MAGIC making GRADE the irresistible choice

THE ECOSYSTEM OF EVIDENCE

Lessons learned in the pandemic era and future challenges

10th International Conference for EBHC Teachers and Developers
10th Conference of the International Society for EBHC
Taormina, 25th - 28th October 2023

#EBHC2023

GIMBE EVIDENCE FOR HEALTH

AI evidence for use in clinical practice

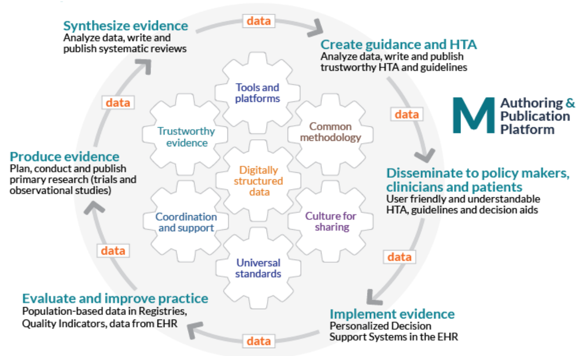
The good, the bad and the ugly – and what now for the EBHC community?

Per Olav Vandvik
CEO, MAGIC Evidence Ecosystem Foundation, Oslo
Professor, Faculty of Medicine, University of Oslo
Acting consultant, Department of Medicine, Lovisenberg Diaconal Hospital Trust,
Senior researcher, Norwegian Institute for Public Health

Declarations of interest: CEO of MAGIC, no AI expert (and perhaps an EBM dinosaur). No financial COI

Agenda

- Perspective of my talk*
  - Advances in EBHC and role of guidelines
  - An encounter with AI, what is it and why the fuzz?
  - Where does AI fit in the evidence ecosystem?



- AI evidence for use in clinical practice
  - The good, the bad and the ugly
  - Pandemic kessons learned: living AI evidence?
  - Making the evidence ecosystem work for AI

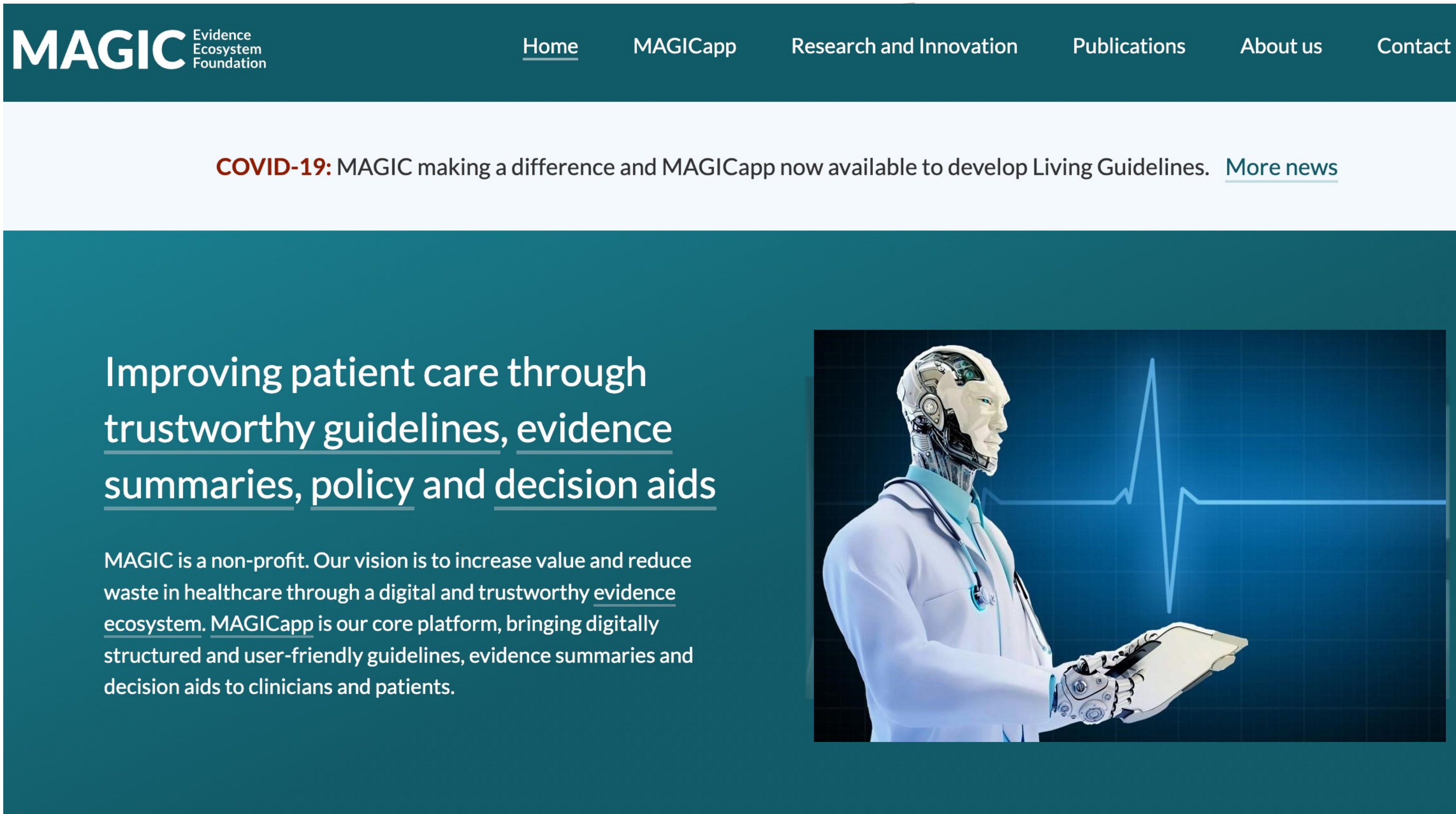
Picture made by GPT-4

- What now for the EBHC community?
  - Critical appraisal of AI evidence; Ready?
  - AI in EBHC education; Keeping up?
  - A call for urgent engagement and collaboration

***Slides will be shared, including a glossary of AI terms and links to useful podcasts and papers**

Perspective of my talk: Use of AI evidence in clinical practice

Great advances in standards, methods, tools and processes in the evidence ecosystem
EBHC shift towards use of pre-appraised evidence and tools: guidelines are critical



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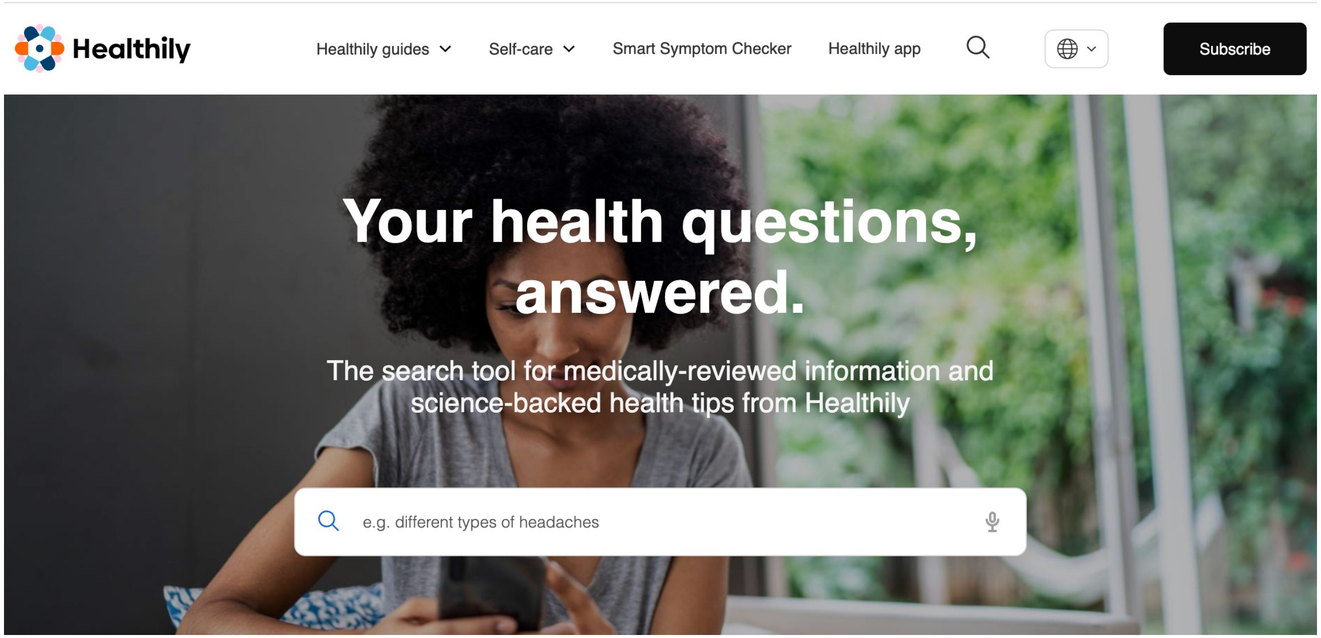
Meet myself, with bodily symptoms and concerns spring 2023

Asked www.healthily.com offering AI platform for self- care in the NHS, keen on Norway



Response after 10 minutes of queries:
”You may have pancreatic cancer or sacroileitis.
You should see a doctor within 2 days!”

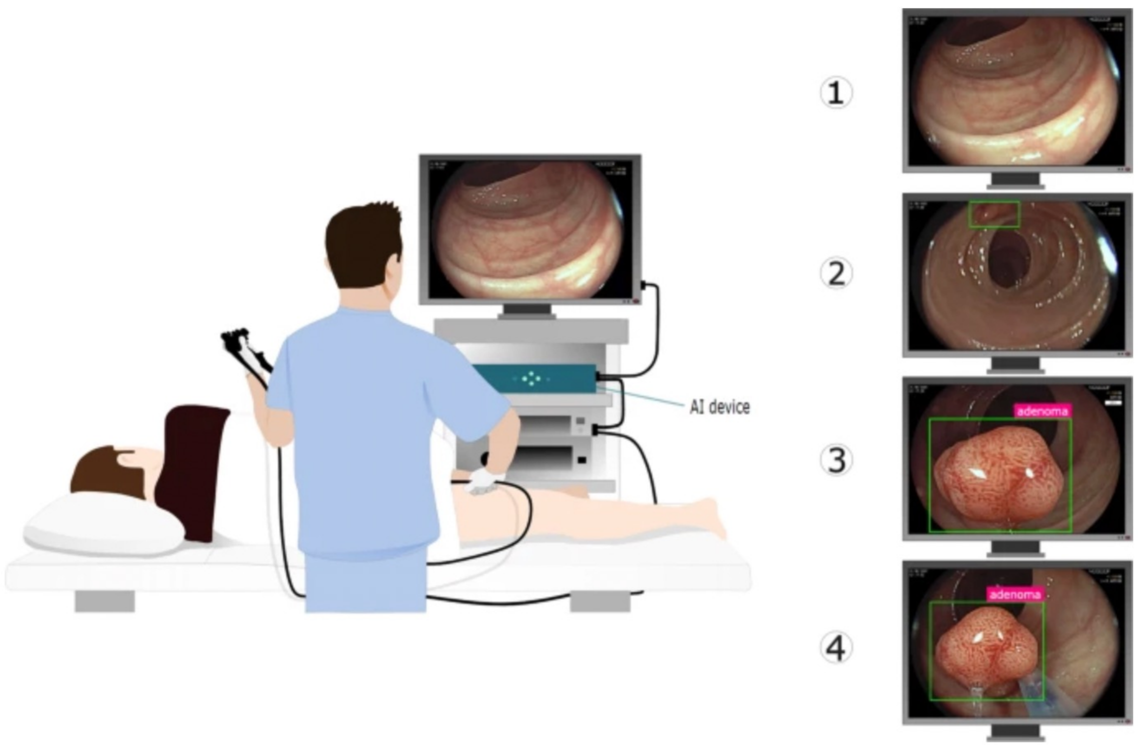
My GP ordered lots of blood tests, MRI of my back + colonoscopy
I am still a bit shaken; Is this a case of the ugly AI?

Colonoscopy did not detect any disease (I still have IBS)

Should I have met AI Genius? Computer Assisted Detection (CADe) of polyps is popular now

My gastroenterologist apologized: “This AI device simply too expensive...”

Fig. 1: AI device intended use workflow.



How can clinicians, citizens and patients make well-informed decisions, based on AI evidence (aligned with EBHC principles)?

Breakthrough for AI 2023: the Large Language Models (LLM)*

How many have ChatGPT in your pockets? 180 million users , fastest growing app ever
Can it answer my overarching question today? It takes 1 minute, I have spent 6 weeks

Web Browsing

PE How can clinicians, citizens and patients make well-informed decisions, based on AI evidence (aligned with EBHC principles)?

Utilizing Artificial Intelligence (AI) in alignment with Evidence-Based Health Care (EBHC) principles can significantly enhance the decision-making process for clinicians, patients, and citizens. Here's a structured approach on how this can be achieved:

1. **Education and Literacy**:
   - **AI Literacy**: It's crucial that all stakeholders have a basic understanding of AI, including its capabilities, limitations, and the implications of its use in healthcare.
   - **EBHC Literacy**: Stakeholders should also have a sound understanding of EBHC principles which emphasize the use of current best evidence in making decisions about the care of individual patients.
2. **Development of Trustworthy AI Tools**:
   - **Validation and Verification**: AI tools should be rigorously teste Regenerate and validated against established medical benchmarks to ensure

Send a message

PE How can clinicians, citizens and patients make well-informed decisions, based on AI evidence (aligned with EBHC principles)?

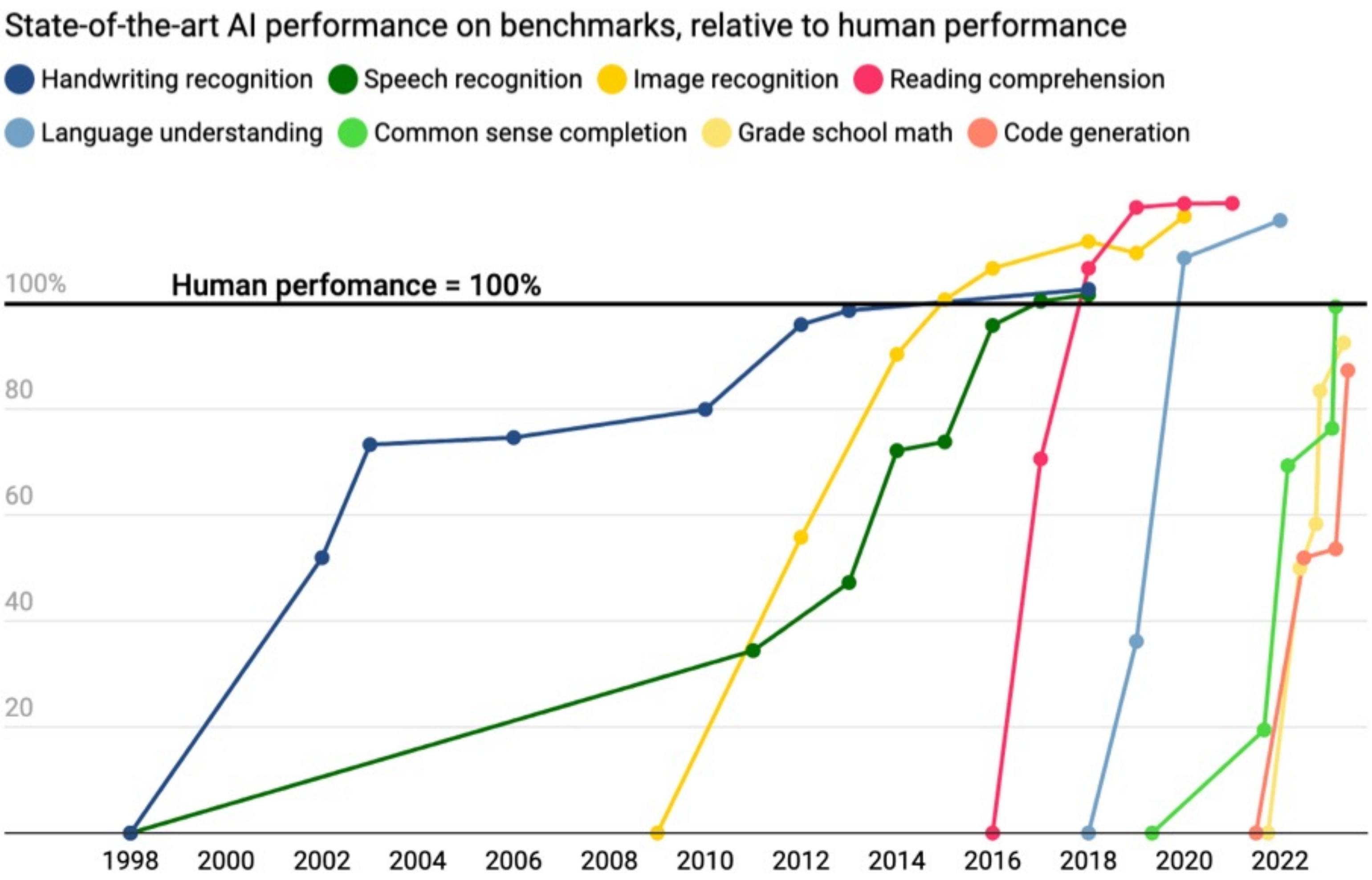
< 2 / 2 > Integrating Artificial Intelligence (AI) with Evidence-Based Health Care (EBHC) can be a powerful approach to improve clinical decision-making, patient care, and public health. Here are some steps and considerations for clinicians, citizens, and patients to make well-informed decisions based on AI evidence while adhering to EBHC principles:

1. **Understanding AI and EBHC**:
   - It's crucial for clinicians, citizens, and patients to have a basic understanding of both AI and EBHC principles. Education and training can provide the necessary background to interpret AI findings within the framework of EBHC.
2. **Transparent AI Systems**:
   - AI systems should be designed to be transparent, explaining their predictions in understandable terms. Transparency facilitates trust and enables users to evaluate the evidence generated by AI against EBHC principles.
3. **Validated AI Algorithms**:
   - Validation of AI algorithms through rigorous testing against real-world data is essential. This ensures that the AI system is reliable and its predictions are evidence-based.
4. **Incorporation of AI in Clinical Guidelines**:
   - AI can be incorporated into clinical guidelines to assist with decision-making. These guidelines should be developed and reviewed by medical experts to ensure align Regenerate with EBHC principles.

***LLM :** A type of Natural Language Processing (NLP) model comprising large neural networks trained over large amounts of text, usually to output continuations of texts from corresponding prefixes.+

What is Artificial Intelligence (AI) and how is it progressing?

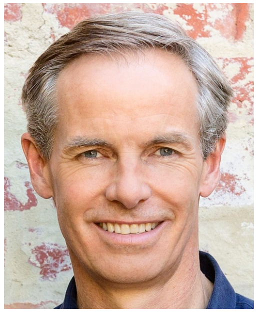
The science of developing computer systems that can perform complex tasks approximating human intelligence



Where and how will AI enhance the evidence ecosystem?

AI acceleration across steps (a topic for another day)

Explosion of AI models, products & services, already implemented in practice



- Accelerated SRs
- AI knowledge products

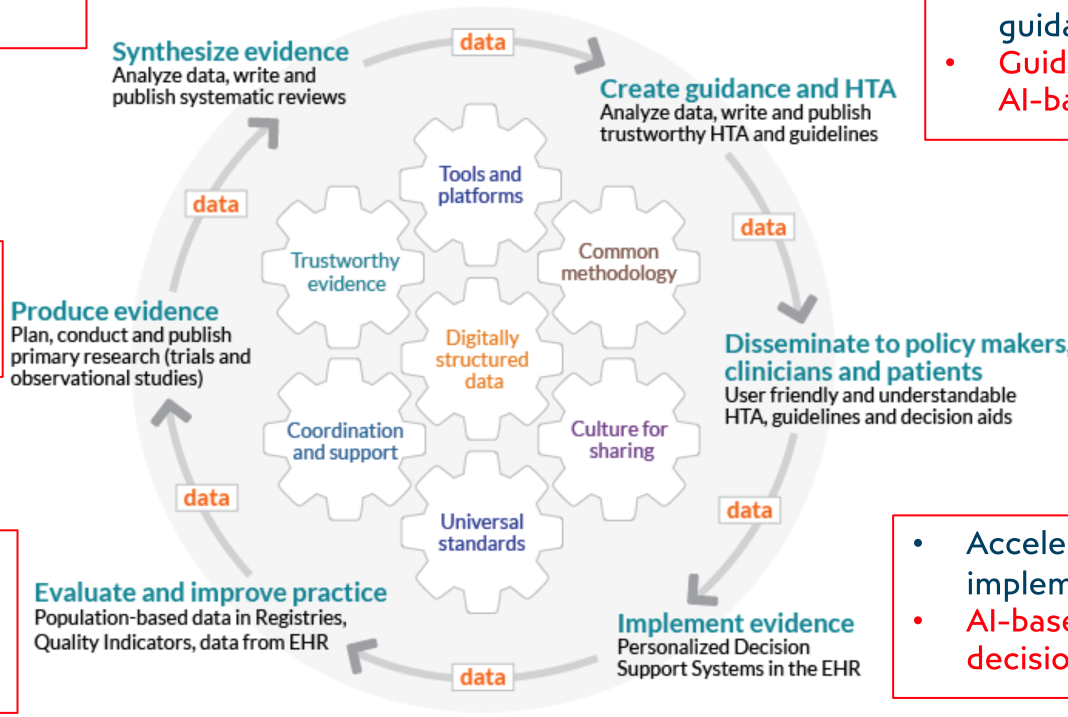
- Accelerated guidance & HTA
- Guidance & HTA of AI-based products

- Accelerated R&D
- AI-based diagnostics, prediction, devices

- Accelerated dissemination
- AI decision support products

- Accelerated program evaluation
- AI-based evaluation data analytics

- Accelerated implementation
- AI-based personalized decision support



Vandvik PO, Brandt L. Future of Evidence Ecosystem Series: Evidence ecosystems and learning health systems: why bother? *Journal of Clinical Epidemiology.* 2020. https://doi.org/10.1016/j.jclinepi.2020.02.008

Agenda

- Setting the scene
    - Progress in EBHC and guidelines; clinical practice perspective
    - What is AI and why the fuzz?
    - Where does AI fit in the evidence ecosystem?
- AI evidence for use in clinical practice
    - Examples of the good, the bad and the ugly
    - Lessons learned in the pandemic, time for living AI evidence?
    - Does the evidence ecosystem work for AI?
- What now for the EBHC community?
    - Critical appraisal methods up for the challenge?
    - AI in EBHC education; are we keeping up?
    - A call for urgent engagement and collaboration

Use of AI evidence in clinical practice

to answer questions on diagnosis, prognosis, and treatment

Examples of the good, the bad and the ugly (from evidence producers)

India Fights Diabetic Blindness With Help From A.I.

Share full article 5

A technician screening a patient at the Aravind Eye Hospital in Madurai, India. The hospital is using a Google system that relies on artificial intelligence to diagnose a retinal problem from such a scan. Atul Loke for The New York Times

AI- assisted diagnosis: The good

Excellent performance (similar to specialists) and worked real-time in Thailand

ghlighted implementation challenges

me diabetic retinopathy screening by deep learning in isite national screening programme: a prospective entional cohort study

oonsuk, Richa Tiwari, Rory Sayres, Variya Nganthavee, Kornwipa Hemarat, Apinpat Kongprayoon, Rajiv Raman, Brian Levinstein, chaekermann, Roy Lee, Sunny Virmani, Kasumi Widner, John Chambers, Fred Hersch, Lily Peng, Dale R Webster

Diabetic retinopathy is a leading cause of preventable blindness, especially in low-income and middle-ntries (LMICs). Deep-learning systems have the potential to enhance diabetic retinopathy screenings in s, yet prospective studies assessing their usability and performance are scarce.

did a prospective interventional cohort study to evaluate the real-world performance and feasibility of deep-learning system into the health-care system of Thailand. Patients with diabetes and listed on the betes registry, aged 18 years or older, able to have their fundus photograph taken for at least one eye, and ening as per the Thai Ministry of Public Health guidelines were eligible for inclusion. Eligible patients d with the deep-learning system at nine primary care sites under Thailand's national diabetic retinopathy rogramme. Patients with a previous diagnosis of diabetic macular oedema, severe non-proliferative nopathy, or proliferative diabetic retinopathy; previous laser treatment of the retina or retinal surgery; iabetic retinopathy eye disease requiring referral to an ophthalmologist; or inability to have fundus taken of both eyes for any reason were excluded. Deep-learning system-based interpretations of patient ges and referral recommendations were provided in real time. As a safety mechanism, regional retina ver-read each image. Performance of the deep-learning system (accuracy, sensitivity, specificity, positive lue [PPV], and negative predictive value [NPV]) were measured against an adjudicated reference standard. fellowship-trained retina specialists. This study is regi 02002.

EALTH CARE DELIVERY

on of a Deep Learning Algorithm etinopathy phs

C. Stumpe, PhD; Derek Wu, BS; Arunachalam Narayanaswamy, PhD;
MEng; Jorge Cuadros, OD, PhD; Ramasamy Kim, OD, DNB;
MPH; Dale R. Webster, PhD

l methods that allow an algorithm to that demonstrate the desired Application of these methods to ation.

m for automated detection of diabetic us photographs.

ecificity of the algorithm for detecting

Editorial pages 2366 and 2368

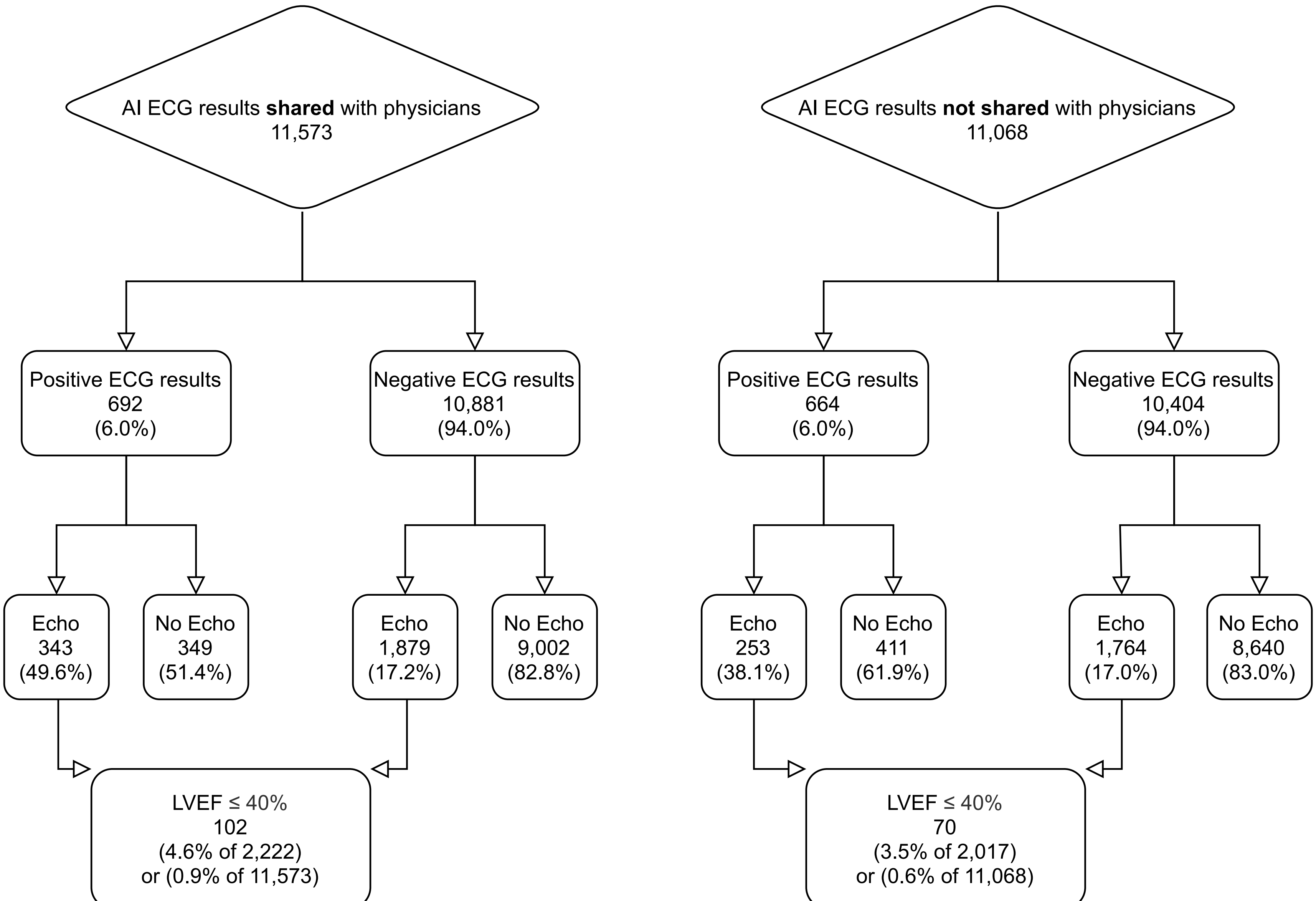
Supplemental content

Findings Between Dec 12, 2018, and March 29, 2020, 7940 patients were screened for inclusion. 7651 (96·3%) patients were eligible for study analysis, and 2412 (31·5%) patients were referred for diabetic retinopathy, diabetic macular oedema, ungradable images, or low visual acuity. For vision-threatening diabetic retinopathy, the deep-learning system had an accuracy of 94·7% (95% CI 93·0–96·2), sensitivity of 91·4% (87·1–95·0), and specificity of 95·4% (94·1–96·7). The retina specialist over-readers had an accuracy of 93·5 (91·7–95·0; p=0·17), a sensitivity of 84·8% (79·4–90·0; p=0·024), and specificity of 95·5% (94·1–96·7; p=0·98). The PPV for the deep-learning system was 79·2 (95% CI 73·8–84·3) compared with 75·6 (69·8–81·1) for the over-readers. The NPV for the deep-learning system was 95·5 (92·8–97·9) compared with 92·4 (89·3–95·5) for the over-readers.

Interpretation A deep-learning system can deliver real-time diabetic retinopathy detection capability similar to retina specialists in community-based screening settings. Socioenvironmental factors and workflows must be taken into consideration when implementing a deep-learning system within a large-scale screening programme in LMICs.

Funding Google and Rajavithi Hospital, Bangkok, Thailand.

Machine learning: computer systems able to learn from data without following explicit instructions
Deep learning: use of multiple layers in an artificial neural network
Neural networks: a collection of connected nodes, loosely modeling neurons in a biological brain



*Sau A, Ng FS- The emerging role of artificial intelligence enabled electrocardiograms in healthcare
BMJ Medicine 2023;**2:**e000193. doi: 10.1136/bmjmed-2022-000193

AI to inform treatment decisions: The ugly?

Can not reliably tell what works (relative effects of interventions)
With heterogenous effects; can AI reliably predict responses to treatment?
I found lots of studies in oncology, no systematic reviews so I asked ChatGPT

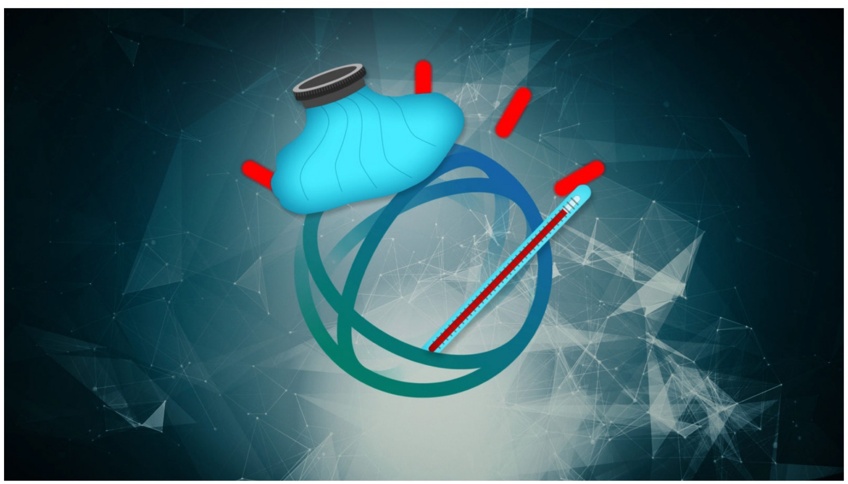
EXCLUSIVE

STAT+

IBM's Watson supercomputer recommended 'unsafe and incorrect' cancer treatments, internal documents show

By Casey Ross and Ike Swetlitz July 25, 2018

Reprints



PE

With heterogenous effects; can AI reliably predict responses to treatment?

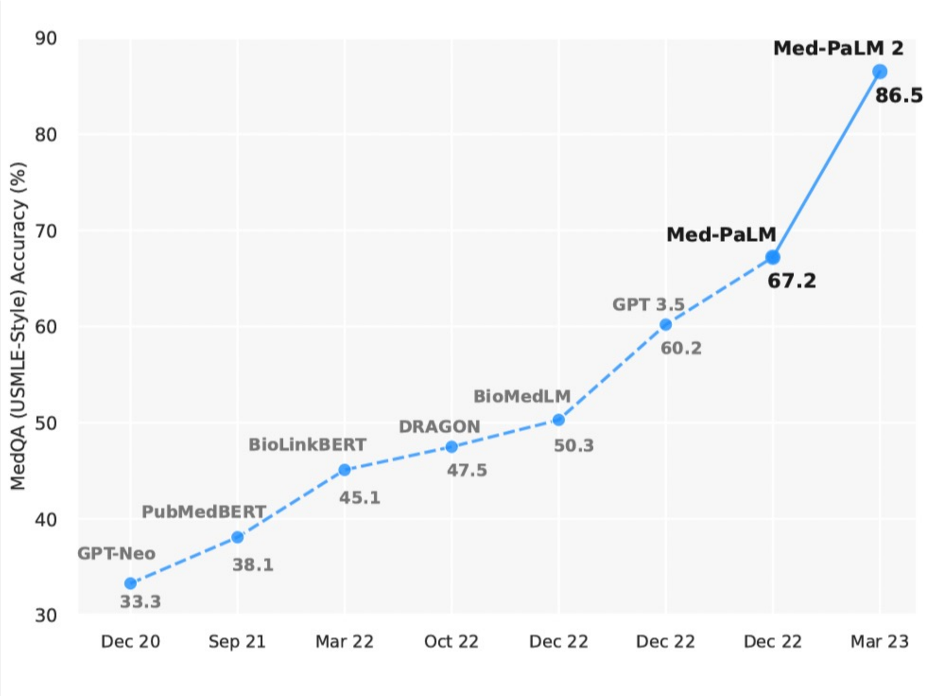
The reliability of AI in predicting responses to treatment in the presence of heterogeneous effects (differences in treatment effects across individuals or subgroups) is a nuanced and multi-faceted issue. The application of AI and machine learning can indeed be powerful in understanding and predicting treatment responses, yet several challenges and considerations persist.

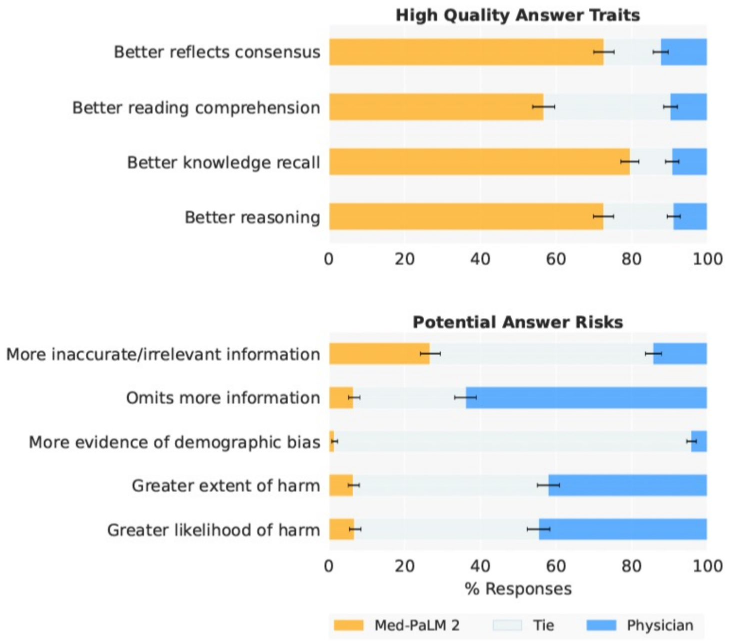
In conclusion, while AI has the potential to reliably predict responses to treatment considering heterogeneous effects, the success of such endeavors relies on addressing the mentioned challenges and considerations.

LLM answering clinical questions at the point of care: The good?

Very rapid progress, but still need validation in clinical settings

Preprint May 2023 outdated already? [arXiv:2305.09617]





[1]Google Research, [2]DeepMind,

LLM answering clinical questions at the point of care

ChatGPT more high quality and empathetic responses to patient questions

JAMA Internal Medicine | Original Investigation

Comparing Physician and Artificial Intelligence Chatbot Responses to Patient Questions Posted to a Public Social Media Forum

John W. Ayers, PhD, MA; Adam Poliak, PhD; Mark Dredze, PhD; Eric C. Leas, PhD, MPH; Zechariah Zhu, BS; Jessica B. Kelley, MSN; Dennis J. Faix, MD; Aaron M. Goodman, MD; Christopher A. Longhurst, MD, MS; Michael Hogarth, MD; Davey M. Smith, MD, MAS

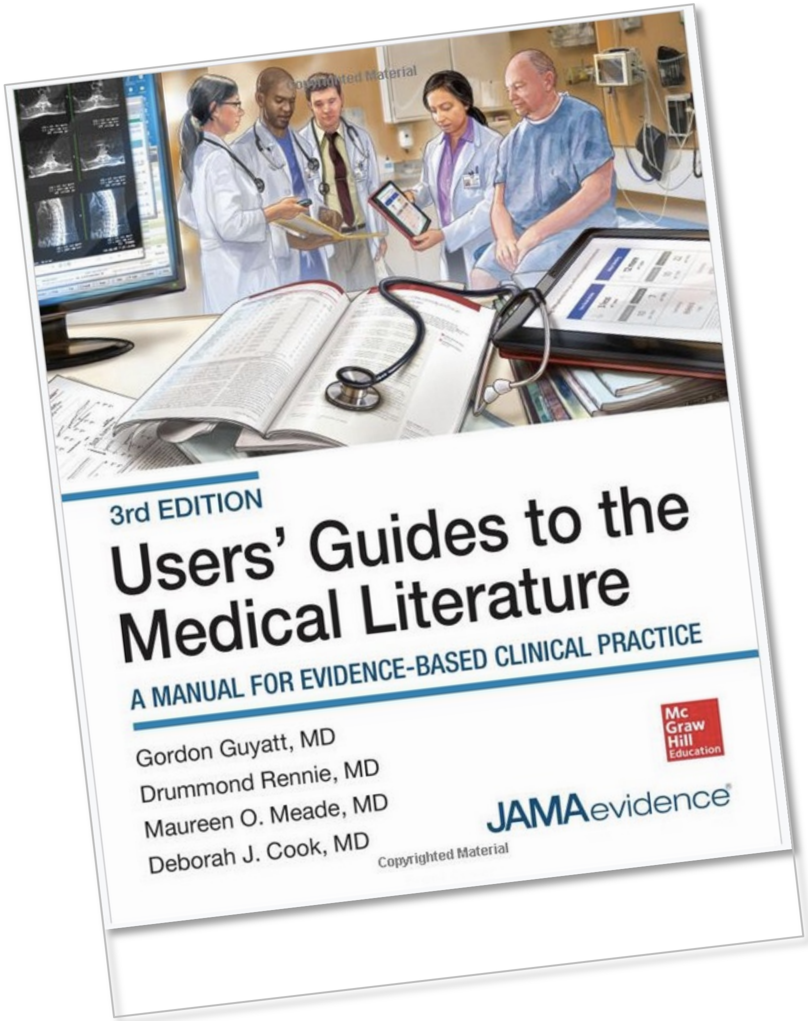
RESULTS Of the 195 questions and responses, evaluators preferred chatbot responses to physician responses in 78.6% (95% CI, 75.0%-81.8%) of the 585 evaluations. Mean (IQR) physician responses were significantly shorter than chatbot responses (52 [17-62] words vs 211 [168-245] words; $t = 25.4$; $P < .001$). Chatbot responses were rated of significantly higher quality than physician responses ($t = 13.3$; $P < .001$). The proportion of responses rated as *good* or *very good* quality (≥ 4), for instance, was higher for chatbot than physicians (chatbot: 78.5%, 95% CI, 72.3%-84.1%; physicians: 22.1%, 95% CI, 16.4%-28.2%;). This amounted to 3.6 times higher prevalence of *good* or *very good* quality responses for the chatbot. Chatbot responses were also rated significantly more empathetic than physician responses ($t = 18.9$; $P < .001$). The proportion of responses rated *empathetic* or *very empathetic* (≥4) was higher for chatbot than for physicians (physicians: 4.6%, 95% CI, 2.1%-7.7%; chatbot: 45.1%, 95% CI, 38.5%-51.8%; physicians: 4.6%, 95% CI, 2.1%-7.7%). This amounted to 9.8 times higher prevalence of *empathetic* or *very empathetic* responses for the chatbot.

CONCLUSIONS In this cross-sectional study, a chatbot generated quality and empathetic responses to patient questions posed in an online forum. Further exploration of this technology is warranted in clinical settings, such as using chatbot to draft responses that physicians could then edit. Randomized trials could assess further if using AI assistants might improve responses, lower clinician burnout, and improve patient outcomes.

ChatGPT and revisiting role of trustworthy guidelines revisited

The robot can not write trusttworthy guidelines

Perhaps they are optimal EBM point of care resources? Now, or in next version?



PE

Thank you. Since I am not a US citizen, I wonder if there are other trustworthy guidelines to inform this question? Maybe even living guidelines?

Finished browsing

The World Health Organization (WHO) has provided a living guideline, which is continually updated as new evidence emerges, regarding the use of therapeutics in the treatment of COVID-19. According to the guideline updated on March 3, 2022, there is a conditional recommendation for the use of a combination of neutralizing monoclonal antibodies (casirivimab and imdevimab) in the following

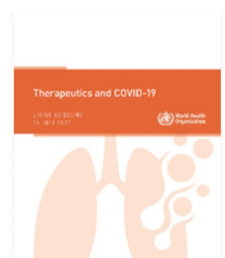
World Health Organization

Health Topics | Countries | Newsroom | Emergencies | Data | About WHO

Home / Publications / Overview / Therapeutics and COVID-19: living guideline

Therapeutics and COVID-19: living guideline

14 July 2022 | COVID-19: Clinical care



Overview

This publication has been superseded by a new version, dated 13 January 2023.

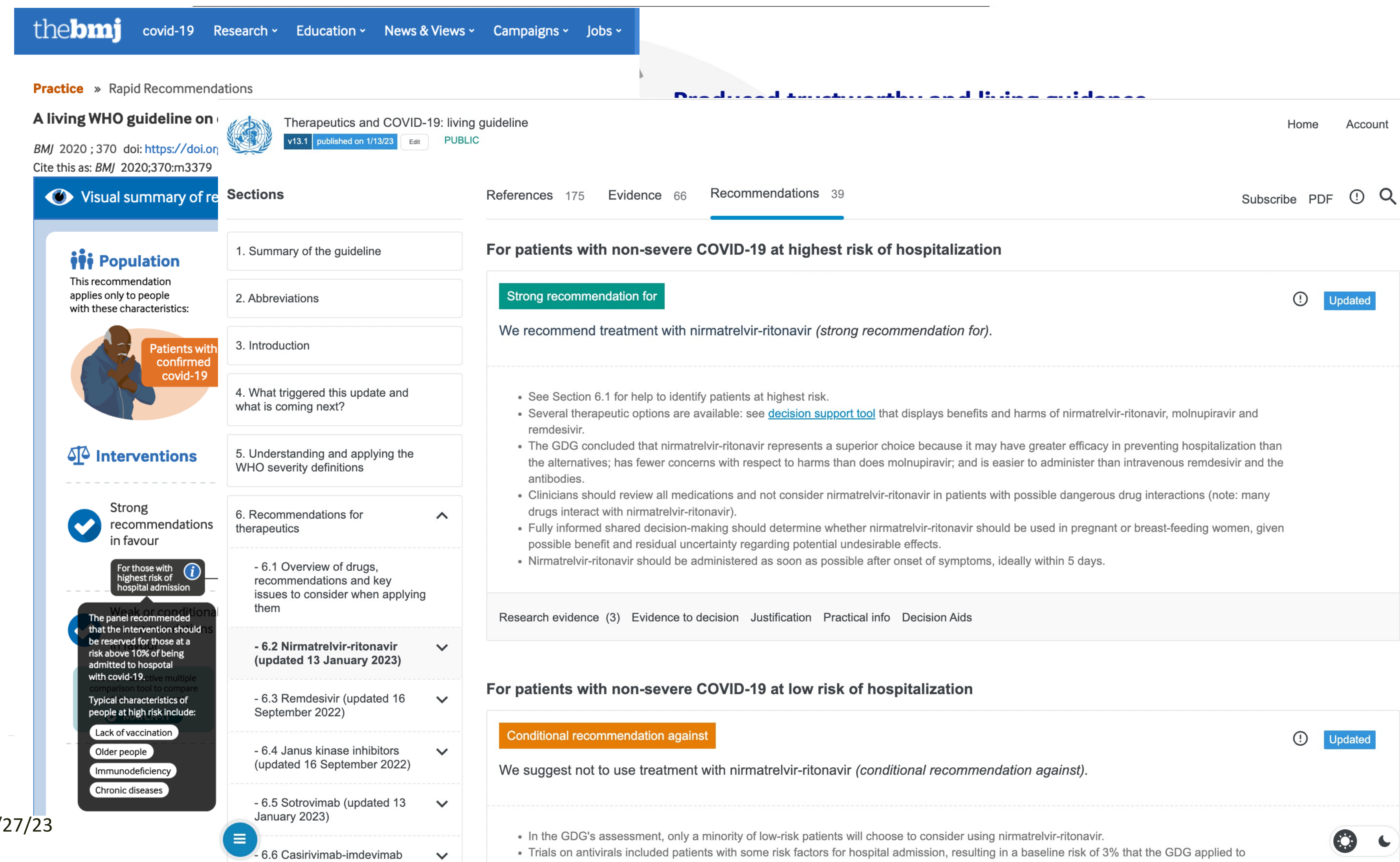
Version dated 13 January 2023

The WHO *Therapeutics and COVID-19: living guideline* contains the Organization's most up-to-date recommendations for the use of therapeutics in the treatment of COVID-19. The **latest version** of this living guideline is available in pdf format (via the 'Download' button) and via an online platform, and is updated regularly as new evidence emerges.

Lessons learned during the pandemic: Living evidence

From trigger trials to updated guidelines at record speed, perfect for AI?

Risk prediction remains a challenge; living prognosis review not helped by AI



Making the evidence ecosystem loop work for AI

Moving to living guidelines for AI, exemplified by AI Genius (CADe, CADx to come)

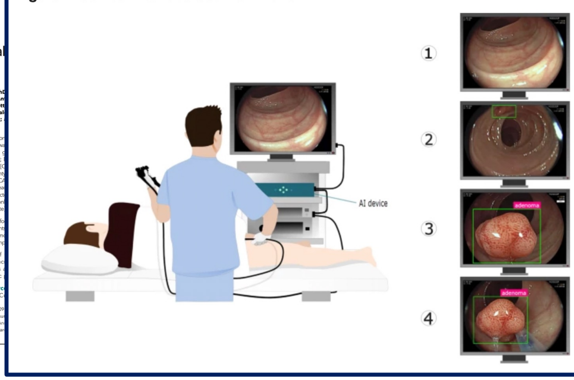
Current standards and methods works just fine, also from Evidence to Decisions (EtD)

Annals of Internal Medicine

Real-Time Computer-Aided Detection of Colorectal
Colonoscopy

A Systematic Review and Meta-analysis

Fig. 1: AI device intended use workflow.



randomized trials on 18 232 patients
higher in the CADe group than in
up (44.0% vs. 35.9%; relative risk,
-certainty evidence), corresponding
0.35 to 0.58]) relative reduction in
vidence). More nonneoplastic pol-

Computer Aided Detection (CADe) Colonoscopy vs Routine Practice Colonoscopy

People undergoing colonoscopy for any indication (screening, surveillance, clinical indications)

15 Outcomes   Graphical view

Outcome Timeframe	Study results and measurements	Absolute effect estimates Routine Practice Colonoscopy	 Computer Aided Detection (CADe) Colonoscopy	Certainty of the Evidence (Quality of evidence)	Plain language summary
Colorectal cancer incidence 10-years 7 Critical	(CI 95% —)	**82** per 10.000	**73** per 10.000 Difference: **9 fewer per 10.000** (CI 95% 8 fewer — 10 fewer)	**Low**	Computer aided detection (CADe) colonoscopy may have little or no difference on colorectal cancer incidence No imp. diff.
Colorectal cancer related deaths 10-years 8 Critical	Relative risk (CI 95% —)	**15** per 10.000	**13** per 10.000 Difference: **2 fewer per 10.000** (CI 95% 2 fewer — 3 fewer)	**Low**	Computer aided detection (CADe) colonoscopy may have little or no difference on colorectal cancer related deaths No imp. diff.

Looking beyond individual examples for clinical application of AI

84 RCTs by now, mostly bad (if not ugly)

129 systematic reviews, mostly bad (2022): We need high-quality umbrella living SR

medRxiv
THE PREPRINT SERVER FOR HEALTH SCIENCES

CSH Cold Spring Harbor Laboratory BMJ Yale

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Randomized Controlled Trials Evaluating AI in Clinical Practice: A Scoping Evaluation

Ryan Han, Julián N. Acosta, Zahra Shakeri, John P.A. Ioannidis, Eric J. Topol, Pranav Rajpurkar

doi: https://doi.org/10.1101/2023.09.12.23295381

International Journal of Medical Informatics 166 (2022) 104855

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journal homepage: www.elsevier.com/locate/ijmedinf

ELSEVIER

Review article

Artificial intelligence and its impact on the domains of universal health coverage, health emergencies and health promotion: An overview of systematic reviews

Check for updates

Antonio Martinez-Millana [a], Aida Saez-Saez [a], Roberto Tornero-Costa [a], Natasha Azzopardi-Muscat [b], Vicente Traver [a], David Novillo-Ortiz [b,*]

[a] *Instituto Universitario de Investigación de Aplicaciones de las Tecnologías de la Información y de las Comunicaciones Avanzadas (ITACA), Universitat Politècnica de València, Camino de Vera S/N, Valencia 46022, Spain*

[b] *Division of Country Health Policies and Systems, World Health Organization, Regional Office for Europe, Copenhagen, Denmark*

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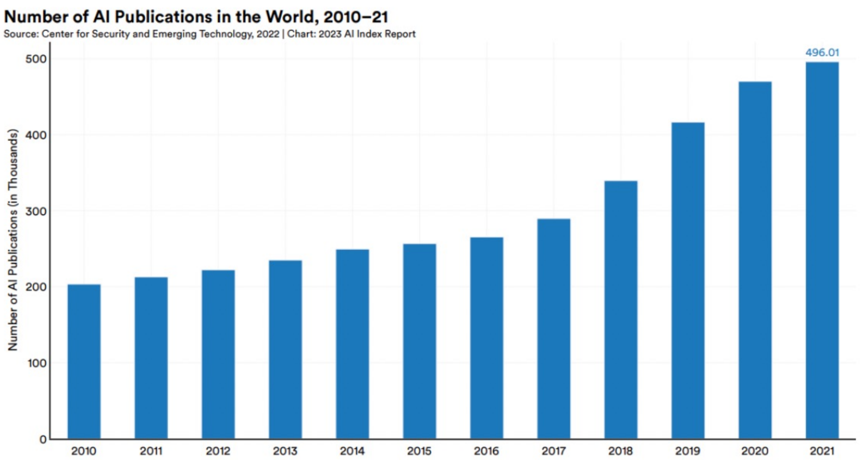
Are we ready to deal with the flood of AI publications?

Nature survey 2023: Optimisms and concerns from scientists

The number of **AI publications** worldwide more than doubled from 2010 to 2021, growing from 200,000 to nearly 500,000.



AI INDEX REPORT 2023 - AI PUBLICATIONS

https://aiindex.stanford.edu/report/.

Feature

ILLUSTRATION BY ACAPULCO STUDIO

AI AND SCIENCE: WHAT 1,600 RESEARCHERS THINK

A *Nature* survey finds that scientists are concerned, as well as excited, by the increasing use of artificial-intelligence tools in research.

By Richard Van Noorden and Jeffrey M. Perkel

Artificial-intelligence (AI) tools are becoming increasingly common in science, and many scientists anticipate that they will soon be central to the practice of research, suggests a *Nature* survey of more than 1,600 researchers around the world.

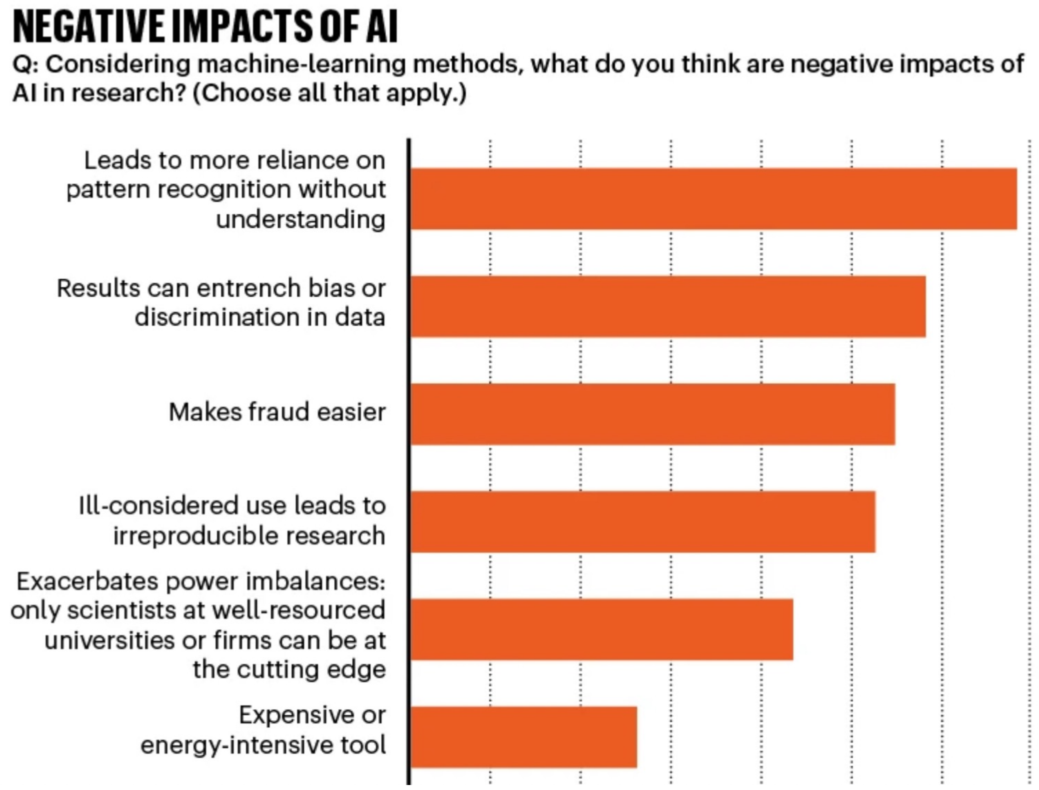
When respondents were asked how useful they thought AI tools would become for their fields in the next decade, more than half expected the tools to be 'very important' or 'essential'. But scientists also expressed strong concerns about how AI is transforming the way that research is done (see 'AI and research: survey results').

The share of research papers that mention AI terms has risen in every field over the past decade, according to an analysis for this article by *Nature*. Machine-learning statistical techniques are now well established, and the past few years have seen rapid advances in generative AI,

672 | Nature | Vol 621 | 28 September 2023

Machine learning challenging standards for proof and truth

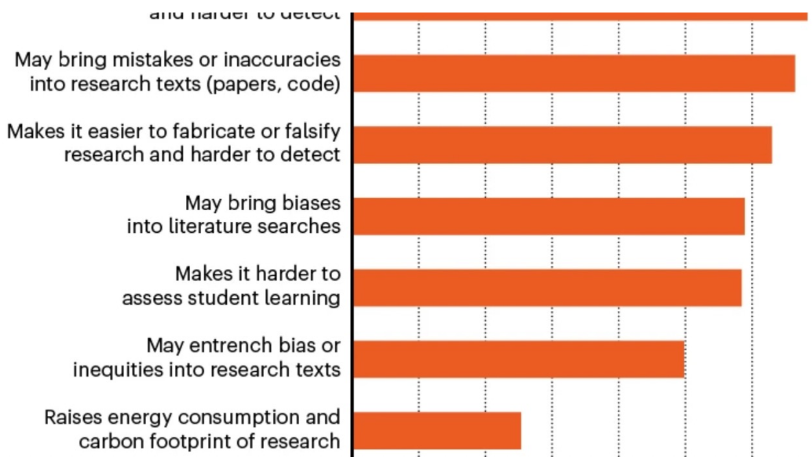
"The main problem is that AI is challenging our existing standards for proof and truth," said Jeffrey Chuang, who studies image analysis of cancer at the Jackson Laboratory in Farmington, Connecticut.



LLM most impressive and most concerning for scientists

proliferation of misinformation, mistakes, fraud, and <u>entrenched with bias</u>

Respondents added that they were worried about faked studies, false information and perpetuating bias if AI tools for medical diagnostics were trained on historically biased data. Scientists have seen evidence of this: a team in the United States reported, for instance, that when they asked the LLM GPT-4 to suggest diagnoses and treatments for a series of clinical case studies, the answers varied depending on the patients' race or gender (T. Zack *et al*. Preprint at medRxiv https://doi.org/ktdz; 2023) – probably reflecting the text that the chatbot was trained on.



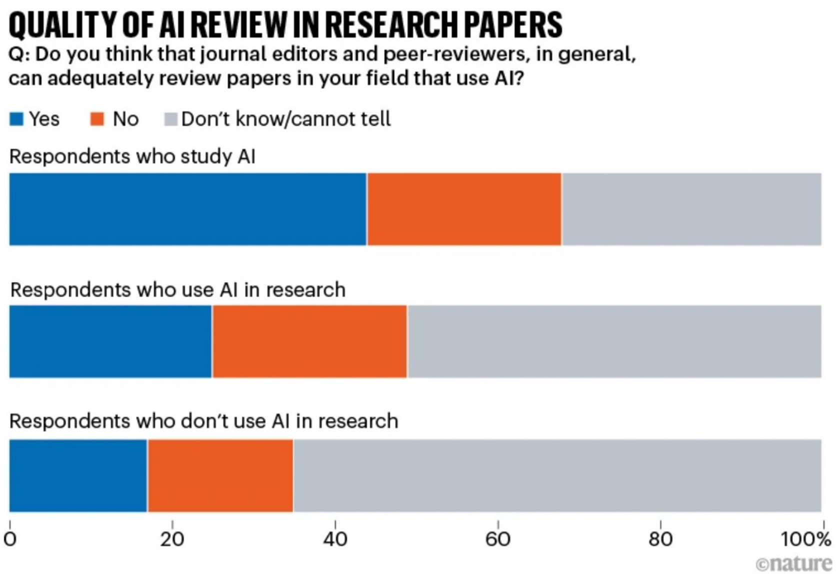
Conclusion (T.Zack et al) :

"Urgent need for comprehensive and transparent bias assessments of tools like GPT-4 for every intented use case before integrated into clinical care"

Can we adequately review AI papers? Any reporting standards?

Many of us probably lack skills to appraise/ peer-review , checklists are emerging

When asked if journal editors and peer reviewers could adequately review papers that used AI, respondents were split. Among the scientists who used AI for their work but didn't directly develop it, around half said they didn't know, one-quarter thought reviews were adequate, and one-quarter thought they were not. Those who developed AI directly tended to have a more positive opinion of the editorial and review processes.



"Reviewers seem to lack the required skills and I see many papers that make basic mistakes in methodology, or lack even basic information to be able to reproduce the results," says Duncan Watson-Parris, an atmospheric physicist who uses machine learning at the Scripps Institution of Oceanography in San Diego, California. The key, he says, is whether journal editors are able to find referees with enough expertise to review the studies.

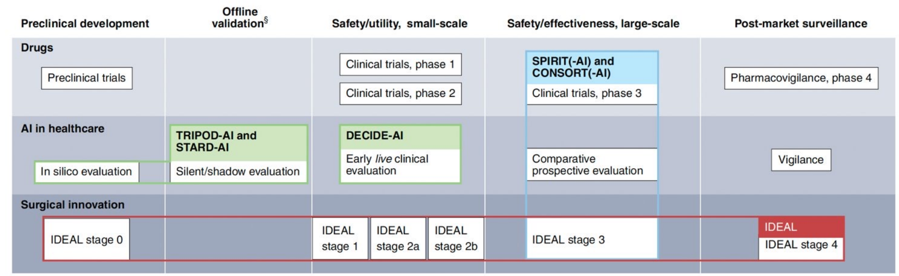


Fig. 1 | Comparison of development pathways for drug therapies, AI in healthcare and surgical innovation. The colored lines represent reporting

CONSENSUS STATEMENT

https://doi.org/10.1038/s41591-020-1034-x

nature medicine

Check for updates

OPEN

Reporting guidelines for clinical trial reports for interventions involving artificial intelligence: the CONSORT-AI extension

Blackbox problem* and the Explainability of AI

- Lack of transparency raises challenges with bias, accountability and responsibility leading to also ethical and legal problems
- Explainable AI (XAI) aims to address these issues by developing models that are more interpretable and transparent
- **XAI has 3 main problems** (thought provoking from Dr. Ghassemi @NEJM AI Grand Rounds podcast)
  - Squishy definition
  - Too simple methods to explain, turns of critical thinking (see preprint below)
  - Medicine has lots of black boxes, we need to know well calibrated, how to use in clinical contexts
- **A key critical appraisal challenge for the EBHC community?**

Harvard-MIT Health Science...

Marzyeh Ghassemi | Harva...

arXiv > cs > arXiv:2205.03295

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Computer Science > Machine Learning

[Submitted on 6 May 2022 (v1), last revised 2 Jun 2022 (this version, v2)]

The Road to Explainability is Paved with Bias: Measuring the Fairness of Explanations

Aparna Balagopalan, Haoran Zhang, Kimia Hamidieh, Thomas Hartvigsen, Frank Rudzicz, Marzyeh Ghassemi

* **Blackbox problem:** The challenge of understanding how AI systems and machine learning models operate, especially in processing data and making predictions or decisions

AI in EBHC education; are we keeping up?

Inevitable that health care professionals need to learn, why not link to EBM?
2 week elective AI course for medical students at University of Oslo lots of fun;-)


DAGENS Medisin Nyheter Debatt Pharma DM Arena DMTV Om oss

KURS_KOMITEEN: (f.v) Medisinstudent Birk Hunskaar, professor Per Olav Vandvik, lege i spesialisering Ishita Barua og universitetslektor Anja Fog Heen utgjør kurs-komiteen til MED3065 – AI, innovasjon, big data og beslutningsstøtte. Foto: Anita Aalby

Medisinstudenter kan nå lære om kunstig intelligens, stor-data og innovasjon

Studenter ved Universitetet i Oslo (UiO) kan for første gang denne våren lære om kunstig intelligens, stor-data og innovasjon koblet til beslutningsstøtte for helsetjenesten.

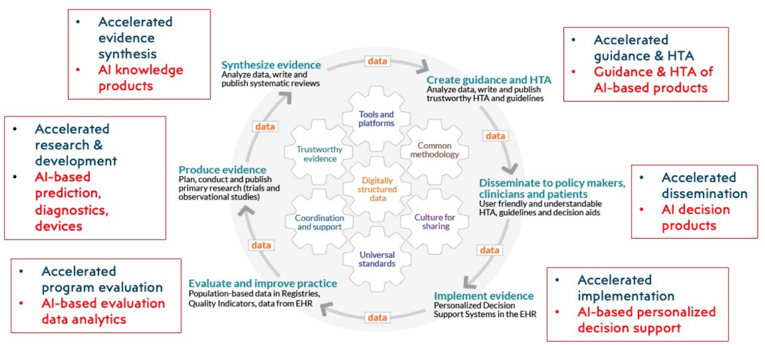
»All should understand how to best use AI tools, their limitations and evidence-base that surrounds them»

NEJM AI Grand Rounds Podcast
Dr. Alan Karthikesalingam
Research lead at Google

Summary: AI evidence for use in clinical practice 2023

What now for the EBHC community?

- AI will increasingly inform (and accelerate) the evidence ecosystem
- Current AI evidence mostly the bad and the ugly but likely to change rapidly
- Start dancing with AI folks, right now
- If my talk did not make sense; ask ChatGPT and be positively surprised;-)



Glossary of key terms for AI

- **AI:** The science of developing computer systems that can perform complex tasks approximating human intelligence
- **Machine learning**: computer systems able to learn from data without following explicit instructions
- **Deep learning**: use of multiple layers in an artificial neural network
- **Neural networks**: a collection of connected nodes, loosely modeling neurons in a biological brain
- **Generative AI**: Can generate text, images, or other media, using patterns of input training data
- **Natural Language Processing (NLP):** A branch of artificial intelligence that seeks to enable computers to interpret and manipulate human text
- **Large Language Model (LLM):** A type of NLP model comprising large neural networks trained over large amounts of text, usually to output continuations of texts from corresponding prefixes.+
- **GPT:** Generative Pre-trained Transformer

Useful resources for learning more

- NEJM AI Grand Rounds