Information is Different Now That You're a Doctor

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Disclosures/Conflict of Interest

- None

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Session Objectives

- Discuss the central role that data and information play in the practice of medicine
- Distinguish between the different aspects of information from a medical professional perspective including efficient and speedy retrieval, analysis of quality, and patient friendliness
- Describe the key issues of data in the electronic health record (EHR) to its use in data analytics, machine learning, and related areas
- Evaluate the discipline of clinical informatics as it pertains to medicine

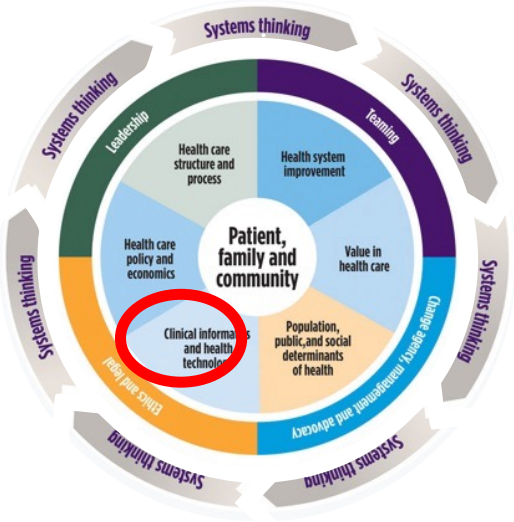
Part of (but not limited to) Health Systems Science:

Hersh and Ehrenfeld, *Clinical Informatics*, Chapter 10 in *Health Systems Science* (Skochelak et al., 2nd edition, 2020)

- Informatics part of health system science but more

For more information:

- Hoyt and Hersh (eds.), *Health Informatics: Practical Guide*, Lulu.com, 2018
  - New edition coming Fall, 2022
- *What is Biomedical Informatics?*
  - http://informatics.health



Information and the new medical student (Shortliffe, 2010)

WHEN I FIRST MEET WITH PRECLINICAL MEDICAL students, I make a point of asking them what they believe will receive the greatest focus of their attention once they are in clinical practice. The most common response, not surprisingly, is patients, and yet it is clear to experienced practitioners that the correct answer is information—in the service of their patients. The need for information underlies essentially all clinical work: the questions asked during a patient history, the tests ordered, the books read, and the questions asked of colleagues. A key correlate to information is knowledge, that elusive concept that justifies all the years of education and training, and that provides the background sense of what is true that allows gathering and interpreting information appropriately. Clinicians often start with data (eg, "Mr Jones' creatinine is 5.2 mg/dL"), those individual elements that combine to allow a synthesis of observations with what is known in order to create summary statements of information (eg, "Mr Jones has renal failure").

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Information skills are essential for medical practice (Glasziou, 2008)

The search engine is now as essential as the stethoscope

What we know about diseases, diagnosis, and effective treatments is growing rapidly. Today health professionals cannot solely rely on what they were first taught if they want to do the best for their patients. It has repeatedly been shown that clinical performance deteriorates over time.[1] A commitment to lifelong learning must be integral to ethical professional practice. However, the speed of the increase in knowledge—more than 2000 new research papers are added to Medline each day—represents a challenge.[2] The skills needed to find potentially relevant studies quickly and reliably, to separate the wheat from the chaff, and to apply sound research findings to patient care have today become as essential as skills with a stethoscope.

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Most of you are “digital natives” but

- Not the same as competence in clinical informatics
- Your relationship with information changes as you become a healthcare professional
- You become responsible not only for “knowing” information, but also
  - Using it to provide better care of patients
  - Leveraging it to improve the healthcare system
  - Protecting privacy and confidentiality of patients
  - Acting professionally with information
  - Critically analyzing data sets and their potential biases
- Computer literacy is a prerequisite, not an end

Why is information different now that you’re in medicine?

- Growth of medical knowledge
  - 75 new clinical trials and 11 systematic reviews published each day (Bastian, 2010)
    - To say nothing of the basic science, especially genomics
- Medical knowledge no longer the exclusive purview of physicians
  - >80% of all Internet users search for personal health information (Fox, 2013)

Many problems in healthcare have information-related solutions

- Quality – not as good as it could be; slightly more than half of patients get care they should get (McGlynn, 2003; McGlynn, 2020)
- Safety – errors cause morbidity and mortality; many preventable (IOM, 2000; Classen, 2011; Leape, 2021)
- Cost – US spends more and gets less (Angrisano, 2007; Brill, 2013; Martin, 2021)
- Inaccessible information – missing information frequent in primary care (Smith, 2005)

EHR is more than "charting"

- Physicians must be able to
  - Move from one vendor system to another
  - Effectively use clinical decision support to remind us to things to do and warn us about things not to do
  - Access information from other settings where patient received care through health information exchange
  - Apply data analytics, especially in setting of population health management, to achieve quality, safety, and cost-effectiveness

Patients want more from us too

- They have access to just about all of the same knowledge resources we can access through the *personal health record* (PHR)
  - And increasingly all of their medical record
- They want to interact with us digitally and want to interact with healthcare the way they interact with airlines, retailers, banks, etc.
- They want access to and control over their data
  - We must educate them in the risks and benefits

Those who pay for care want more accountability from us

- Purchasers (employers, government) and payors (insurers) want assurance that care provided is high-quality and cost-effective
  - *Clinical decision support* aims to help physicians make best choices and avoid errors
  - Growing use of *quality measurement and improvement*

We also have responsibilities around data and information

- Patients expect us to keep their information private and secure
  - *Health Insurance Portability and Accountability Act* (HIPAA) regulations guide our actions
    - Treatment, payment, and operations (TPO) allow disclosure
    - Other uses require patient consent
- Our public-facing persona must be professional, especially on social media
- Growing recognition of bias as we make more use of data and algorithms
  - Protecting from companies and others "monetizing" our personal health data (McGraw, 2020; Cole, 2021)
  - Algorithms mis-appropriating resources based on biased data (Obermeyer, 2019; Kakani, 2020)
  - Reconsidering use of race in algorithms (Butterfield, 2021)

Informatics skills essential for 21st century practice (Hersh, 2014; 2017; 2020)

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PERSPECTIVES

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

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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) 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.

From Competencies to Competence: Model, Approach, and Lessons Learned From Implementing a Clinical Informatics Curriculum for Medical Students

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1. Find, search, and apply knowledge-based information to patient care and other clinical tasks.
   a. Information retrieval/search—choose correct sources for specific task, search using advanced features, apply results.
   b. Evaluate information resources (literature, databases, etc.) for their quality, funding sources, biases.
   c. Identify tools to assess patient safety (e.g., medication interactions).
   d. Utilize knowledge-based tools to answer clinical questions at the point of care (e.g., text resources, calculators).
   e. Formulate an answerable clinical question.
   f. Determine the costs/charges of medications and tests.
   g. Identify deviations from normal (labs/x-rays/results) and develop a list of causes of the deviation.
2. Effectively read from, and write to, the electronic health record for patient care and other clinical activities.
   a. Graph, display, and trend vital signs and laboratory values over time.
   b. Adopt a uniform method of reviewing a patient record.
   c. Create and maintain an accurate problem list.
   d. Recognize medical safety issues related to poor chart maintenance.
   e. Identify a normal range of results for a specific patient.
   f. Access and compare radiographs over time.
   g. Identify inaccuracies in the problem list/history/medications list/allergies.
   h. Create useable notes.
   i. Write orders and prescriptions.
   j. List common errors with data entry (drop-down lists, copy and paste, etc.).
3. Use and guide implementation of clinical decision support (CDS).
   a. Recognize different types of CDS.
   b. Be able to use different types of CDS.
   c. Work with clinical and informatics colleagues to guide CDS use in clinical settings.
4. Provide care using population health management approaches.
   a. Utilize patient record (data collection and data entry) to assist with disease management.
   b. Create reports for populations in different health care delivery systems.
   c. Use and apply data in accountable care, care coordination, and the primary care medical home settings.
5. Protect patient privacy and security.
   a. Use security features of information systems.
   b. Adhere to Health Insurance Portability and Accountability Act (HIPAA) privacy and security regulations.
   c. Describe and manage ethical issues in privacy and security.
6. Use information technology to improve patient safety.
   a. Perform a root cause analysis to uncover patient safety problems.
   b. Maintain familiarity with safety issues.
   c. Use resources to solve safety issues.
7. Engage in quality measurement selection and improvement.
   a. Recognize the types and limitations of different types of quality measures.
   b. Determine the pros and cons of a quality measure, how to measure it, and how to use it to change care.
8. Use health information exchange (HIE) to identify and access patient information across clinical settings.
   a. Recognize issues of dispersed patient information across clinical locations.
   b. Participate in the use of HIE to improve clinical care.
9. Engage patients to improve their health care delivery though personal health records (PHRs) and patient portals.
   a. Instruct patients in proper use of a PHR.
   b. Write an e-message to a patient using a patient portal.
   c. Demonstrate appropriate written communication with all members of the health care team.
   d. Integrate technology into patient education (e.g., decision-making tools, diagrams, patient education).
   e. Educate patients to discern quality of online medical resources (websites, apps, patient support groups, social media, etc.).
   f. Maintain patient engagement while using an electronic health record (EHR) (eye contact, body language, etc.).
10. Maintain professionalism through use of information technology tools.
    a. Describe and manage ethics of media use (cloud storage issues, texting, cell phones, social media professionalism).
11. Provide clinical care via telemedicine and refer patients as indicated.
    a. Be able to function clinically in telemedicine/telehealth environments.
12. Apply personalized/precision medicine.
    a. Recognize growing role of genomics and personalized medicine in care.
    b. Identify resources enabling access to actionable information related to precision medicine.
13. Participate in practice-based clinical and translational research.
    a. Use EHR alerts and other tools to identify patients and populations eligible for participation in clinical trials.
    b. Participate in practice-based research to advance medical knowledge.
14. Apply machine learning applications in clinical care.
    a. Discuss the applications of artificial/augmented intelligence in clinical settings.
    b. Describe the limitations and potential biases of data and algorithms.

EHR also allows many re-uses of patient data

- Use data to improve care delivery
- Healthcare quality measurement and improvement
- Clinical and translational research
- Precision medicine
- Public health surveillance

Data allows us to implement the *learning health system*

- Unlike other industries (e.g., aviation), medicine does not learn as well from its mistakes
  - Need to move away from culture of blame
  - Many problems based on systems, not individuals
- Growing amount of clinical data in EHR and other systems allow us to learn and improve
  - Can only be done with high-quality and usable information

(NAP, 2012)

Built on a foundation of data

- We have unprecedented amounts of data, not only from EHR but (Topol, 2019)
  - Patient-collected data, e.g., wearables, tracking, etc.
  - Omics, e.g., genes, their expression, proteins, microbiome, etc.
- And new techniques to make use of that data
  - *Data science* – "science of learning from data" (Donoho, 2017; in biomedicine: Hoyt, 2019)
  - *Big Data* – the four Vs: volume, velocity, variety, and variability (Chang, 2019)
  - *Machine learning* – computer programs that learn from data (Alpaydin, 2020)
  - *Deep learning* – new approaches to machine learning based on neural networks (Esteva, 2019)
  - *Artificial (augmented?) intelligence* – computer programs that perform tasks associated with human intelligence (AMA, 2018)
- Overviews
  - Deep Medicine (Topol, 2019)
  - National Academy of Medicine (Matheny, 2019)
  - (Rajkomar, 2022)

Machine learning will soon impact clinical practice

- Most success has been with image interpretation (Liu, 2019; Esteva, 2021)
  - Radiology – chest x-rays
  - Ophthalmology – retinal images
  - Dermatology – skin lesions
  - Pathology – breast cancer slides
- But success in other areas
  - Predicting adverse events in hospitals (Rajkomar, 2018)
  - Generating clinical notes from patient and physician verbal interaction (Rajkomar, 2019)
  - Predicting protein-folding from amino acid sequences (Jumper, 2021)
- Now need to translate basic science into clinical practice with clinical trials
  - Only (as of 2021) 65 randomized controlled trials in all medicine (Zhou, 2021)

Machine learning and AI going forward

- Must "democratize data" and algorithms (Allen, 2019)
- Address ethical concerns about use of data and algorithms (Chen, 2020)
- Need "algorithmovigilance" (Embi, 2021)
- Will AI replace physicians?
  - "AI won't replace radiologists, but radiologists who use AI will replace radiologists who don't," Langlotz, Stanford radiologist (Reardon, 2019)

We must also learn to practice medicine by alternative modalities

- Telehealth/telemedicine – clinical care separated by time and/or distance (Daniel, 2015)
  - Synchronous – real-time
  - Asynchronous – sending images, video, etc.
- Usage exploded at onset of pandemic, aided by relaxation of rules (Verma, 2020)
  - Has reduced somewhat but much above earlier baseline (Reader, 2022)
  - Ongoing concerns about digital divide and digital health equity (Barnett, 2022)

Informatics lessons from COVID-19

- Has exposed not only health disparities but technology disparities
  - Broadband Internet is a social determinant of health (Sieck, 2021)
  - Public health information systems not up to task (Gottlieb, 2021)
- Disinformation is deadly
  - Spread widely by small number of people (Disinformation Dozen, 2021)
  - Augmented via automated means on social media, e.g., Facebook (Ayers, 2021)
  - Leading to assaults on science and scientists (Hotez, 2021; Hotez, 2021)


The New York Times

NEW YORK, TUESDAY, SEPTEMBER 28, 2021

Covid Politics Are Walloping Red America

Concentration of Cases in Right-Leaning Areas

The Partisan Tilt of Vaccination Rates ...

Almost every reliably red state now has a higher share of unvaccinated people than almost every reliably blue state.

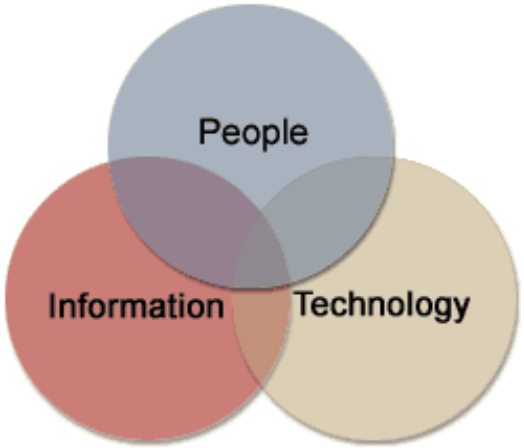
... And Deaths From the Coronavirus

Average daily Covid deaths in the U.S., per 100,000 residents, by county vote share 2020.

(Leonhardt, 2021; via @EricTopol)

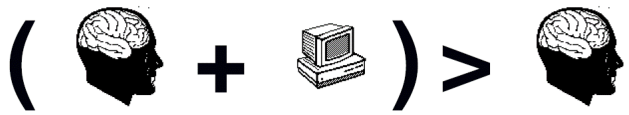
Clinical informatics

- Part of larger *biomedical and health informatics*, the field concerned with the optimal use of information, often aided by technology, to improve
  - Individual health
  - Healthcare
  - Public health
  - Biomedical research
- (Hersh, 2009; Detmer, 2014)



Fundamental theorem of informatics

Goal of informatics is



Goal is not

(Friedman, 2009)

Clinical informatics

- Competence required of all; career opportunities available for some
- Growing number of physicians work in roles such as *Chief Medical Informatics Officer* (CMIO) or others in academia or industry
  - Clinical informatics is now a subspecialty of all medical specialties
- OHSU is a national leader in research and education; MD informatics curriculum probably more advanced than any other medical school
  - http://www.ohsu.edu/informatics

What can you do in clinical informatics?

- Informatics skills are essential to the practice of the 21st century physician
  - You should master informatics just as you master any other clinical skill
- For those interested as a career, plenty of opportunities in medical school and beyond
  - Scholarly projects, electives, and more
  - Advanced study – e.g., graduate degree and/or fellowship
  - Clinical informatics subspecialty

Conclusions

- Clinical informatics can benefit healthcare, public health, and individual health
- We must engage patients in use of informatics tools, with particular attention to access and equity
- We must aim to minimize harms from poor-quality and mis-used health data