The Critical Need to Build the Evidence Base for AI Implementations in Biomedicine and Health

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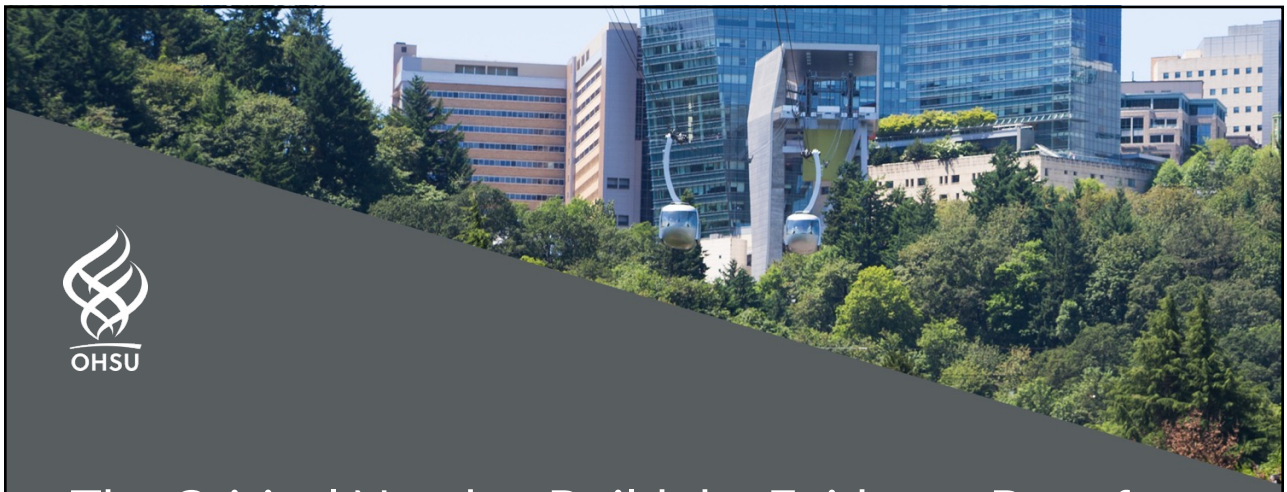

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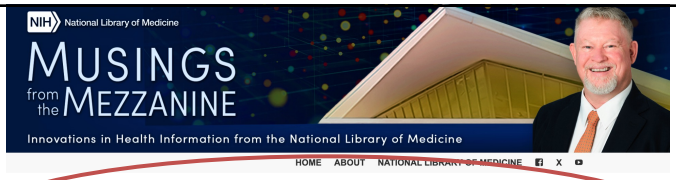

Translational AI: A Necessity and Opportunity for Biomedical Informatics and Data Science

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Perspective

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Perspective

Search still matters: information retrieval in the era of generative AI

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Abstract

Objective: Information retrieval (IR, also known as search) systems are ubiquitous in modern times. How does the emergence of generative artificial intelligence (AI), based on large language models (LLMs), fit into the IR process?

Process: This perspective explores the use of generative AI in the context of the motivations, considerations, and outcomes of the IR process with a focus on the academic use of such systems.

Conclusions: There are many information needs, from simple to complex, that motivate use of IR. Users of such systems, particularly academics, have concerns for authoritativeness, timeliness, and contextualization of search. While LLMs may provide functionality that aids the IR process, the continued need for search systems, and research into their improvement, remains essential.

Key words: information storage and retrieval; generative artificial intelligence; large language models; ChatGPT.

ACMI 2024

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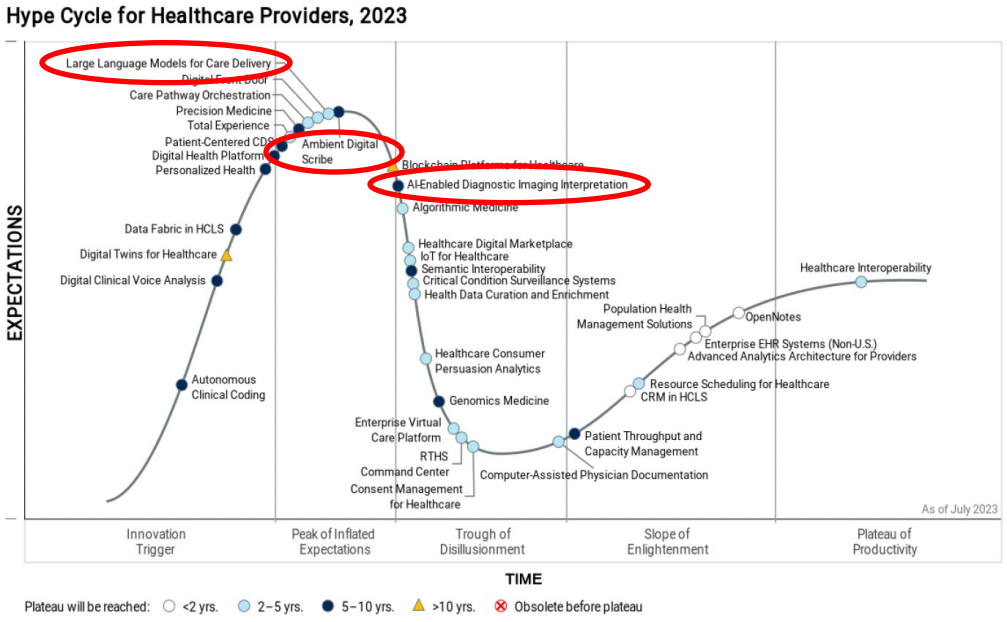
Overview of talk

- Translational AI
  - https://nlmdirector.nlm.nih.gov/2024/02/07/translational-ai-a-necessity-and-opportunity-for-biomedical-informatics-and-data-science/
  - https://informaticsprofessor.blogspot.com/2024/02/translational-ai-necessity-and.html
- Search still matters
  - https://doi.org/10.1093/jamia/ocae014
  - https://www.theregister.com/2024/01/30/ai_is_changing_search/
  - https://informaticsprofessor.blogspot.com/2024/01/whither-search-new-perspective-on.html

Overheard in a workshop on AI for innovative medical educators, September 2022

"I hope that AI won't be as awful as the EHR"



Gartner

OHSU

What do we need for AI applications to make it to the plateau of productivity?

- Translational AI
  - Show us the evidence
- Search still matters
  - In many circumstances, who said what is more important than providing a generated answer

OHSU

How do we "show the evidence?"

- From evidence-based medicine (EBM), best evidence for any clinical intervention is from randomized controlled trials (RCTs) or systematic reviews of RCTs
- Although not as easy to carry out as RCTs of drugs or devices (and placebos), AI must demonstrate benefit for patient outcomes and/or healthcare delivery improvement
  - Additional issues for RCTs of AI (Liu, 2020)
- As with drugs and devices, we need to move from "basic science" to "clinical science"
- Not everything can be studied in an RCT and RCTs cannot be done for every last clinical question (Greenhalgh, 2022)

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What is the evidence so far?

- Many, many papers published about models and simulated use (basic science), including systematic reviews of those papers
- Very few RCTs demonstrating value from real-world use (clinical science) – systematic reviews of RCTs show (Zhou, 2021; Plana, 2022; Han, 2023)
  - Much smaller numbers of RCTs – about 100, depending on how we count
  - 65-82% of RCT showed positive outcomes
  - Many RCTs showed aspects of "risk of bias"
- Concerns about generalization beyond initial clinical settings
  - Biased data and algorithms (Obermeyer, 2019: Dhar, 2021; Chen, 2023)
  - Data and algorithm drift (Finlayson, 2021; Vaid, 2023)

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Learning from some specific examples

- Computer-aided detection (CADe) of polyps in colonoscopy
  - One of earliest and most widely-studied applications of AI
  - Recent systematic review shows polyps missed by colonoscopists are discovered, but mostly small and clinically inconsequential (Hassan, 2023)
  - RCT of CADe found no increased detection of advanced neoplasias (Mangas-Sanjuan, 2023)
- 30-day hospital readmissions
  - After implementation of CMS penalty, proliferation of highly accurate predictive models published in mid-2010s
  - Recent RCT showed use of high-quality model and implementation of program around it did not reduce readmissions (Donzé, 2023)

Examples (cont.)

- RCT to assess whether use of previously validated hospital-acquired venous thromboembolism (HA-VTE) prognostic model, together with pediatric hematologist review, could reduce pediatric inpatient rates of HA-VTE (Walker, 2023)
  - No difference for intervention group randomized to use model
  - Reluctance to use model by primary care physicians – used only 26% of time
  - Even for children in intervention arm, model mostly not used, i.e., the "Cassandra Problem" (Wilson, 2023)
- Scoping review of ML in pediatric critical care (Heneghan, 2023)
  - *Publication of supervised machine learning models to address clinical challenges in pediatric critical care medicine has increased dramatically… While these approaches have the potential to benefit children with critical illness, the literature demonstrates incomplete reporting, absence of external validation, and infrequent clinical implementation.*

How do we get to "translational AI?"

- Singh, X, Feb 8 2024: *Researched models aren't implemented. Implemented models aren't researched*
- Clinician competence and education (Russell, 2023; Hersh, 2023)
- Postmarket surveillance, e.g., *algorithmovigilance* (Embi, 2021)
- Responsible use of AI (Dorr, 2023)

Search still matters

- Generative AI systems such as ChatGPT are cool and fun, but
  - For some tasks that many of us do, need more than answers, e.g.,
    - Clinical – patient-care questions
    - Research – methods and insights
    - Teaching – synthesizing knowledge for our students
  - Where the information comes from is as important what it says
- Information retrieval (IR) systems "do not inform user about a subject; indicate the existence (or nonexistence) and whereabouts of documents related to an information request" (Lancaster, 1978)

Search in the era of generative AI

- Another adage of EBM
  - Gen AI for background questions
  - Search and critical appraisal for foreground questions
- Retrieval-augmented generation (RAG) for improving Gen AI but do we need "generation-augmented retrieval" for LLMs to aid search?
  - Evidence modest so far, e.g., using ChatGPT for generating Boolean queries did not improve search results (Wang, 2023)
- Help us learn more
  - Text Retrieval Conference (TREC) 2024 – Biomedical Generative Retrieval, https://trec-cds.org/

Questions?

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