Artificial Intelligence: Implications for Health Professions Education

AMIA Academic Forum 2024 Keynote Talk
June 18, 2024

William Hersh, MD
Professor
Department of Medical Informatics & Clinical Epidemiology
School of Medicine
Oregon Health & Science University
Portland, OR, USA
https://www.ohsu.edu/informatics
Email: hersh@ohsu.edu
Web: http://www.billhersh.info/
Blog: https://informaticsprofessor.blogspot.com/
Twitter: @williamhersh

References

Ali, S.R., Dobbs, T.D., Hutchings, H.A., Whitaker, I.S., 2023. Using ChatGPT to write patient clinic letters. Lancet Digit Health 5, e179–e181. https://doi.org/10.1016/S2589-7500(23)00048-1

AMA: Physicians enthusiastic but cautious about health care AI [WWW Document], 2023. . American Medical Association. URL https://www.ama-assn.org/press-center/press-releases/ama-physicians-enthusiastic-cautious-about-health-care-ai (accessed 1.16.24).

Artificial Intelligence in Health, Health Care, and Biomedical Science: An AI Code of Conduct Principles and Commitments Discussion Draft [WWW Document], 2024. . NAM Perspectives. URL https://nam.edu/artificial-intelligence-in-health-health-care-and-biomedical-science-an-ai-code-of-conduct-principles-and-commitments-discussion-draft/ (accessed 4.9.24).

Attia, Z.I., Friedman, P.A., Noseworthy, P.A., Lopez-Jimenez, F., Ladewig, D.J., Satam, G., Pellikka, P.A., Munger, T.M., Asirvatham, S.J., Scott, C.G., Carter, R.E., Kapa, S., 2019. Age and Sex Estimation Using Artificial Intelligence From Standard 12-Lead ECGs. Circ Arrhythm Electrophysiol 12, e007284. https://doi.org/10.1161/CIRCEP.119.007284

Ayers, J.W., Poliak, A., Dredze, M., Leas, E.C., Zhu, Z., Kelley, J.B., Faix, D.J., Goodman, A.M., Longhurst, C.A., Hogarth, M., Smith, D.M., 2023a. Comparing Physician and Artificial Intelligence Chatbot Responses to Patient Questions Posted to a Public Social Media Forum. JAMA Intern Med 183, 589–596. https://doi.org/10.1001/jamainternmed.2023.1838

Ayers, J.W., Zhu, Z., Poliak, A., Leas, E.C., Dredze, M., Hogarth, M., Smith, D.M., 2023b. Evaluating Artificial Intelligence Responses to Public Health Questions. JAMA Netw Open 6, e2317517. https://doi.org/10.1001/jamanetworkopen.2023.17517

Ball, P., 2023. Is AI leading to a reproducibility crisis in science? Nature 624, 22–25. https://doi.org/10.1038/d41586-023-03817-6

Benoit, J.R.A., 2023. ChatGPT for Clinical Vignette Generation, Revision, and Evaluation. https://doi.org/10.1101/2023.02.04.23285478

Bensoussan, Y., Elemento, O., Rameau, A., 2024. Voice as an AI Biomarker of Health-Introducing Audiomics. JAMA Otolaryngol Head Neck Surg 150, 283–284. https://doi.org/10.1001/jamaoto.2023.4807

Cabral, S., Restrepo, D., Kanjee, Z., Wilson, P., Crowe, B., Abdulnour, R.-E., Rodman, A., 2024. Clinical Reasoning of a Generative Artificial Intelligence Model Compared With Physicians. JAMA Intern Med. https://doi.org/10.1001/jamainternmed.2024.0295

Chen, A., Chen, D.O., Tian, L., 2023. Benchmarking the symptom-checking capabilities of ChatGPT for a broad range of diseases. J Am Med Inform Assoc ocad245. https://doi.org/10.1093/jamia/ocad245

Chin, M.H., Afsar-Manesh, N., Bierman, A.S., Chang, C., Colón-Rodríguez, C.J., Dullabh, P., Duran, D.G., Fair, M., Hernandez-Boussard, T., Hightower, M., Jain, A., Jordan, W.B., Konya, S., Moore, R.H., Moore, T.T., Rodriguez, R., Shaheen, G., Snyder, L.P., Srinivasan, M., Umscheid, C.A., Ohno-Machado, L., 2023. Guiding Principles to Address the Impact of Algorithm Bias on Racial and Ethnic Disparities in Health and Health Care. JAMA Netw Open 6, e2345050. https://doi.org/10.1001/jamanetworkopen.2023.45050

Choi, J.H., Monahan, A., Schwarcz, D., 2023. Lawyering in the Age of Artificial Intelligence. https://doi.org/10.2139/ssrn.4626276

Cooper, A., Rodman, A., 2023. AI and Medical Education — A 21st-Century Pandora's Box. New England Journal of Medicine. https://doi.org/10.1056/NEJMp2304993

Copeland, B.J., 2024. Artificial intelligence (AI) | Definition, Examples, Types, Applications, Companies, & Facts | Britannica [WWW Document]. Encyclopedia Britannica. URL https://www.britannica.com/technology/artificial-intelligence (accessed 6.14.24).

Coyner, A.S., Singh, P., Brown, J.M., Ostmo, S., Chan, R.V.P., Chiang, M.F., Kalpathy-Cramer, J., Campbell, J.P., Imaging and Informatics in Retinopathy of Prematurity Consortium, 2023. Association of Biomarker-Based Artificial Intelligence With Risk of Racial Bias in Retinal Images. JAMA Ophthalmol 141, 543–552. https://doi.org/10.1001/jamaophthalmol.2023.1310

Decker, H., Trang, K., Ramirez, J., Colley, A., Pierce, L., Coleman, M., Bongiovanni, T., Melton, G.B., Wick, E., 2023. Large Language Model-Based Chatbot vs Surgeon-Generated Informed Consent Documentation for Common Procedures. JAMA Netw Open 6, e2336997. https://doi.org/10.1001/jamanetworkopen.2023.36997

Dell'Acqua, F., McFowland, E., Mollick, E.R., Lifshitz-Assaf, H., Kellogg, K., Rajendran, S., Krayer, L., Candelon, F., Lakhani, K.R., 2023. Navigating the Jagged Technological Frontier: Field Experimental Evidence of the Effects of AI on Knowledge Worker Productivity and Quality. https://doi.org/10.2139/ssrn.4573321

Denny, P., Prather, J., Becker, B.A., Finnie-Ansley, J., Hellas, A., Leinonen, J., Luxton-Reilly, A., Reeves, B.N., Santos, E.A., Sarsa, S., 2024. Computing Education in the Era of Generative AI. Commun. ACM 67, 56–67. https://doi.org/10.1145/3624720

Desaire, H., Chua, A.E., Isom, M., Jarosova, R., Hua, D., 2023. Distinguishing academic science writing from humans or ChatGPT with over 99% accuracy using off-the-shelf machine learning tools. Cell Rep Phys Sci 4, 101426. https://doi.org/10.1016/j.xcrp.2023.101426

Donzé, J., Aujesky, D., Williams, D., Schnipper, J.L., 2013. Potentially avoidable 30-day hospital readmissions in medical patients: derivation and validation of a prediction model. JAMA Intern Med 173, 632–638. https://doi.org/10.1001/jamainternmed.2013.3023

Dorr, D.A., Adams, L., Embí, P., 2023. Harnessing the Promise of Artificial Intelligence Responsibly. JAMA 329, 1347–1348. https://doi.org/10.1001/jama.2023.2771

Dratsch, T., Chen, X., Rezazade Mehrizi, M., Kloeckner, R., Mähringer-Kunz, A., Püsken, M., Baeßler, B., Sauer, S., Maintz, D., Pinto Dos Santos, D., 2023. Automation Bias in Mammography: The Impact of Artificial Intelligence BI-RADS Suggestions on Reader Performance. Radiology 307, e222176. https://doi.org/10.1148/radiol.222176

Edwards, C., 2024. Teaching Transformed. Commun. ACM 67, 12–13. https://doi.org/10.1145/3637208

Embi, P.J., 2021. Algorithmovigilance-Advancing Methods to Analyze and Monitor Artificial Intelligence-Driven Health Care for Effectiveness and Equity. JAMA Netw Open 4, e214622. https://doi.org/10.1001/jamanetworkopen.2021.4622

Finlayson, S.G., Subbaswamy, A., Singh, K., Bowers, J., Kupke, A., Zittrain, J., Kohane, I.S., Saria, S., 2021. The Clinician and Dataset Shift in Artificial Intelligence. N Engl J Med 385, 283–286. https://doi.org/10.1056/NEJMc2104626

Gichoya, J.W., Banerjee, I., Bhimireddy, A.R., Burns, J.L., Celi, L.A., Chen, L.-C., Correa, R., Dullerud, N., Ghassemi, M., Huang, S.-C., Kuo, P.-C., Lungren, M.P., Palmer, L.J., Price, B.J., Purkayastha, S., Pyrros, A.T., Oakden-Rayner, L., Okechukwu, C., Seyyed-Kalantari, L., Trivedi, H., Wang, R., Zaiman, Z., Zhang, H., 2022. AI recognition of patient race in medical imaging: a modelling study. Lancet Digit Health 4, e406–e414. https://doi.org/10.1016/S2589-7500(22)00063-2

Gray, A., 2024. ChatGPT "contamination": estimating the prevalence of LLMs in the scholarly literature. https://doi.org/10.48550/arXiv.2403.16887

Greenhalgh, T., Fisman, D., Cane, D.J., Oliver, M., Macintyre, C.R., 2022. Adapt or die: how the pandemic made the shift from EBM to EBM+ more urgent. BMJ Evid Based Med 27, 253–260. https://doi.org/10.1136/bmjebm-2022-111952

Han, C., Kim, D.W., Kim, S., You, S.C., Park, J.Y., Bae, S., Yoon, D., 2023. Evaluation Of GPT-4 for 10-Year Cardiovascular Risk Prediction: Insights from the UK Biobank and KoGES Data. https://doi.org/10.2139/ssrn.4583995

Han, R., Acosta, J.N., Shakeri, Z., Ioannidis, J., Topol, E., Rajpurkar, P., 2023. Randomized Controlled Trials Evaluating AI in Clinical Practice: A Scoping Evaluation. https://doi.org/10.1101/2023.09.12.23295381

Hassan, C., Spadaccini, M., Mori, Y., Foroutan, F., Facciorusso, A., Gkolfakis, P., Tziatzios, G., Triantafyllou, K., Antonelli, G., Khalaf, K., Rizkala, T., Vandvik, P.O., Fugazza, A., Rondonotti, E., Glissen-Brown, J.R., Kamba, S., Maida, M., Correale, L., Bhandari, P., Jover, R., Sharma, P., Rex, D.K., Repici, A., 2023. Real-Time Computer-Aided Detection of Colorectal Neoplasia During Colonoscopy : A Systematic Review and Meta-analysis. Ann Intern Med. https://doi.org/10.7326/M22-3678

Heneghan, J.A., Walker, S.B., Fawcett, A., Bennett, T.D., Dziorny, A.C., Sanchez-Pinto, L.N., Farris, R.W.D., Winter, M.C., Badke, C., Martin, B., Brown, S.R., McCrory, M.C., Ness-Cochinwala, M., Rogerson, C., Baloglu, O., Harwayne-Gidansky, I., Hudkins, M.R., Kamaleswaran, R., Gangadharan, S., Tripathi, S., Mendonca, E.A., Markovitz, B.P., Mayampurath, A., Spaeder, M.C., Pediatric Data Science and Analytics (PEDAL) subgroup of the Pediatric Acute Lung Injury and Sepsis Investigators (PALISI) Network, 2023. The Pediatric Data Science and Analytics Subgroup of the Pediatric Acute Lung Injury and Sepsis Investigators Network: Use of Supervised Machine Learning Applications in

Pediatric Critical Care Medicine Research. Pediatr Crit Care Med. https://doi.org/10.1097/PCC.0000000000003425
Hersh, W., 2024a. Search still matters: information retrieval in the era of generative AI. J Am Med Inform Assoc ocae014. https://doi.org/10.1093/jamia/ocae014
Hersh, W., 2024b. Translational AI: A Necessity and Opportunity for Biomedical Informatics and Data Science. NLM Musings from the Mezzanine. URL https://nlmdirector.nlm.nih.gov/2024/02/07/translational-ai-a-necessity-and-opportunity-for-biomedical-informatics-and-data-science/ (accessed 2.10.24).
Hersh, W., 2023. Physician and Medical Student Competence in AI Must Include Broader Competence in Clinical Informatics. Informatics Professor. URL https://informaticsprofessor.blogspot.com/2023/09/physician-and-medical-student.html (accessed 9.15.23).
Hersh, W., Ehrenfeld, J., 2020. Clinical Informatics, in: Health Systems Science, 2nd Edition. pp. 156–170.
Hersh, W.R., Gorman, P.N., Biagioli, F.E., Mohan, V., Gold, J.A., Mejicano, G.C., 2014. Beyond information retrieval and electronic health record use: competencies in clinical informatics for medical education. Adv Med Educ Pract 5, 205–212. https://doi.org/10.2147/AMEP.S63903
Hinton, G.E., Osindero, S., Teh, Y.-W., 2006. A fast learning algorithm for deep belief nets. Neural Comput 18, 1527–1554. https://doi.org/10.1162/neco.2006.18.7.1527
Holmstrom, L., Christensen, M., Yuan, N., Weston Hughes, J., Theurer, J., Jujjavarapu, M., Fatehi, P., Kwan, A., Sandhu, R.K., Ebinger, J., Cheng, S., Zou, J., Chugh, S.S., Ouyang, D., 2023. Deep learning-based electrocardiographic screening for chronic kidney disease. Commun Med (Lond) 3, 73. https://doi.org/10.1038/s43856-023-00278-w
Hong, S., Lin, Y., Liu, Bang, Liu, Bangbang, Wu, B., Li, D., Chen, J., Zhang, J., Wang, J., Zhang, Li, Zhang, Lingyao, Yang, M., Zhuge, M., Guo, T., Zhou, T., Tao, W., Wang, W., Tang, X., Lu, X., Zheng, X., Liang, X., Fei, Y., Cheng, Y., Xu, Z., Wu, C., 2024. Data Interpreter: An LLM Agent For Data Science. https://doi.org/10.48550/arXiv.2402.18679
Huang, J., Neill, L., Wittbrodt, M., Melnick, D., Klug, M., Thompson, M., Bailitz, J., Loftus, T., Malik, S., Phull, A., Weston, V., Heller, J.A., Etemadi, M., 2023. Generative Artificial Intelligence for Chest Radiograph Interpretation in the Emergency Department. JAMA Netw Open 6, e2336100. https://doi.org/10.1001/jamanetworkopen.2023.36100
Idrisoglu, A., Dallora, A.L., Anderberg, P., Berglund, J.S., 2023. Applied Machine Learning Techniques to Diagnose Voice-Affecting Conditions and Disorders: Systematic Literature Review. J Med Internet Res 25, e46105. https://doi.org/10.2196/46105
James, C.A., Wachter, R.M., Woolliscroft, J.O., 2022. Preparing Clinicians for a Clinical World Influenced by Artificial Intelligence. JAMA 327, 1333–1334. https://doi.org/10.1001/jama.2022.3580
Jumper, J., Evans, R., Pritzel, A., Green, T., Figurnov, M., Ronneberger, O., Tunyasuvunakool, K., Bates, R., Žídek, A., Potapenko, A., Bridgland, A., Meyer, C., Kohl, S.A.A., Ballard, A.J., Cowie, A., Romera-Paredes, B., Nikolov, S., Jain, R., Adler, J., Back, T., Petersen, S., Reiman, D., Clancy, E., Zielinski, M., Steinegger, M., Pacholska, M., Berghammer, T., Bodenstein, S., Silver, D., Vinyals, O., Senior, A.W., Kavukcuoglu, K., Kohli, P., Hassabis, D., 2021. Highly accurate protein structure prediction with AlphaFold. Nature 596, 583–589. https://doi.org/10.1038/s41586-021-03819-2

Kanjee, Z., Crowe, B., Rodman, A., 2023. Accuracy of a Generative Artificial Intelligence Model in a Complex Diagnostic Challenge. JAMA 330, 78–80. https://doi.org/10.1001/jama.2023.8288
Kapoor, S., Narayanan, A., 2023. Leakage and the reproducibility crisis in machine-learning-based science. Patterns (N Y) 4, 100804. https://doi.org/10.1016/j.patter.2023.100804
Katz, U., Cohen, E., Shachar, E., Somer, J., Fink, A., Morse, E., Shreiber, B., Wolf, I., 2024. GPT versus Resident Physicians — A Benchmark Based on Official Board Scores. NEJM AI 0, AIdbp2300192. https://doi.org/10.1056/AIdbp2300192
Khare, Y., 2023. Generative AI vs Predictive AI: What is the Difference? Analytics Vidhya. URL https://www.analyticsvidhya.com/blog/2023/09/generative-ai-vs-predictive-ai/ (accessed 12.12.23).
King, M., 2023. How Search Generative Experience works and why retrieval-augmented generation is our future [WWW Document]. Search Engine Land. URL https://searchengineland.com/how-search-generative-experience-works-and-why-retrieval-augmented-generation-is-our-future-433393 (accessed 12.10.23).
Koopman, B., Zuccon, G., 2023. Dr ChatGPT tell me what I want to hear: How different prompts impact health answer correctness, in: Bouamor, H., Pino, J., Bali, K. (Eds.), Proceedings of the 2023 Conference on Empirical Methods in Natural Language Processing. Presented at the EMNLP 2023, Association for Computational Linguistics, Singapore, pp. 15012–15022. https://doi.org/10.18653/v1/2023.emnlp-main.928
Kung, T.H., Cheatham, M., Medenilla, A., Sillos, C., De Leon, L., Elepaño, C., Madriaga, M., Aggabao, R., Diaz-Candido, G., Maningo, J., Tseng, V., 2023. Performance of ChatGPT on USMLE: Potential for AI-assisted medical education using large language models. PLOS Digit Health 2, e0000198. https://doi.org/10.1371/journal.pdig.0000198
Lancaster, F.W., 1979. Information retrieval systems: Characteristics, testing, and evaluation, 2nd ed edition. ed. John Wiley & Sons, New York.
Langlotz, C.P., 2019. Will Artificial Intelligence Replace Radiologists? Radiol Artif Intell 1, e190058. https://doi.org/10.1148/ryai.2019190058
Lee, B.K., Mayhew, E.J., Sanchez-Lengeling, B., Wei, J.N., Qian, W.W., Little, K.A., Andres, M., Nguyen, B.B., Moloy, T., Yasonik, J., Parker, J.K., Gerkin, R.C., Mainland, J.D., Wiltschko, A.B., 2023. A principal odor map unifies diverse tasks in olfactory perception. Science 381, 999–1006. https://doi.org/10.1126/science.ade4401
Levine, D.M., Tuwani, R., Kompa, B., Varma, A., Finlayson, S.G., Mehrotra, A., Beam, A., 2023. The Diagnostic and Triage Accuracy of the GPT-3 Artificial Intelligence Model. https://doi.org/10.1101/2023.01.30.23285067
Levkovich, I., Elyoseph, Z., 2023. Identifying depression and its determinants upon initiating treatment: ChatGPT versus primary care physicians. Fam Med Community Health 11, e002391. https://doi.org/10.1136/fmch-2023-002391
Lewis, A.E., Weiskopf, N., Abrams, Z.B., Foraker, R., Lai, A.M., Payne, P.R.O., Gupta, A., 2023. Electronic health record data quality assessment and tools: a systematic review. J Am Med Inform Assoc ocad120. https://doi.org/10.1093/jamia/ocad120
Li, D., Gupta, K., Bhaduri, M., Sathiadoss, P., Bhatnagar, S., Chong, J., 2024. Comparing GPT-3.5 and GPT-4 Accuracy and Drift in Radiology Diagnosis Please Cases. Radiology 310, e232411. https://doi.org/10.1148/radiol.232411
Liang, W., Izzo, Z., Zhang, Y., Lepp, H., Cao, H., Zhao, X., Chen, L., Ye, H., Liu, S., Huang, Z., McFarland, D.A., Zou, J.Y., 2024a. Monitoring AI-Modified Content at Scale: A Case

Study on the Impact of ChatGPT on AI Conference Peer Reviews. https://doi.org/10.48550/arXiv.2403.07183
Liang, W., Yuksekgonul, M., Mao, Y., Wu, E., Zou, J., 2023. GPT detectors are biased against non-native English writers. Patterns (N Y) 4, 100779. https://doi.org/10.1016/j.patter.2023.100779
Liang, W., Zhang, Y., Wu, Z., Lepp, H., Ji, W., Zhao, X., Cao, H., Liu, S., He, S., Huang, Z., Yang, D., Potts, C., Manning, C.D., Zou, J.Y., 2024b. Mapping the Increasing Use of LLMs in Scientific Papers. https://doi.org/10.48550/arXiv.2404.01268
Liu, X., Rivera, S.C., Moher, D., Calvert, M.J., Denniston, A.K., SPIRIT-AI and CONSORT-AI Working Group, 2020. Reporting guidelines for clinical trial reports for interventions involving artificial intelligence: the CONSORT-AI Extension. BMJ 370, m3164. https://doi.org/10.1136/bmj.m3164
Mangas-Sanjuan, C., de-Castro, L., Cubiella, J., Díez-Redondo, P., Suárez, A., Pellisé, M., Fernández, N., Zarraquiños, S., Núñez-Rodríguez, H., Álvarez-García, V., Ortiz, O., Sala-Miquel, N., Zapater, P., Jover, R., CADILLAC study investigators*, 2023. Role of Artificial Intelligence in Colonoscopy Detection of Advanced Neoplasias : A Randomized Trial. Ann Intern Med. https://doi.org/10.7326/M22-2619
McCarthy, J., Feigenbaum, E.A., 1990. In Memoriam: Arthur Samuel: Pioneer in Machine Learning. AIMag 11, 10–10. https://doi.org/10.1609/aimag.v11i3.840
Medical groups taking their time to adopt the right set of AI tools [WWW Document], 2023. . Medical Group Management Association. URL https://www.mgma.com/mgma-stat/medical-groups-taking-their-time-to-adopt-the-right-set-of-ai-tools (accessed 11.22.23).
Meyer, A., Benn, R., 2023. Hype Cycle for Healthcare Providers, 2023 [WWW Document]. Gartner. URL https://www.gartner.com/en/documents/4534899 (accessed 1.6.23).
Mitsuyama, Y., Matsumoto, T., Tatekawa, H., Walston, S.L., Kimura, T., Yamamoto, A., Watanabe, T., Miki, Y., Ueda, D., 2023. Chest radiography as a biomarker of ageing: artificial intelligence-based, multi-institutional model development and validation in Japan. The Lancet Healthy Longevity 0. https://doi.org/10.1016/S2666-7568(23)00133-2
Mollick, E., 2024. Co-Intelligence: Living and Working with AI. Portfolio.
Mollick, E., 2023. The Homework Apocalypse [WWW Document]. One Useful Thing. URL https://www.oneusefulthing.org/p/the-homework-apocalypse (accessed 3.20.24).
Mollick, E.R., Mollick, L., 2023a. Using AI to Implement Effective Teaching Strategies in Classrooms: Five Strategies, Including Prompts. https://doi.org/10.2139/ssrn.4391243
Mollick, E.R., Mollick, L., 2023b. Assigning AI: Seven Approaches for Students, with Prompts. https://doi.org/10.2139/ssrn.4475995
Mukherjee, P., Humbert-Droz, M., Chen, J.H., Gevaert, O., 2023. SCOPE: predicting future diagnoses in office visits using electronic health records. Sci Rep 13, 11005. https://doi.org/10.1038/s41598-023-38257-9
Nam, J., 2023. 56% of College Students Have Used AI on Assignments or Exams | BestColleges [WWW Document]. BestColleges.com. URL https://www.bestcolleges.com/research/most-college-students-have-used-ai-survey/ (accessed 12.13.23).
Nori, H., Lee, Y.T., Zhang, S., Carignan, D., Edgar, R., Fusi, N., King, N., Larson, J., Li, Y., Liu, W., Luo, R., McKinney, S.M., Ness, R.O., Poon, H., Qin, T., Usuyama, N., White, C., Horvitz, E., 2023. Can Generalist Foundation Models Outcompete Special-Purpose Tuning? Case Study in Medicine. https://doi.org/10.48550/arXiv.2311.16452

Odri, G.-A., Yun Yoon, D.J., 2023. Detecting generative artificial intelligence in scientific articles: evasion techniques and implications for scientific integrity. Orthop Traumatol Surg Res 103706. https://doi.org/10.1016/j.otsr.2023.103706

Omiye, J.A., Lester, J.C., Spichak, S., Rotemberg, V., Daneshjou, R., 2023. Large language models propagate race-based medicine. npj Digit. Med. 6, 1–4. https://doi.org/10.1038/s41746-023-00939-z

Palmer, K., 2023. The 'model-eat-model world' of clinical AI: How predictive power becomes a pitfall. STAT. URL https://www.statnews.com/2023/10/10/the-model-eat-model-world-of-clinical-ai-how-predictive-power-becomes-a-pitfall/ (accessed 11.28.23).

Plana, D., Shung, D.L., Grimshaw, A.A., Saraf, A., Sung, J.J.Y., Kann, B.H., 2022. Randomized Clinical Trials of Machine Learning Interventions in Health Care: A Systematic Review. JAMA Netw Open 5, e2233946. https://doi.org/10.1001/jamanetworkopen.2022.33946

Poldrack, R.A., Lu, T., Beguš, G., 2023. AI-assisted coding: Experiments with GPT-4. https://doi.org/10.48550/arXiv.2304.13187

Poplin, R., Varadarajan, A.V., Blumer, K., Liu, Y., McConnell, M.V., Corrado, G.S., Peng, L., Webster, D.R., 2018. Prediction of cardiovascular risk factors from retinal fundus photographs via deep learning. Nat Biomed Eng 2, 158–164. https://doi.org/10.1038/s41551-018-0195-0

Pyrros, A., Borstelmann, S.M., Mantravadi, R., Zaiman, Z., Thomas, K., Price, B., Greenstein, E., Siddiqui, N., Willis, M., Shulhan, I., Hines-Shah, J., Horowitz, J.M., Nikolaidis, P., Lungren, M.P., Rodríguez-Fernández, J.M., Gichoya, J.W., Koyejo, S., Flanders, A.E., Khandwala, N., Gupta, A., Garrett, J.W., Cohen, J.P., Layden, B.T., Pickhardt, P.J., Galanter, W., 2023. Opportunistic detection of type 2 diabetes using deep learning from frontal chest radiographs. Nat Commun 14, 4039. https://doi.org/10.1038/s41467-023-39631-x

Rajkomar, A., Oren, E., Chen, K., Dai, A.M., Hajaj, N., Hardt, M., Liu, P.J., Liu, X., Marcus, J., Sun, M., Sundberg, P., Yee, H., Zhang, K., Zhang, Y., Flores, G., Duggan, G.E., Irvine, J., Le, Q., Litsch, K., Mossin, A., Tansuwan, J., Wang, D., Wexler, J., Wilson, J., Ludwig, D., Volchenboum, S.L., Chou, K., Pearson, M., Madabushi, S., Shah, N.H., Butte, A.J., Howell, M.D., Cui, C., Corrado, G.S., Dean, J., 2018. Scalable and accurate deep learning with electronic health records. npj Digital Medicine 1, 1–10. https://doi.org/10.1038/s41746-018-0029-1

Rajpurkar, P., Chen, E., Banerjee, O., Topol, E.J., 2022. AI in health and medicine. Nat Med 1–8. https://doi.org/10.1038/s41591-021-01614-0

Rajpurkar, P., Lungren, M.P., 2023. The Current and Future State of AI Interpretation of Medical Images. N Engl J Med 388, 1981–1990. https://doi.org/10.1056/NEJMra2301725

Rao, A., Pang, M., Kim, J., Kamineni, M., Lie, W., Prasad, A.K., Landman, A., Dreyer, K., Succi, M.D., 2023. Assessing the Utility of ChatGPT Throughout the Entire Clinical Workflow: Development and Usability Study. J Med Internet Res 25, e48659. https://doi.org/10.2196/48659

Russell, R.G., Lovett Novak, L., Patel, M., Garvey, K.V., Craig, K.J.T., Jackson, G.P., Moore, D., Miller, B.M., 2023. Competencies for the Use of Artificial Intelligence-Based Tools by Health Care Professionals. Acad Med 98, 348–356. https://doi.org/10.1097/ACM.0000000000004963

Sadasivan, V.S., Kumar, A., Balasubramanian, S., Wang, W., Feizi, S., 2023. Can AI-Generated Text be Reliably Detected? https://doi.org/10.48550/arXiv.2303.11156

Sarraju, A., Bruemmer, D., Van Iterson, E., Cho, L., Rodriguez, F., Laffin, L., 2023. Appropriateness of Cardiovascular Disease Prevention Recommendations Obtained From a Popular Online Chat-Based Artificial Intelligence Model. JAMA. https://doi.org/10.1001/jama.2023.1044

Shah, C., 2023. AI information retrieval: A search engine researcher explains the promise and peril of letting ChatGPT and its cousins search the web for you [WWW Document]. The Conversation. URL http://theconversation.com/ai-information-retrieval-a-search-engine-researcher-explains-the-promise-and-peril-of-letting-chatgpt-and-its-cousins-search-the-web-for-you-200875 (accessed 8.22.23).

Shah, C., 2022. A Hands-On Introduction to Machine Learning. Cambridge University Press.

Spitale, G., Biller-Andorno, N., Germani, F., 2023. AI model GPT-3 (dis)informs us better than humans. Sci Adv 9, eadh1850. https://doi.org/10.1126/sciadv.adh1850

Swanson, K., Liu, G., Catacutan, D.B., Arnold, A., Zou, J., Stokes, J.M., 2024. Generative AI for designing and validating easily synthesizable and structurally novel antibiotics. Nat Mach Intell 6, 338–353. https://doi.org/10.1038/s42256-024-00809-7

Tang, A.S., Rankin, K.P., Cerono, G., Miramontes, S., Mills, H., Roger, J., Zeng, B., Nelson, C., Soman, K., Woldemariam, S., Li, Y., Lee, A., Bove, R., Glymour, M., Aghaeepour, N., Oskotsky, T.T., Miller, Z., Allen, I.E., Sanders, S.J., Baranzini, S., Sirota, M., 2024. Leveraging electronic health records and knowledge networks for Alzheimer's disease prediction and sex-specific biological insights. Nat Aging 4, 379–395. https://doi.org/10.1038/s43587-024-00573-8

Tang, J., LeBel, A., Jain, S., Huth, A.G., 2023. Semantic reconstruction of continuous language from non-invasive brain recordings. Nat Neurosci 26, 858–866. https://doi.org/10.1038/s41593-023-01304-9

Tang, R., Chuang, Y.-N., Hu, X., 2024. The Science of Detecting LLM-Generated Text. Commun. ACM 67, 50–59. https://doi.org/10.1145/3624725

Topol, E., 2022. The amazing power of "machine eyes." Ground Truths. URL https://erictopol.substack.com/p/the-amazing-power-of-machine-eyes (accessed 10.14.22).

Topol, E., 2019. Deep Medicine: How Artificial Intelligence Can Make Healthcare Human Again, Illustrated Edition. ed. Basic Books, New York.

Tu, T., Palepu, A., Schaekermann, M., Saab, K., Freyberg, J., Tanno, R., Wang, A., Li, B., Amin, M., Tomasev, N., Azizi, S., Singhal, K., Cheng, Y., Hou, L., Webson, A., Kulkarni, K., Mahdavi, S.S., Semturs, C., Gottweis, J., Barral, J., Chou, K., Corrado, G.S., Matias, Y., Karthikesalingam, A., Natarajan, V., 2024. Towards Conversational Diagnostic AI. https://doi.org/10.48550/arXiv.2401.05654

Tu, X., Zou, J., Su, W., Zhang, L., 2024. What Should Data Science Education Do With Large Language Models? Harvard Data Science Review 6. https://doi.org/10.1162/99608f92.bff007ab

Ueda, D., Matsumoto, T., Ehara, S., Yamamoto, A., Walston, S.L., Ito, A., Shimono, T., Shiba, M., Takeshita, T., Fukuda, D., Miki, Y., 2023. Artificial intelligence-based model to classify cardiac functions from chest radiographs: a multi-institutional, retrospective model development and validation study. Lancet Digit Health S2589-7500(23)00107–3. https://doi.org/10.1016/S2589-7500(23)00107-3

Vaid, A., Sawant, A., Suarez-Farinas, M., Lee, J., Kaul, S., Kovatch, P., Freeman, R., Jiang, J., Jayaraman, P., Fayad, Z., Argulian, E., Lerakis, S., Charney, A.W., Wang, F., Levin, M., Glicksberg, B., Narula, J., Hofer, I., Singh, K., Nadkarni, G.N., 2023. Implications of the

Use of Artificial Intelligence Predictive Models in Health Care Settings : A Simulation Study. Ann Intern Med. https://doi.org/10.7326/M23-0949

Vazquez, M.A., Oliver, G., Amarasingham, R., Amarasingham Ruben, Sundaram Venkatraghavan, Chan Kevin, Ahn Chul, Zhang Song, Bickel Perry, Parikh Samir M., Wells Barbara, Miller R. Tyler, Hedayati Susan, Hastings Jeffrey, Jaiyeola Adeola, Nguyen Tuan-Minh, Moran Brett, Santini Noel, Barker Blake, Velasco Ferdinand, Myers Lynn, Meehan Thomas P., Fox Chester, Toto Robert D., 2024. Pragmatic Trial of Hospitalization Rate in Chronic Kidney Disease. New England Journal of Medicine 390, 1196–1206. https://doi.org/10.1056/NEJMoa2311708

Walker, S.C., French, B., Moore, R.P., Domenico, H.J., Wanderer, J.P., Mixon, A.S., Creech, C.B., Byrne, D.W., Wheeler, A.P., 2023. Model-Guided Decision-Making for Thromboprophylaxis and Hospital-Acquired Thromboembolic Events Among Hospitalized Children and Adolescents: The CLOT Randomized Clinical Trial. JAMA Netw Open 6, e2337789. https://doi.org/10.1001/jamanetworkopen.2023.37789

Walters, W.H., Wilder, E.I., 2023. Fabrication and errors in the bibliographic citations generated by ChatGPT. Sci Rep 13, 14045. https://doi.org/10.1038/s41598-023-41032-5

Wang, S., Scells, H., Koopman, B., Zuccon, G., 2023. Can ChatGPT Write a Good Boolean Query for Systematic Review Literature Search? https://doi.org/10.48550/arXiv.2302.03495

Weiss, J., Raghu, V.K., Paruchuri, K., Zinzuwadia, A., Natarajan, P., Aerts, H.J.W.L., Lu, M.T., 2024. Deep Learning to Estimate Cardiovascular Risk From Chest Radiographs : A Risk Prediction Study. Ann Intern Med. https://doi.org/10.7326/M23-1898

Widner, K., Virmani, S., Krause, J., Nayar, J., Tiwari, R., Pedersen, E.R., Jeji, D., Hammel, N., Matias, Y., Corrado, G.S., Liu, Y., Peng, L., Webster, D.R., 2023. Lessons learned from translating AI from development to deployment in healthcare. Nat Med 29, 1304–1306. https://doi.org/10.1038/s41591-023-02293-9

Wu, K., Wu, E., Cassasola, A., Zhang, A., Wei, K., Nguyen, T., Riantawan, S., Riantawan, P.S., Ho, D.E., Zou, J., 2024. How well do LLMs cite relevant medical references? An evaluation framework and analyses. https://doi.org/10.48550/arXiv.2402.02008

Xu, S., Yang, L., Kelly, C., Sieniek, M., Kohlberger, T., Ma, M., Weng, W.-H., Kiraly, A., Kazemzadeh, S., Melamed, Z., Park, J., Strachan, P., Liu, Y., Lau, C., Singh, P., Chen, C., Etemadi, M., Kalidindi, S.R., Matias, Y., Chou, K., Corrado, G.S., Shetty, S., Tse, D., Prabhakara, S., Golden, D., Pilgrim, R., Eswaran, K., Sellergren, A., 2023. ELIXR: Towards a general purpose X-ray artificial intelligence system through alignment of large language models and radiology vision encoders [WWW Document]. arXiv.org. URL https://arxiv.org/abs/2308.01317v2 (accessed 9.26.23).

Yu, F., Moehring, A., Banerjee, O., Salz, T., Agarwal, N., Rajpurkar, P., 2024. Heterogeneity and predictors of the effects of AI assistance on radiologists. Nat Med 30, 837–849. https://doi.org/10.1038/s41591-024-02850-w

Zakka, C., Shad, R., Chaurasia, A., Dalal, A.R., Kim, J.L., Moor, M., Fong, R., Phillips, C., Alexander, K., Ashley, E., Boyd, J., Boyd, K., Hirsch, K., Langlotz, C., Lee, R., Melia, J., Nelson, J., Sallam, K., Tullis, S., Vogelsong, M.A., Cunningham, J.P., Hiesinger, W., 2024. Almanac — Retrieval-Augmented Language Models for Clinical Medicine. NEJM AI 1, AIoa2300068. https://doi.org/10.1056/AIoa2300068

Zanon, C., Toniolo, A., Bini, C., Quaia, E., 2023. ChatGPT Goes to The Radiology Department: A Pictorial Review. https://doi.org/10.20944/preprints202312.0714.v1

Zhou, Q., Chen, Z.-H., Cao, Y.-H., Peng, S., 2021. Clinical impact and quality of randomized controlled trials involving interventions evaluating artificial intelligence prediction tools: a systematic review. NPJ Digit Med 4, 154. https://doi.org/10.1038/s41746-021-00524-2

Artificial Intelligence: Implications for Health Professions Education

William Hersh, MD, FACMI, FAMIA
Oregon Health & Science University
2024 AMIA Academic Forum Retreat

1

Objectives and disclosures

After this talk, you will to be able to

- Define the major types of AI and their applications, successes, and limitations in biomedicine
- Discuss the evidence base for AI, its limitations, and how to improve it
- Describe the issues and challenges for AI in medical education

Disclosures

- None

2

Artificial intelligence (AI)

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

3

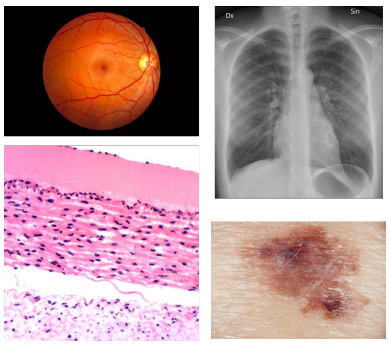
Predictive AI in medicine

"Predictive AI" driven by advances in ML, increasing availability of data, and more powerful computers and networks (Topol, 2019; Rajpurkar, 2022)

- Deep learning in imaging breakthroughs 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



4

Predictive AI not limited to imaging

Adverse events in hospitalizations from electronic health record (EHR) data (Rajkomar, 2018)

Protein folding from amino acid sequences (Jumper, 2021)

Model based on past ICD-10 codes and lab results to predict future diagnoses in office visits (Mukherjee, 2023)

Semantic reconstruction of continuous language from fMRI brain recordings (Tang, 2023)

Map chemicals to odors perceived by humans (Lee, 2023)

Predict Alzheimer's Disease from EHR data up to 7 years before diagnosis (Tang, 2024)

Voice as a biomarker in Parkinson's Disease, Alzheimer's Disease, cognitive impairment, COVID-19, and others (Idrisoglu, 2023; Bensoussan, 2024)

The list goes on and on, especially with addition of generative AI…

5

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

Retinal images

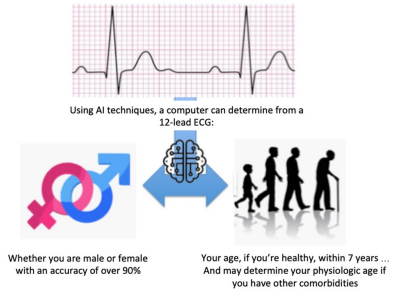
- Age, biological sex, and cardiovascular risk determination from retinal images (Poplin, 2018)
- Race (Coyner, 2023)

Electrocardiograms (ECGs)

- Age and biological sex determination (Attia, 2019)
- Chronic kidney disease (Holmstrom, 2023)

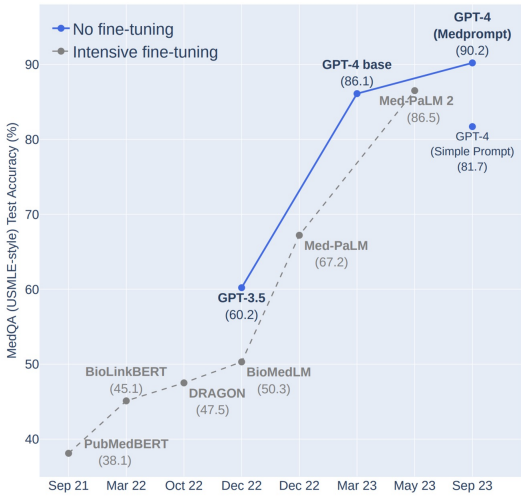
Chest x-rays

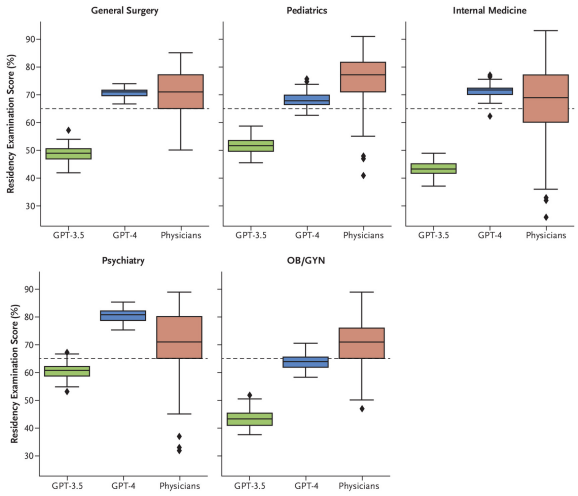
- Race (Gichoya, 2022)
- Cardiac function and valvular heart diseases (Ueda, 2023)
- Diabetes (Pyrros, 2023)
- Correlation with chronological age in healthy cohorts and, for various chronic diseases, difference between estimated age and chronological age (Mitsuyama, 2023)
- Cardiac risk as accurately as common models, e.g., atherosclerotic cardiovascular disease (ASCVD) (Weiss, 2024)



6

Success of generative AI – board exams (Kung, 2023; Nori, 2023; Katz, 2024; and more)





7

Success of LLMs (cont.)

Solving clinical cases – comparable to but not better than expert humans (Levine, 2023; Kanjee, 2023; Rao, 2023; Benoit, 2023; Chen, 2023; Levkovich, 2023)

In simulated (text-based) objective structured clinical exam (OSCE) format, Google's Articulate Medical Intelligence Explorer (AMIE) outperformed primary care physicians in text-based dialogue in history-taking, diagnostic accuracy, management reasoning, communication skills, and empathy (Tu, 2024)

For 20 clinical cases, GPT-4 performed comparable to attending physicians and residents in diagnostic accuracy, correct clinical reasoning, and cannot-miss diagnosis inclusion (Cabral, 2024)

8

Results of LLMs (cont.)

Communicating with patients

- Answering questions in public forums (Sarraju, 2023; Ayers, 2023)
- Writing letters with comparable or better empathy (Ali, 2023, Ayers, 2023)
- Generating surgical consent forms better than surgeons (Decker, 2023)

Closing the loop with predictive AI

- Classifying CXR findings based on previous images and reports (Xu, 2023)
- Generating CXR reports from new images in ED from prior images and reports (Huang, 2023)
- Predicting cardiovascular risk comparable to Framingham models (Han, 2023)
- Designing and validating easily synthesizable and structurally novel antibiotics (Swanson, 2024)

9

But there are some downsides to generative AI

Dictionary.com 2023 word of year: hallucinate

- https://content.dictionary.com/word-of-the-year-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

8 clinical questions asked of 4 LLMs recapitulated “harmful, race-based medicine” (Omiye, 2023)

10

Downsides to generative AI (cont.)

Equally compelling disinformation – humans cannot distinguish between true and false tweets generated by GPT-3 and written by real Twitter users (Spitale, 2023)

Automated GPT detectors have mixed results (Sadasivan, 2023; Odri, 2023; Desaire, 2023; Tang, 2024)

- More likely to classify non-native English writing as AI-generated (Liang, 2023)
- Humans not able to discern AI writing either (Dell'Acqua, 2023)

11

And some downsides to AI in general

After clinical models deployed, performance may decline due to actual real-world use (Vaid, 2023; Palmer, 2023)

Implementing diabetic retinopathy screening in rural Thailand and India found (Widner, 2023)

- Challenges related to equipment operation, workflows, and image quality
- Need for training and attention to human factors

ML algorithms, especially generative AI, have large carbon footprints, although details sometimes not known due to lack of company transparency (Kirkpatrick, 2023)

- One estimate is that electricity consumption of AI request is 10-fold more than Google search (de Vries, 2023)

12

Downsides to AI in general (cont.)

Variable impacts on different levels of radiologists, leading to automation bias and detrimental effects of incorrect AI (Dratsch, 2023; Yu, 2024)

Concerns about reproducibility (Ball, 2023)

- Data bias (especially from EHR – Lewis, 2023; Chin, 2023)
- Data leakage (Kapoor, 2023)
- Data drift/shift (Finlayson, 2021; Li, 2024)

13

Will AI help or hinder healthcare?

Real-world use still modest

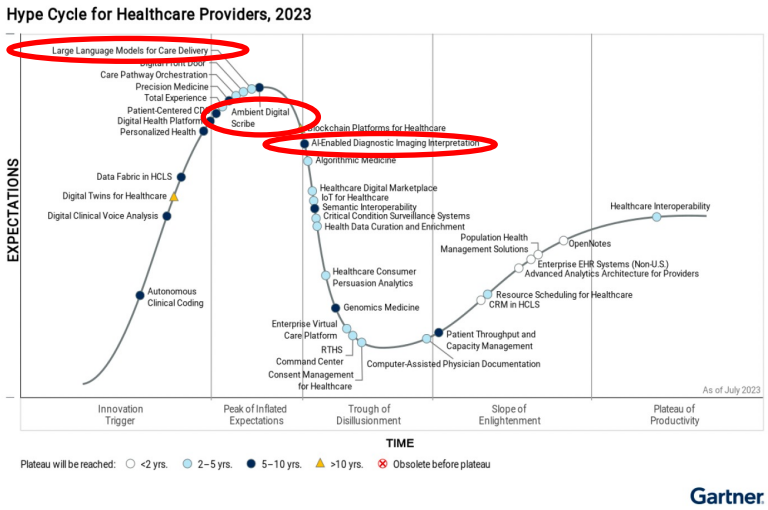
- As of Sept 2023, only 21% of medical groups using AI applications in practice (MGMA, 2023)
- EHR usability, patient communications, and billing outrank AI as top tech priorities among medical groups (MGMA, 2023)
- AI tools used by only 38% of physicians (AMA, 2023)

"AI won't replace radiologists, but radiologists who use AI will replace radiologists who don't," (Langlotz, 2019)

- (Plug in your health profession)

14

AI is at peak of inflated expectations (Meyer, 2023)



15

What do we need for AI applications to get to plateau of productivity?

Translational AI (Hersh, 2024)

- Show us the evidence
- How do we learn about it

Education of clinical workforce and others (Hersh, 2023)

Search still matters (Hersh, 2024)

- In many circumstances, who said what is more important than providing a generated answer

16

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)

17

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”

18

Perspective 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)

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 physicians – used only 26% of time
- For children in intervention arm, model mostly not used, AI's "Cassandra problem" (Wilson, 2023)?

More failure of model success to improve clinical outcomes

- Hospital readmissions (Donzé, 2023)
- Chronic kidney disease (Vazquez, 2024)

19

How do we get to "translational AI?"

In pediatric critical care ML research, "the literature demonstrates incomplete reporting, absence of external validation, and infrequent clinical implementation" (Heneghan, 2023)

Singh, X/Twitter, Feb 8 2024: "Researched models aren't implemented. Implemented models aren't researched."

Postmarket surveillance, e.g., algorithmovigilance (Embi, 2021)

Responsible use (Dorr, 2023) and code of conduct (Adams, NAM, 2024) for AI

Building the evidence base (Hersh, 2024)

20

Also critical is education of clinicians and informaticians

AI should build on competencies in clinical informatics (Hersh, 2014; Hersh 2020; Hersh, 2023)

Others note

- 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)
- Impact in many fields beyond medicine, including
  - Computer science (Denny, 2024)
  - Data science (Hong, 2024)
  - Law (Choi, 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

21

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

Domain	Competency
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

22

Educators need to assign and innovate with AI (Mollick, 2024)

Assigning (Mollick, 2023)

Can use as

- Mentor
- Tutor
- Coach
- Teammate
- Student
- Simulator
- Tool

Risks include

- Confabulation
- Bias – from training content
- Privacy – policies not always clear
- Instructional – student over-reliance

Innovating (Mollick, 2024)

One Useful Thing

- https://www.oneusefulthing.org/

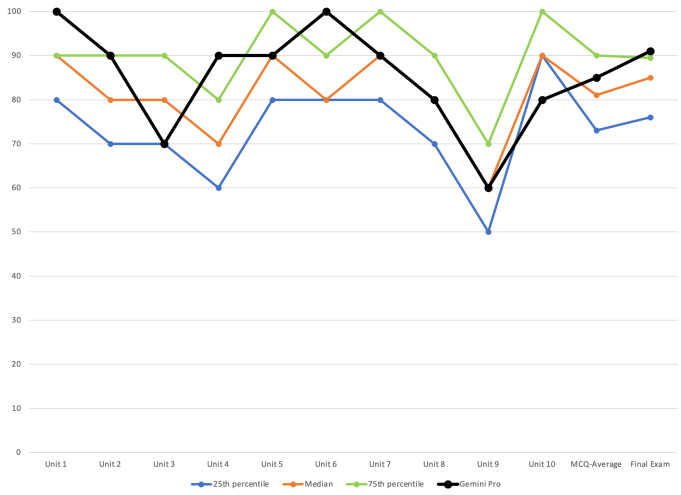
CATEGORY	PROMPT	PEDAGOGICAL PRINCIPLES
SIMULATION	Role-playing with AI feedback	Practicing and applying knowledge
SIMULATION	Goal-playing with AI feedback	Practicing applying frameworks in new situations
CRITIQUE	Critique a scenario	Structuring knowledge. Critical thinking and protégé effect
TEACH	Teach the AI	Teaching others is a powerful learning technique
CO-CREATE	Co-create a case	Break the illusion of explanatory depth. Structuring knowledge. Retrieval
MENTOR AND COACH	Reflection coach	Reflection is critical to learning
MENTOR AND COACH	Integration agent	Creating connections and interleaving concepts
TUTOR	Tutor	Tutoring is an effective technique for improving learning

Generative AI is a challenge for educators

The “homework apocalypse” (Mollick, 2023)

It is happening in informatics too (Hersh, under review, 2024)

- Well-known, highly subscribed introductory course (10x10, BMI 510, MINF 705B)
- Commercial LLMs prompted using interactive Web interface for multiple-choice and final exam questions from 2023 course materials
- Highest score by Gemini Pro at about 75th percentile for 139 students



Need policy for generative AI: mine for introductory course

OHSU *Introduction to Biomedical & Health Informatics* Course Policy for Use of ChatGPT and Generative AI

William Hersh, MD
Professor
Department of Medical Informatics & Clinical Epidemiology
School of Medicine
Oregon Health & Science University

https://dmice.ohsu.edu/hersh/introcourse-generativeAI-policy.html

This page reflects course policy for the Oregon Health & Science University (OHSU) course that I teach called, *Introduction to Biomedical & Health Informatics*. I teach versions of this course in several OHSU programs, including:

- Biomedical Informatics Graduate program - BMI 510/610 - Introduction to Biomedical & Health Informatics
- AMIA 10x10 ("ten by ten") course - OHSU-AMIA 10x10 course
- MD curriculum course, MINF 705B/709A

ChatGPT and generative AI systems based on large language models (LLMs) can be a useful tool for learning all kinds of topics, including in biomedical and health informatics. These tools should not, however, be used to substitute one's own knowledge. Students can "converse" with ChatGPT or generative AI systems to get ideas for answers to questions, but the final responses to discussion forums, quiz and test questions, and the term paper, should reflect their own thinking, judgment, and language.

It is critically important that students not "shortchange" their learning by being overly reliant on generative AI systems. While most scientific fields have long surpassed the amount of knowledge that can be maintained in a human brain, it is important to have a fundamental core of knowledge and understanding in memory to be able to apply critical thinking to problems and analyses. In addition, just as students must attribute use of papers, books, and other sources in their work, they must also attribute use of generative AI when it is used in discussion forums or assignments.

This policy is derived from the overall OHSU policy for academic integrity, including the use of AI. The OHSU Biomedical Informatics Graduate Program is developing a general policy for use of generative AI in courses, but in the meantime, I am adopting the following guidelines for course activities:

- **Discussion forums** - the purpose of the discussion forums is for students to discuss issues that elaborate on unit course materials. Individual forum postings are not graded, although a component of the course grade is based on participation in the forums, comparable to what used to be participation in live classrooms. While students can "converse" with generative AI to get ideas for responses to forum questions, what is actually posted in the forum by students should represent their own ideas and thought processes.
- **Homework self-assessment** - students can ask generative AI about topics mentioned in the multiple-choice questions but are expected to answer the questions based on their own knowledge of materials covered in the lectures.
- **Term paper/project** - students can ask generative AI for help in brainstorming about their term paper. Generative AI systems do not write long papers, and their output tends to focus on generalities and may be prone to confabulation, especially in generating references. The 10-15 page term paper should have a focus on a specific topic, and delve into it with coherent discussion and ample references, including recent ones, as outlined in the course syllabus.
- **Final exam** - students must not access generative AI during the final exam, just as they may not consult humans during the open-book exams that I give.

If you are a student and have a question on whether use of generative AI is appropriate, please reach out directly to me (email is best for initial contact).

As a guiding principle, we expect and require that all work submitted be the student's own, original work. When considering using such a generative AI tool, students should ask themselves: Will the tool's output be something I will be turning in directly? In general, students may use such tools as a source of information, but not to produce output that they intend to turn in or as a replacement for a traditional cited reference.

Most ethical and conduct policies in our informatics educational programs, and in the work we subsequently do as professionals, are enforced through an **honor code**. We recognize we cannot police all inappropriate use of AI or other activities. We hope that students will find ways to use LLMs to enhance their learning but not substitute for or become dependent on it.

Last update: May 20, 2024

25

Search still matters (Hersh, 2024)

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, 1979)

26

Other concerns for search

Concerns for search and LLMs (Shah, 2023)

- Opacity and hallucinations
  - LLMs don't know when they don't know
- Stealing content and Web site traffic
  - LLMs learn from other people's content and may divert traffic from their Web sites
- Taking away learning and serendipity
  - Search is exploring and we may learn new unrelated things

LLMs "contaminating" scientific literature and peer review

- Scientific literature – estimates range from
  - 1% generally (Gray, 2024)
  - 6% for Nature portfolio and 17.5% in computer science (Liang, 2024)
- Peer review
  - Usage in AI conference peer reviews estimated to be 6.5-16.9% (Liang, 2024)

27

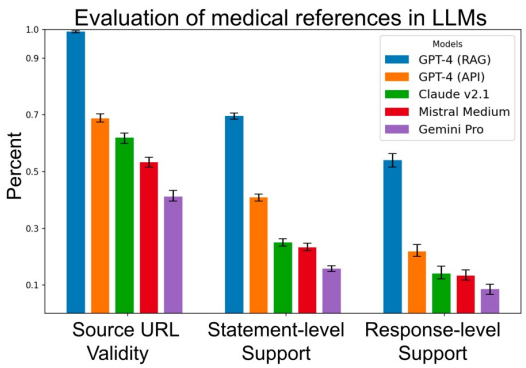
Search in the era of generative AI

Another adage of EBM?

- Gen AI for background questions
- Search and critical appraisal for foreground questions

Retrieval-augmented generation (RAG) may improve Gen AI but do we need "generation-augmented retrieval" for LLMs to aid search?

- ChatGPT for generating Boolean queries did not improve search results (Wang, 2023)
- Best LLM with RAG (GPT-4 in CoPilot) achieved about 70% statement-level support and <50% for others (Wu, 2024)
- Research being pursued in Text Retrieval Conference (TREC) Biomedical Generative Retrieval (BioGen) Track
  - https://dmice.ohsu.edu/trec-biogen/



28

Conclusions

AI will profoundly impact the practice and education of all health professions

Translational AI is a necessity and opportunity for clinicians, researchers and others

Healthcare, informatics, and educational professionals must be competent with AI as much as any other tool in clinical practice

Educators must develop new approaches to teaching and student assessment in era of generative AI

Generative AI systems must provide attribution for their assertions

29

Questions?

William Hersh, MD
Professor
Department of Medical Informatics & Clinical Epidemiology
Oregon Health & Science University
Portland, OR, USA
Email
hersh@ohsu.edu
Web
http://www.billhersh.info
Blog
https://informaticsprofessor.blogspot.com/
Textbook
http://www.informaticsbook.info
What is Informatics?
http://informatics.health

30