Artificial Intelligence (AI): Implications for Health Professions Education

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SUMMIT ON HIGHER EDUCATION

Artificial Intelligence (AI): Implications for Health Professions Education

William Hersh, MD, FACMI, FAMIA, FIAHSI

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Meet the presenter

William Hersh, MD, FACMI, FAMIA, FIAHSI

William Hersh is a Professor in the Department of Medical Informatics & Clinical Epidemiology (DMICE) in the School of Medicine at Oregon Health & Science University (OHSU) in Portland, Oregon, USA. He served as the Inaugural Chair of DMICE from 2003-2022. Dr. Hersh is a leader and innovator in biomedical informatics both in education and research.

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Agenda / Objectives

After this talk, you will be able to

1. Define the terminology and major types of AI
2. Discuss key issues for AI in health professions education
3. Describe competencies in AI for health professions learners
4. Further learn from annotated bibliography

Definitions and terminology related to artificial intelligence (AI)

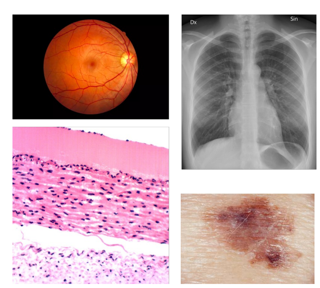
- AI – "information systems and algorithms capable of performing tasks associated with human intelligence" (Rajpurkar, 2022; Sahni, 2023)
  - Predictive AI – use of data and algorithms to predict some output (e.g., diagnosis, treatment recommendation, prognosis, etc.)
  - Generative AI – generates new output based on prompts (e.g., text, images, etc.)
- A large part of modern success of AI due to machine learning – "computer programs that learn without being explicitly programmed" (McCarthy, 1990, attributed to Samuel, 1959)
  - Most success with deep learning, based on many-layered neural networks
- Other terms
  - Data science – science of learning from data (Donoho, 2017)
  - Data analytics – use of data and statistical analysis to build explanatory and predictive models and drive decisions and actions (Davenport, 2017)
  - Big Data – data characterized by large volume, velocity, variety and variability (Chang, 2019)

History of AI – first era in mid-20th century

- Earliest paper related to AI and biomedical informatics attributed to Ledley and Lusted (1959) aiming to model physician reasoning through symbolic logic and probability
- Warner (1961) developed mathematical model for diagnosing congenital heart disease
- In 1960s-1970s, emergence of "expert systems" – computer programs aiming to mimic human expertise (historical overview – Lea, 2023)
  - Rule-based systems – PhD dissertation of Shortliffe (1975) and subsequent work (Clancey, 1984)
  - Disease profiles and scoring algorithms – INTERNIST-1 (Miller, 1982) and DxPlain (Barnett, 1987)
- Limited by approach of manual construction and maintenance of knowledge
  - Not scalable or sustainable
  - Led to "AI winter" between 1990-2010
  - Main remnant is clinical decision support (CDS) for electronic health records (EHRs) that emerged in 1990s (Greenes, 2023)

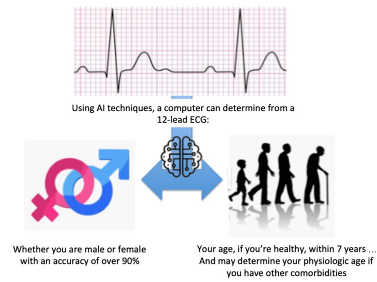
Re-emergence of AI in 21st century

- "Predictive AI" driven by advances in machine learning, increasing availability of data, and more powerful computers and networks (Topol, 2019; Rajpurkar, 2022)
  - Deep learning in imaging advanced by Hinton (2006)
- Most success in 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
- But achievements in other areas
  - Predicting adverse events in hospitalizations from EHR data (Rajkomar, 2018)
  - Generating clinical notes from patient and physician verbal interaction (Rajkomar, 2019)
  - Predicting protein folding from amino acid sequences (Jumper, 2021)
  - Semantic reconstruction of continuous language from fMRI brain recordings was 82% accurate (Tang, 2023)



Also success in "seeing" where humans cannot (Topol, 2022)

- Retinal images
  - Age, biological sex, and cardiovascular risk determination from retinal images (Poplin, 2018)
  - Race (Coyner, 2023)
- Electrocardiograms (ECGs)
  - Age and biological sex determination (Attia, 2019)
  - Hyperkalemia from 2 (of 12) leads (Galloway, 2019)
  - Diagnosis and risk stratification in occlusive myocardial infarction (Al-Zaiti, 2023)
  - Chronic kidney disease (Holmstrom, 2023)
  - Left ventricular systolic dysfunction from ECG images (Sangha, 2023)
- Chest x-rays
  - Race (Gichoya, 2022)
  - Cardiac function and valvular heart diseases (Ueda, 2023)
  - Diabetes (Pyrros, 2023)
  - Correlation with chronological age in healthy cohorts and, for various chronic diseases, difference between estimated age and chronological age (Mitsuyama, 2023)



And now "generative AI"

- Introduction of ChatGPT in November, 2022 brought new type of AI into focus: generative AI
  - Initially based on GPT-3.5 model; added larger GPT-4 soon after
- Based on large language models (LLMs) that use large amounts of training data processed by deep neural networks and tuned for specific tasks
  - Trained on massive amounts of text and other content, e.g., large Web crawls, books, Wikipedia, and more for ChatGPT (Roberts, 2022)
  - Use transformer models that predict words in sequence and give importance to "attention" words (Raschka, 2023)
  - Fine-tuned for specific tasks – aiming for "zero-shot" answers (Chung, 2022)
  - Activated by (and importance of) prompting (Liu, 2023)

Results of ChatGPT and other LLMs

- Medical board exams
  - USMLE "arms race," starting with (Kung, 2023)
    - Claimed best – https://www.openevidence.com/blog/openevidence-ai-first-ai-score-above-90-percent-on-the-usmle
  - Passing level on some board exams (clinical informatics – Kumah-Crystal, 2023; radiology – Bhayana, 2023) but not others (neonatology - Beam, 2023)
- Answering questions
  - Vary by subject domain and type, but sometimes wrong and/or incomplete (e.g., Antaki, 2023; Chen, 2023)
- Solving clinical cases
  - Comparable to but not better than expert humans (e.g., Levine, 2023; Kanjee, 2023; Rao, 2023; Benoit, 2023)
- Communicating with patients
  - Answer questions in public forums and write letters with comparable or better empathy (e.g., Sarraju, 2023; Ali, 2023, Ayers, 2023)

But there are downsides

- Equally compelling disinformation – humans cannot distinguish between true and false tweets generated by GPT-3 and written by real Twitter users (Spitale, 2023)
- Fabrication and errors in the bibliographic citations – asked to produce short literature reviews on 42 multidisciplinary topics (Walters, 2023)
  - 55% of GPT-3.5 citations and 18% of GPT-4 citations fabricated
  - 43% of real (non-fabricated) GPT-3.5 citations and 24% of real GPT-4 citations include substantive errors
- Prompted to cite articles about learning health systems, GPT-3.5 cited 98% incorrect; GPT-4 cited more and only 20.6% incorrect (Chen, 2023)
- 8 dermatology questions asked of 4 LLMs recapitulated "harmful, race-based medicine" (Omiye, 2023)
- Performs worse than humans in abstraction and analogy problems (Moskvichev, 2023)
- GPT detectors more likely to classify non-native English writing as AI-generated (Liang, 2023)

Bibliometric analysis of ChatGPT (Alessandri-Bonetti, 2023)

- 724 articles published in PubMed through July 1, 2023
- Five major areas of publications
  - Ethics – user responsibility, accuracy of ChatGPT output, risk of lack of human oversight, and social implications of widespread use of AI
  - Clinical practice – clinical decision making often tested using simulated clinical scenarios
  - Medical education – provide interactive and personalized learning experiences, resembling an interactive medical encyclopedia, including performance at licensing exams such as USMLE
  - Scientific research – testing ability to generate ideas for and assist in writing of scientific articles, grants, and review papers
  - Patient education – deliver accessible, reliable, and understandable medical information to patients

Will AI help or hinder healthcare?

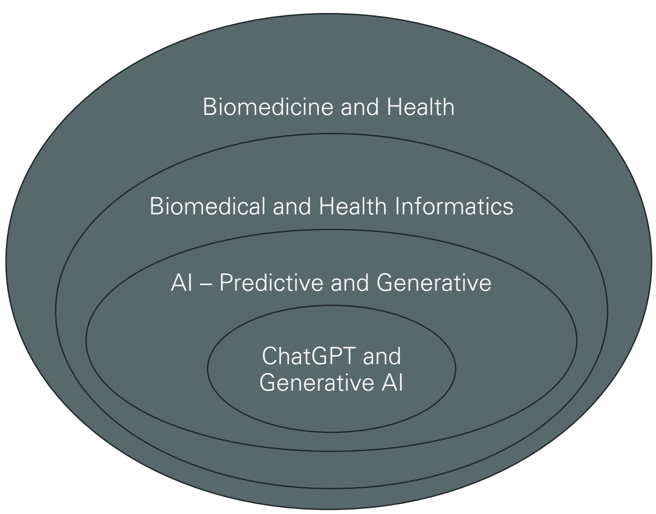
- Real-world use and evidence base still modest
  - Systematic review of clinical trials of predictive AI systems showed only 41 trials (tiny relative to predictive modeling papers), mediocre methodologies and risk of bias, and mixed positive/negative results (Plana, 2022)
- "AI won't replace radiologists, but radiologists who use AI will replace radiologists who don't," (Langlotz, 2019)
- Must address bias in data and algorithms
  - AI may compromise care if not used properly (DeCamp, 2023)
  - Must be implemented in responsible (Dorr, 2023) and fair (Chen, 2023) ways

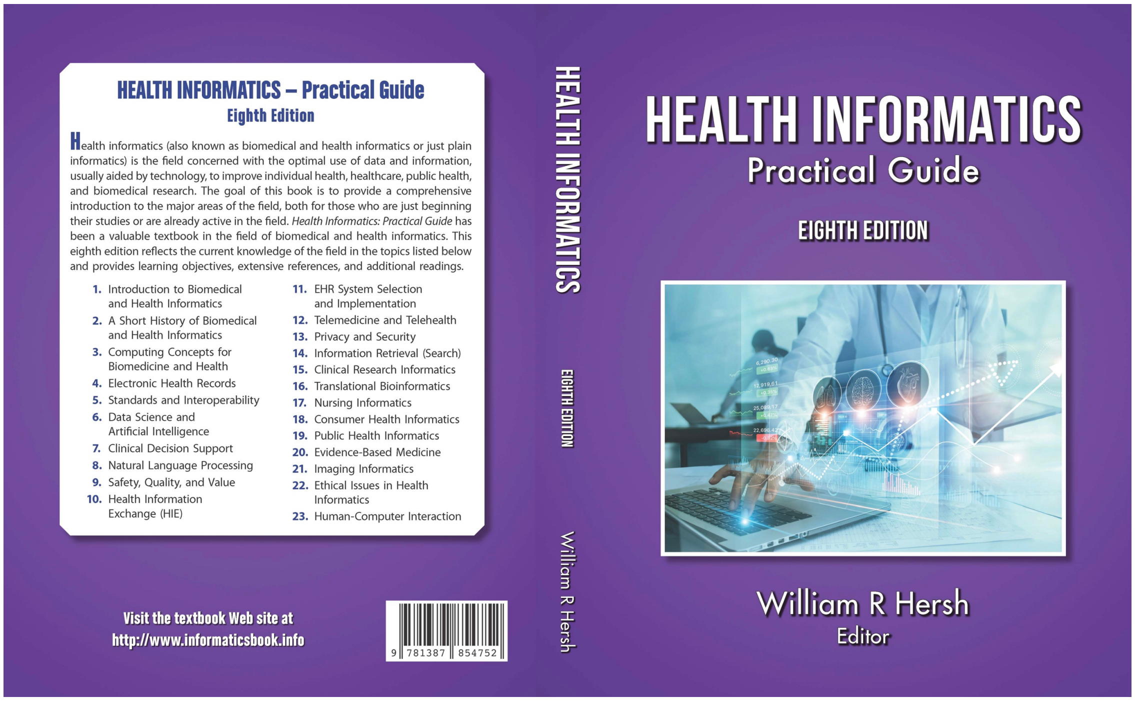
AI and health professions education

- Mostly physician-based but applies to all health professions
- Before generative AI there was recognition of need for competencies in clinical informatics for medical education (Hersh, 2014; Hersh 2020)
- Others noted
  - AI should be taught as a "fundamental toolset" (Ötleş, 2022)
  - Clinicians must be prepared to practice in a world of AI (James, 2022)
  - Medical schools face dual challenges of needing to teach about AI in practice but also adapt to its use by learners and faculty (Cooper, 2023)
- New AI-based competency frameworks
  - Use of AI-based tools by healthcare professionals (Russell, 2023)
  - We must prepare physicians for the "clinical algorithm era" (Goodman, 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

Where does AI fit in health professions education?





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Generative AI in education – it's already here

- "My class required AI. Here's what I've learned so far." (Mollick, 2023)
- "I'm a student. You have no idea how much we're using ChatGPT. No professor or software could ever pick up on it." (Terry, 2023)
- "The end of the take-home essay? How ChatGPT changed my plans for the fall." (Robin, 2023)
- "Here's my AI policy for students: I don't have one." (Zimmerman, 2023)
- "ChatGPT has transformed the problem of grade inflation from a minor corruption to an enterprise-destroying blight." (Clune, 2023)

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Chat GPT benefits and risks in education (Sok, 2023)

- Benefits
  - Creating learning assessment
  - Enhancing pedagogical practice
  - Offering virtual personal tutoring
  - Creating an outline
  - Brainstorming ideas
- Risks
  - Academic integrity issues
  - Unfair learning assessment
  - Inaccurate information
  - Over-reliance on AI

Prompting ChatGPT in education

- Benefits for students (Mollick, 2022)
  - Improving transfer of knowledge
    - Apply concept(s) to new situations
    - Critique output as right or wrong
  - Teaching how to evaluate
    - Assess and improve output
  - Break illusion of explanatory depth
    - Explain steps of a concept
- Benefits for faculty (Mollick, 2023)
  - Providing multiple examples and explanations
  - Uncovering and addressing student misconceptions
  - Frequent low-stakes testing
  - Assessing student learning
  - Distributing practice of important ideas over time

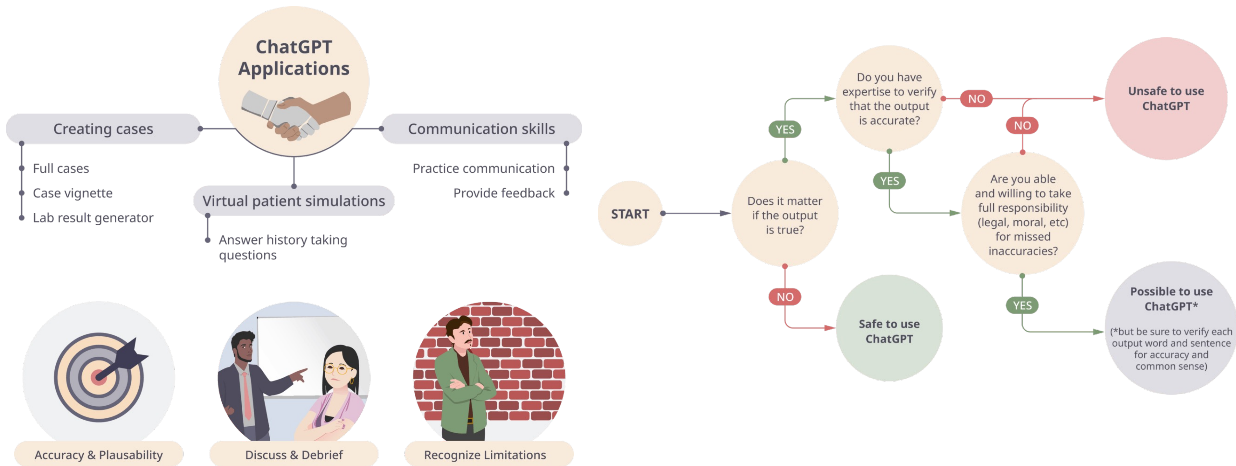
ChatGPT will change education, not destroy it (Heaven, 2023)

- Assessment already broken: "if ChatGPT makes it easy to cheat on an assignment, teachers should throw out the assignment rather than ban the chatbot"
- Change focus: use ChatGPT to generate an argument and then annotate it according to how effective argument was for a specific audience; then turn in rewrite based on their criticism
- Overcome misinformation and bias: ask students to use ChatGPT to generate text on a topic and then point out flaws
- Interact with ChatGPT to debate and generate counterarguments

Strategies for responsible use of ChatGPT in education (Halaweh, 2023)

- Explicit policy in course syllabi or assessments
- Student reflection
- Audit trail of queries
- Use AI detector tools
- Swap student and instructor roles in use

ChatGPT in medical education (Ratliff, 2023)



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Recommendations for medical faculty and institutions (Boscardin, 2023)

- Educators
  - Increase AI knowledge
  - Understand the current landscape of AI use in medical education
  - Review strategies for successful AI integration into education
  - Become stewards of ethical use of AI
- Institutions
  - Review and revise school policies (and create new policies as needed) regarding use of generative AI
  - Support faculty development about AI and provide resources for teaching
  - Offer information-checking tools for originality and plagiarism to faculty

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Competencies for use of AI-based tools by healthcare professionals (Russell, 2023)

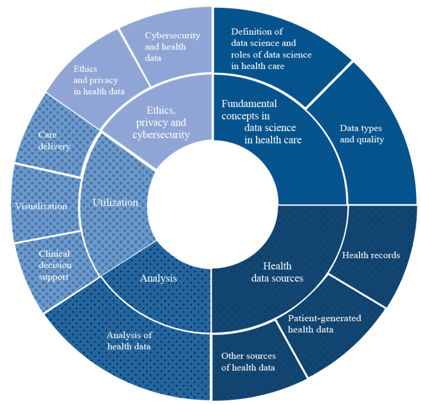
- Basic knowledge of AI
  - Explain what AI is and describe its healthcare applications
- Social and ethical implications of AI
  - Explain how social, economic, and political systems influence AI-based tools and how these relationships impact justice, equity, and ethics
- AI-enhanced clinical encounters
  - Carry out AI-enhanced clinical encounters that integrate diverse sources of information in creating patient-centered care plans
- Evidence-based evaluation of AI-based tools
  - Evaluate the quality, accuracy, safety, contextual appropriateness, and biases of AI-based tools and their underlying datasets in providing care to patients and populations
- Workflow analysis for AI-based tools
  - Analyze and adapt to changes in teams, roles, responsibilities, and workflows resulting from implementation of AI-based tools
- Practice-based learning and improvement regarding AI-based tools
  - Participate in continuing professional development and practice-based improvement activities related to use of AI tools in healthcare

Competencies for use of AI in primary care (Liaw, 2023)

Domain	Bottom Line	Competency
Foundational knowledge	What is this tool?	Clinicians will explain the fundamentals of AI, how AI-based tools are created and evaluated, the critical regulatory and socio-legal issues of the AI-based tools, and the current and emerging roles of AI in health care.
Critical appraisal	Should I use this tool?	Clinicians will appraise the evidence behind AI-based tools and assess their appropriate uses via validated evaluation frameworks for health care AI.
Medical decision making	When should I use this tool?	Clinicians will identify the appropriate indications for and incorporate the outputs of AI-based tools into medical decision making such that effectiveness, value, equity, fairness, and justice are enhanced.
Technical use	How do I use this tool?	Clinicians will execute the tasks needed to operate AI-based tools in a manner that supports efficiency and builds mastery.
Patient communication	How should I communicate with patients regarding the use of the tool?	Clinicians will communicate what the tool is and why it is being used, answer questions about privacy and confidentiality, and engage in shared decision making, in a manner that preserves or augments the clinician-patient relationship.
Unintended consequences (cross-cutting)	What are the "side effects" of this tool?	Clinicians will anticipate and recognize the potential adverse effects of AI-based tools and take appropriate actions to mitigate or address unintended consequences.

Core competencies in data science for medical education in age of AI in healthcare (Seth, 2023)

- Fundamental concepts in data science in health care
  - Definition of data science and roles of data science in health care
  - Data types and quality
- Health data sources
  - Health records
  - Patient-generated health data
  - Other sources of health data
- Analysis
  - Analysis of health data
- Usage
  - Visualization
  - Care delivery
  - Clinical decision support
- Ethics, privacy, and cybersecurity
  - Ethics and privacy in health data
  - Cybersecurity and health data



Preparing physicians for the "clinical algorithm era" (Goodman, 2023)

- Preclinical medical education
  - Teach probability in medical school using intuitive, modern approaches
  - Teach probabilistic clinical reasoning
  - Assess probability and probabilistic reasoning skills
  - Teach core, foundational working knowledge of CDS and EHR implementation, relevant to clinical use
  - Practice interpreting CDS output in applied learning
- Clinical training
  - Reinforce probabilistic training and application
  - Build CDS interpretation into curricula
  - Reinforce working knowledge of CDS and EHR implementation, relevant to clinical use
  - Include working knowledge of CDS in ACGME core competencies

Conclusions

- Predictive and generative AI will profoundly impact the practice and education of health professions
  - Day-to-day impact, especially in clinical settings, small so far but likely to grow
  - Need real-world implementation and evaluation for safety and efficacy just like all other clinical interventions
- Clinical and informatics professionals must be able to understand, implement, and critique applications of AI in their work and in healthcare more broadly
- Health professions educators must adapt to generative AI for writing, examination, and other pedagogic tasks

Questions?

Please use the Q&A box within zoom to enter your questions.

Thank You

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