinician practice

- 21st century physicians and other clinicians must have competence in clinical informatics
- OHSU medical school curriculum being revised
  - Provides opportunity to introduce more informatics into curriculum
  - Process also aided by AMA Accelerating Change in Medical Education grant
- Driven by competencies focused on uses for informatics and not just technology itself

OREGON HEALTH & SCIENCE UNIVERSITY

Advances in Medical Education and Practice

Dovepress
open access to scientific and medical research

Open Access Full Text Article

PERSPECTIVES

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

William R Hersh[1]
Paul N Gorman[1]
Frances E Biagioli[2]
Vishnu Mohan[1]
Jeffrey A Gold[3]
George C Mejicano[4]

[1]Department of Medical Informatics and Clinical Epidemiology, [2]Department of Family Medicine, [3]Department of Medicine, [4]School of Medicine, Oregon Health & Science University, Portland, OR, USA

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) and 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 process 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.

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 patient care and other clinical tasks	Information retrieval/search: choose correct source for specific task, search using advanced features, apply results
	Evaluate information resources (literature, databases, etc) for their quality, funding sources, biases
	Identify tools to assess patient safety (eg, medication interactions)
	Utilize knowledge-based tools to answer clinical questions at the point of care (eg, textbooks, calculators, etc)
	Formulate an answerable clinical question
	Determine the costs/charges of medications and tests
	Identify deviations from normal (laboratory tests/X-ray/results) 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 reviewing a patient record
	Create and maintain an accurate problem list
	Recognize medical safety 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 list/allergies
	Create useable notes
	Write orders and prescriptions
	List common errors with data entry (drop down lists, copy and paste, etc)
Use and guide implementation of CDS	Recognize different types of CDS
	Be able to use different types of CDS
	Work with clinical and informatics colleagues to guide CDS use in clinical settings
Provide care using population health management approaches	Utilize patient record (data collection and data entry) to assist with disease management
	Create reports for populations in different health care delivery systems
	Use and apply data in accountable care, care coordination, and the primary care medical home settings
Protect patient privacy and security	Use security features of information systems
	Adhere to HIPAA privacy and security regulation
	Describe and manage ethical issues in privacy and security
Use information technology to improve patient safety	Perform a root-cause analysis to uncover patient safety problems
	Familiarity with safety issues
	Use resources to solve safety issues
Engage in quality measurement selection and improvement	Recognize the types and limitations of different types of quality measures
	Determine the pros and cons of a quality measure, how to measure it, and how to use it to change care
Use HIE to identify and access patient information across clinical settings	Recognize issues of dispersed patient information across clinical locations
	Participate in the use of HIE to improve clinical care
Engage patients to improve their health and care delivery though personal health records and patient portals	Instruct 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 patient education (eg, decision making tools, diagrams, patient education)
	Educate patients to discern quality of online medical resources (Web sites, applications, patient support groups, social media, etc)
	Maintain patient engagement while using an electronic health record (eye contact, body language, etc)
Maintain professionalism through use of information technology tools	Describe and manage ethics of media use (cloud storage issues, texting, cell phones, social media professionalism)
Provide clinical care via telemedicine, and refer those for whom it is necessary	Be able to function clinically in telemedicine/telehealth environments
Apply personalized/precision medicine	Recognize growing role of genomics and personalized medicine in care
	Identify resources enabling access to actionable information related to precision medicine
Participate in practice-based clinical and translational research	Use electronic health record alerts and other tools to identify patients and populations for offering clinical trial participation
	Participate in practice-based research to advance medical knowledge

Conclusions

- Some problems in healthcare have informatics solutions
- The new subspecialty of clinical informatics will provide solutions and (for some) career opportunities
- There are many issues in clinical informatics of importance for all physicians

OREGON HEALTH & SCIENCE UNIVERSITY

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

29

OREGON HEALTH & SCIENCE UNIVERSITY