Information is Different Now That You're a Doctor

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Disclosures/Conflict of Interest

- None

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Session Objectives

- Define the field of clinical informatics and the central role that data and information play in medicine and healthcare
- Describe how information is different from a medical professional perspective, including how it is used for care and other purposes, kept private and secure, and shared with patients
- Discuss the impact and challenges of artificial intelligence (AI) in medicine
- Describe the discipline of clinical informatics as it pertains to healthcare professionals, including those who work professionally in it

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About me

- Professor in Department of Medical Informatics & Clinical Epidemiology (DMICE)
- Medical school and residency in internal medicine at University of Illinois Chicago, followed by fellowship in medical informatics at Harvard University
- At OHSU since 1990
- Served as Inaugural Chair of DMICE from 2003-2022
- Have developed informatics educational programs for informaticians, physicians, and others over the years

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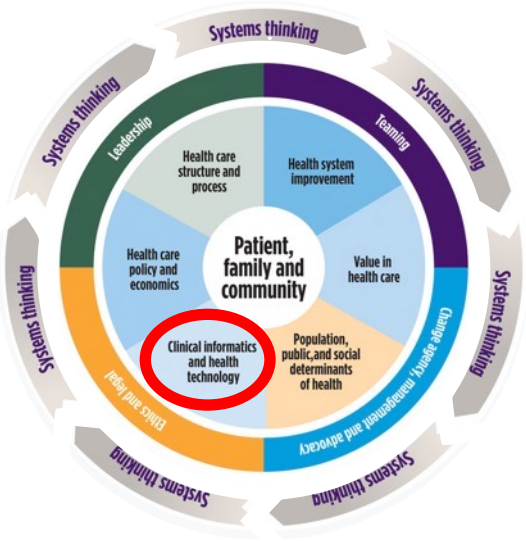
Clinical informatics is part of (but not limited to) Health Systems Science

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



For more information:

- Hersh (Ed.), *Health Informatics: Practical Guide, 8th Edition*, Lulu.com, 2022
  - http://www.informaticsbook.info/
- What is Biomedical Informatics?
  - http://informatics.health

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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 medical 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 AI, data used for it, and potential biases
- Computer literacy is a prerequisite, not an end

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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)

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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; Leape, 2021)
- Cost – US spends more and gets less (Gunja, 2023)
- Inaccessible information – missing information still not always accessible (Pylypchuk, 2023)

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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 of things to do and warn us about things not to do (Greenes, 2023)
  - Access information from other settings where patient received care through *health information exchange* (Dixon, 2022)
  - Apply *data analytics*, especially in setting of population health management, to achieve quality, safety, and cost-effectiveness
  - Integrate *artificial intelligence* (AI) in care of patients

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Patients want more access to data and information 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

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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
  - Use of *quality measurement and improvement*
- Leading to calls for a *learning health system*, where we learn from data to improve care (IOM, 2012)

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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 with protected health information (PHI)
    - Treatment, payment, and operations (TPO) allow disclosure
    - Other uses require patient consent
    - Only applies to data within healthcare system
- Our public-facing persona must be professional, especially on social media
- Growing recognition of bias in data and algorithms
  - Algorithms mis-appropriating resources (Obermeyer, 2019; Kakani, 2020)
  - Companies and others "monetizing" our personal health data (McGraw, 2020)
  - Implementing responsible (Dorr, 2023) and fair (Chen, 2023) AI

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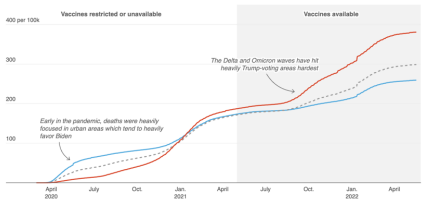
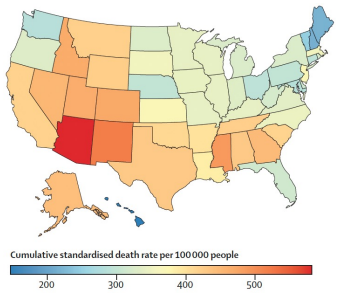
Including some lessons learned from COVID-19

- Disinformation spread widely by small number of people (Disinformation Dozen, 2021), including about 50 physicians (Sule, 2023), augmented via large following and automated means on social media, e.g., Facebook (Ayers, 2021)
- Impact related to vaccine uptake and (indirectly) political leanings (Wood, 2022; Bollyky, 2023)
- Leading to assaults on science and scientists (Hotez, 2021; Hotez, 2023)





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We must also manage and lead the introduction of AI in medicine

- AI – information systems and algorithms capable of performing tasks associated with human intelligence (Copeland, 2024)
- Some classify AI into two broad categories (Khare, 2023)
  - *Predictive AI* – use of data and algorithms to predict some output (e.g., diagnosis, treatment recommendation, prognosis, etc.)
  - *Generative AI* – generates new output based on prompts (e.g., text, images, etc.)
- A large part of modern success of AI due to *machine learning* (ML) – "computer programs that learn without being explicitly programmed" (McCarthy, 1990, attributed to Samuel, 1959; Shah, 2023)
  - Most success with *deep learning*, based on many-layered neural networks

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Impressive results of predictive AI on various types of data

- Most success has been with image interpretation (Rajpurkar, 2023); examples include
  - Radiology – chest x-rays for diagnosis of pneumonia and tuberculosis
  - Ophthalmology – retinal images for diagnosis of diabetic retinopathy
  - Dermatology – skin lesions for diagnosis of cancer
  - Pathology – breast cancer slides to predict metastasis
- Achievements in other areas
  - Predicting adverse events in hospitalizations (Rajkomar, 2018)
  - Generating clinical notes from patient and physician verbal interaction (Rajkomar, 2019)
  - Semantic reconstruction of continuous language from fMRI brain recordings (Tang, 2023)
  - Map chemicals to odors perceived by humans (Lee, 2023)
  - Predicting protein folding from amino acid sequences (Abramson, 2024)
  - Predict Alzheimer's Disease using EHR data up to 7 years before diagnosis (Tang, 2024)

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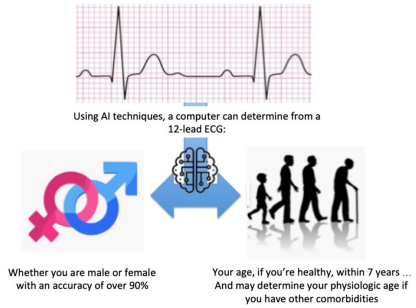
Including ability to "see" where humans cannot (Topol, 2023)

- Retinal images
  - Age, sex, and cardiovascular risk determination from retinal images (Poplin, 2018)
  - Race (Coyner, 2023)
- ECG
  - Age and sex determination (Attia, 2019)
  - Chronic kidney disease (Holmstrom, 2023)
- Chest x-ray
  - Race (Gichoya, 2022)
  - Cardiac function and valvular heart diseases (Ueda, 2023)
  - Diabetes mellitus (Pyrros, 2023)
  - Correlation with chronological age in healthy cohorts and, for various chronic diseases, difference between estimated age and chronological age (Mitsuyama, 2023)
  - Cardiac risk as accurately as common models, e.g., atherosclerotic cardiovascular disease (ASCVD) (Weiss, 2024)



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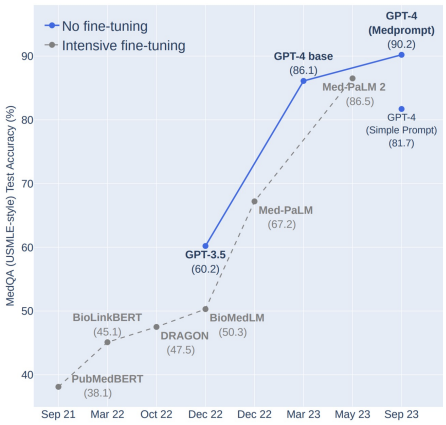
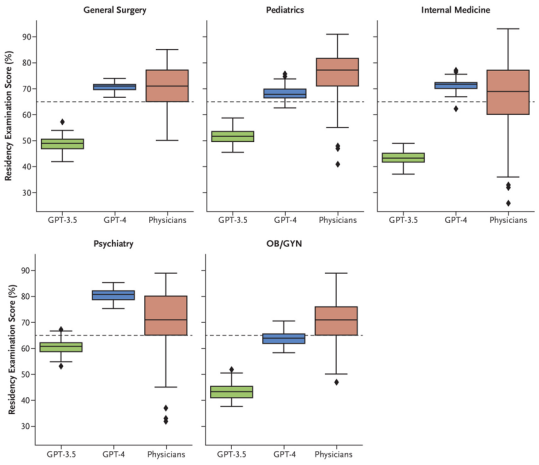
And now, generative AI and large language models (LLM)

- Introduction of ChatGPT in November 2022 brought a new type of AI into focus: generative AI
- LLMs based on transformer models trained with large amounts of text (Omiye, 2024)
- Impressive performance in medicine and beyond, e.g.,
  - US Medical Licensing Exam (USMLE) (Nori, 2023)
  - Board exams in e.g., radiology (Bhayana, 2023) and clinical informatics (Kumah-Crystal, 2023)
  - *New England Journal of Medicine* clinical cases (Kanjee, 2023)
  - Answering questions in social media forums (Ayers, 2023)
  - Drafting letters to patients (Ali, 2023)



Performing comparable to physicians

- Physician history-taking, diagnostic accuracy, management reasoning, communication skills, and empathy (Tu, 2024)
- Attending physicians and residents in diagnostic accuracy, correct clinical reasoning, and cannot-miss diagnosis inclusion (Cabral, 2024)
- Post-residency board exams (Katz, 2024)



Will AI replace physicians?

- Real-world use and evidence base still modest
  - Systematic reviews of clinical trials of predictive AI systems show small number of trials (relative to predictive modeling papers), mediocre methodologies, and mixed results (Plana, 2022; Han, 2024)
- LLMs impressive but
  - Prone to confabulation (Lee, 2023)
  - Most only provide answers and not references to cite their assertions (Hersh, 2024)
- "AI won't replace radiologists, but radiologists who use AI will replace radiologists who don't," (Langlotz, 2019)

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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 from peak but well above pre-pandemic baseline (Anderson, 2022)

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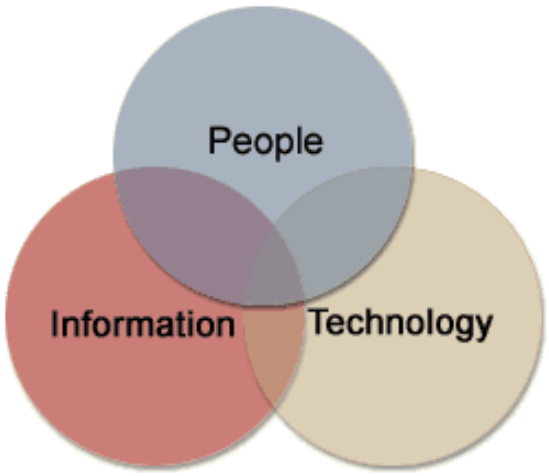
Informatics and medical education

- "Informatics training for clinicians is more important than hardware and software" (Safran, 2009)
- Health informatics is a "required skill for 21st century clinicians" (Fridsma, 2018)
- Competencies (Hersh, 2014; Hersh, 2023) and curricula (Hersh, 2017)
- Clinicians must be prepared to practice in a world of AI (James, 2022)
- New AI-competency frameworks highlight what health professions students must master (Russell, 2023; Liaw, 2023)

1. Find, search, and apply knowledge-based information to patient care and other clinical tasks
2. Effectively read from, and write to, the electronic health record (EHR) for patient care and other clinical activities
3. Use and guide implementation of clinical decision support (CDS)
4. Provide care using population health management approaches
5. Protect patient privacy and security
6. Use information technology to improve patient safety
7. Engage in quality measurement selection and improvement
8. Use health information exchange (HIE) to identify and access patient information across clinical settings
9. Engage patients to improve their health and care delivery though personal health records and patient portals
10. Maintain professionalism in use of information technology tools, including social media
11. Provide clinical care via telemedicine and refer patients as indicated
12. Apply personalized/precision medicine
13. Participate in practice-based clinical and translational research
14. Use and critique artificial intelligence (AI) applications in clinical care

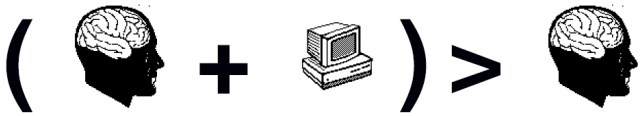
Clinical informatics

- 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
- (Detmer, 2014; Hersh, 2020; Hersh 2022)



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 now a subspecialty of all medical specialties (Detmer, 2014)
  - ACGME-accredited fellowships gold standard for training (Kim, 2023)

What can you do in clinical informatics in medical school?

- Informatics skills are essential to the practice of the 21st century physician
  - You should master informatics just as you master any other clinical skill
  - Activities available throughout the curriculum, including
    - Epidemiology, Evidence-Based Medicine, and Informatics thread
    - Clinical Informatics elective – available as 2-week block (MINF 705B) or across an academic quarter (MINF 709A)
    - Research opportunities in informatics (MINF 701B)
- 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 fellowship

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Questions to ponder

- What are the most important ways that clinical informatics can benefit clinical practice?
- How can and should we engage patients in the use of informatics tools?
- How can we make the best use of AI while minimizing its risks?

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Thank you.