

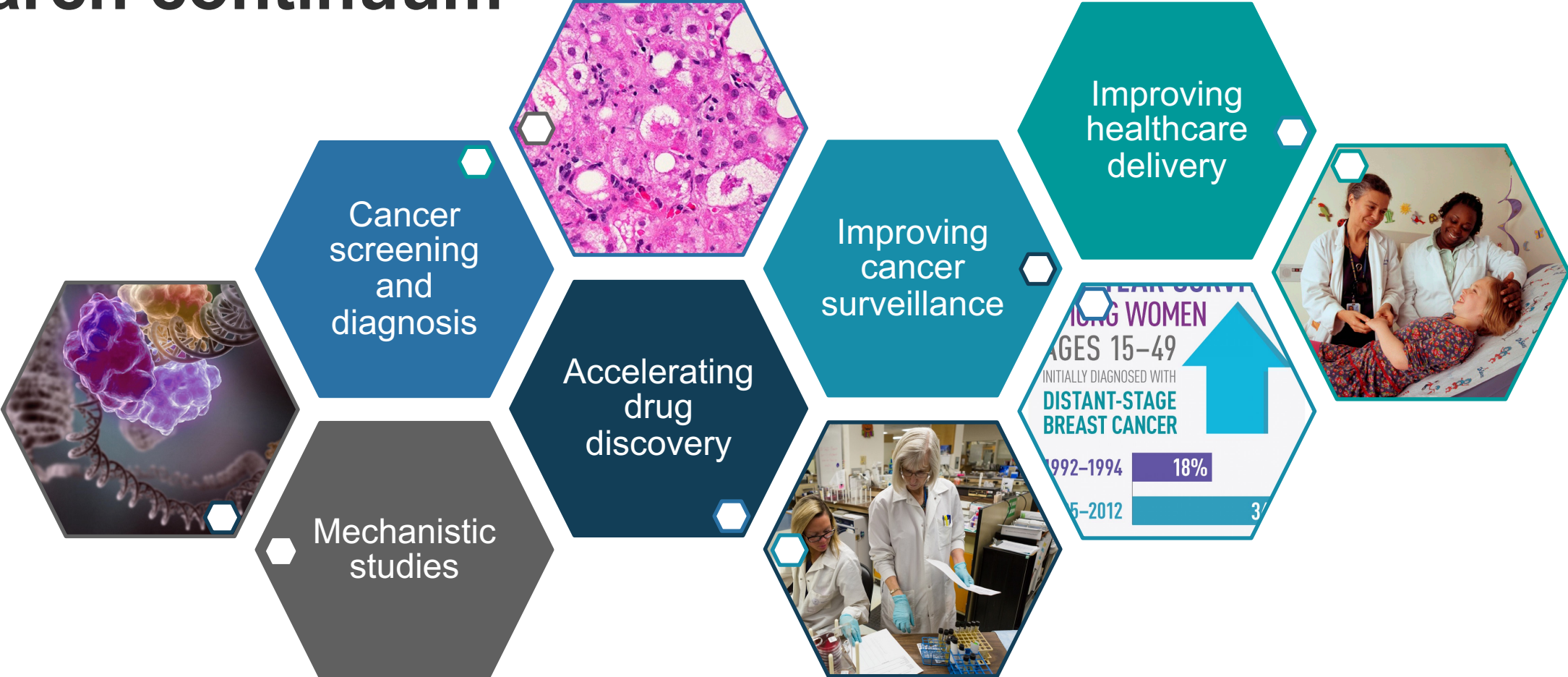
Advancing Trustworthy Artificial Intelligence for Cancer Research

Juli Klemm, Ph.D.
NCI Center for Strategic Scientific Initiatives

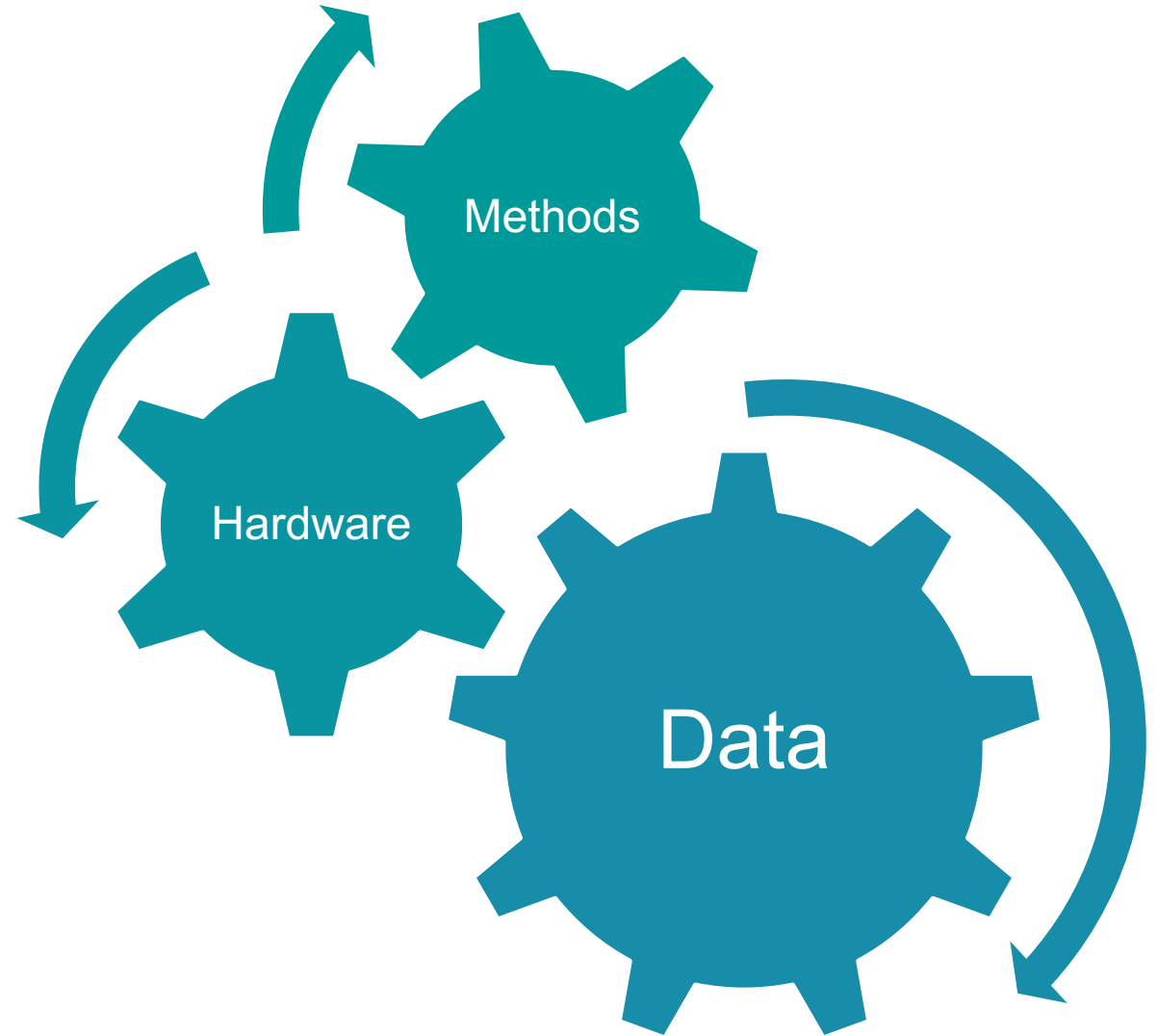
Topics for today

- Introduction to artificial intelligence in cancer research
- Ethical considerations and activities to address these considerations
- NCI's support for the appropriate use of artificial intelligence

Artificial intelligence across the cancer research continuum

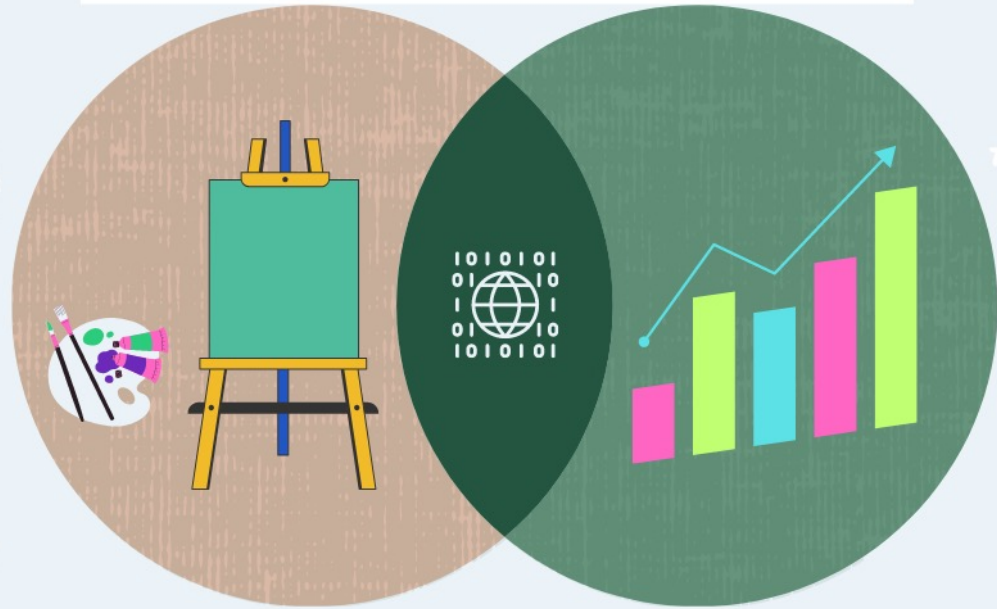


**Recent advances
have led to
promising new
applications of AI to
cancer research**



Categories of Artificial Intelligence

Generative VS Predictive AI



Predictive: Analyzes data to make predictions

Example: AI model trained to distinguish images of benign skin lesions from malignant melanoma

Generative: Generates new content based on existing data

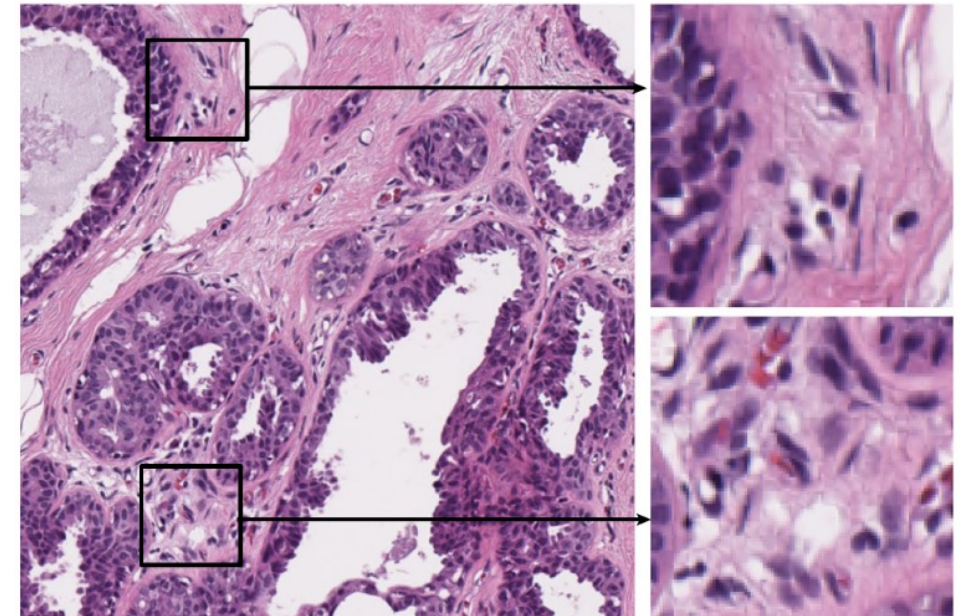
Example: Chatbot that creates a plain language summary from a clinical report

AI methods for improved accuracy and reproducibility in medical image analysis

nature medicine

Article

A population-level digital histologic biomarker for enhanced prognosis of invasive breast cancer



Amgan et al., Nature Communications, 2023

AI methods to accelerate information extraction

Research and Applications

Automatic extraction of cancer registry reportable information from free-text pathology reports using multitask convolutional neural networks

Mohammed Alawad,¹ Shang Gao,¹ John X. Qiu,¹ Hong Jun Yoon,¹ J. Blair Christian,¹ Lynne Penberthy,² Brent Mumphrey,³ Xiao-Cheng Wu,³ Linda Coyle,⁴ and Georgia Tourassi^{1*}



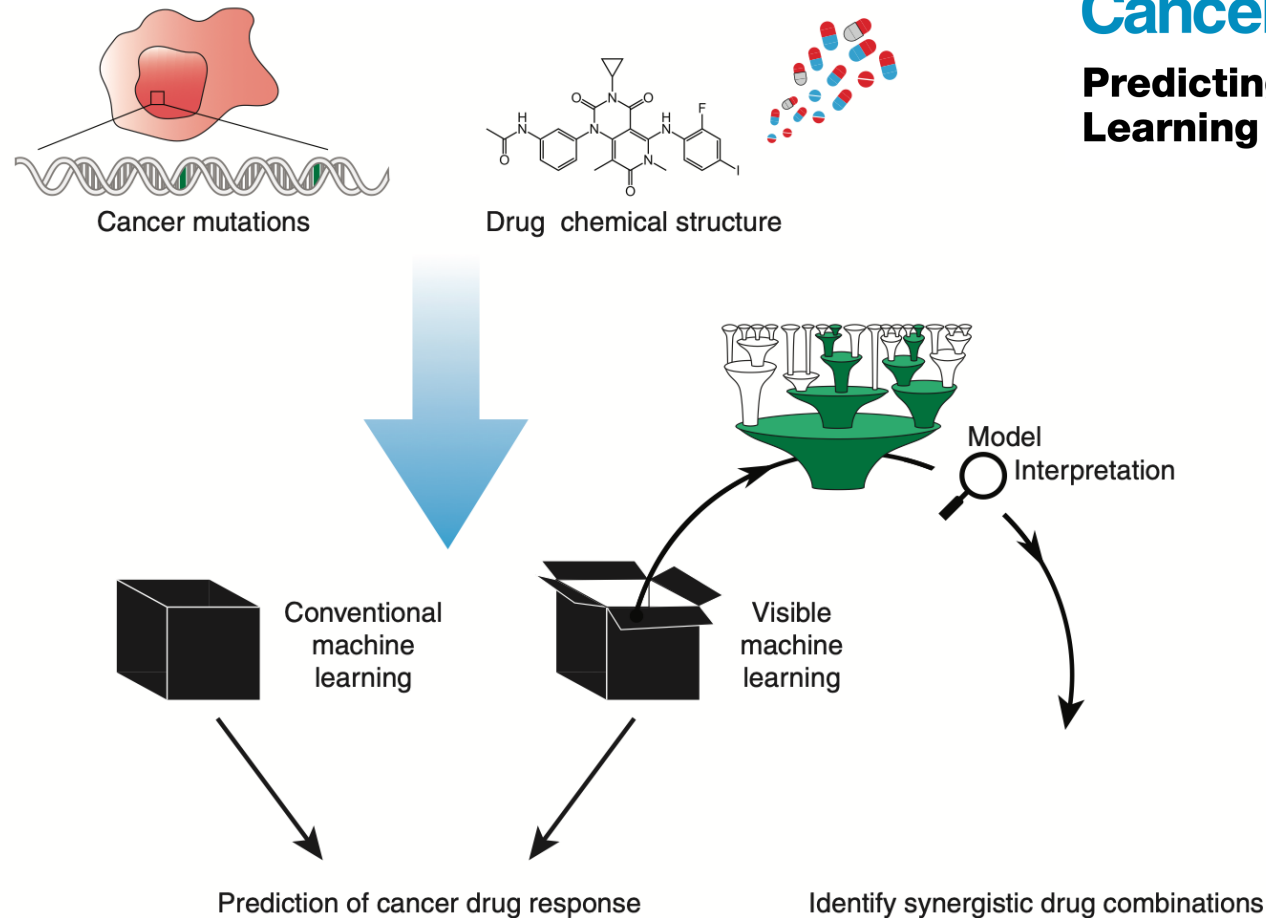
Alawad et al., JAMIA, 2020

Improving AI model interpretability by integrating biological knowledge

Article

Cancer Cell

Predicting Drug Response and Synergy Using a Deep Learning Model of Human Cancer Cells

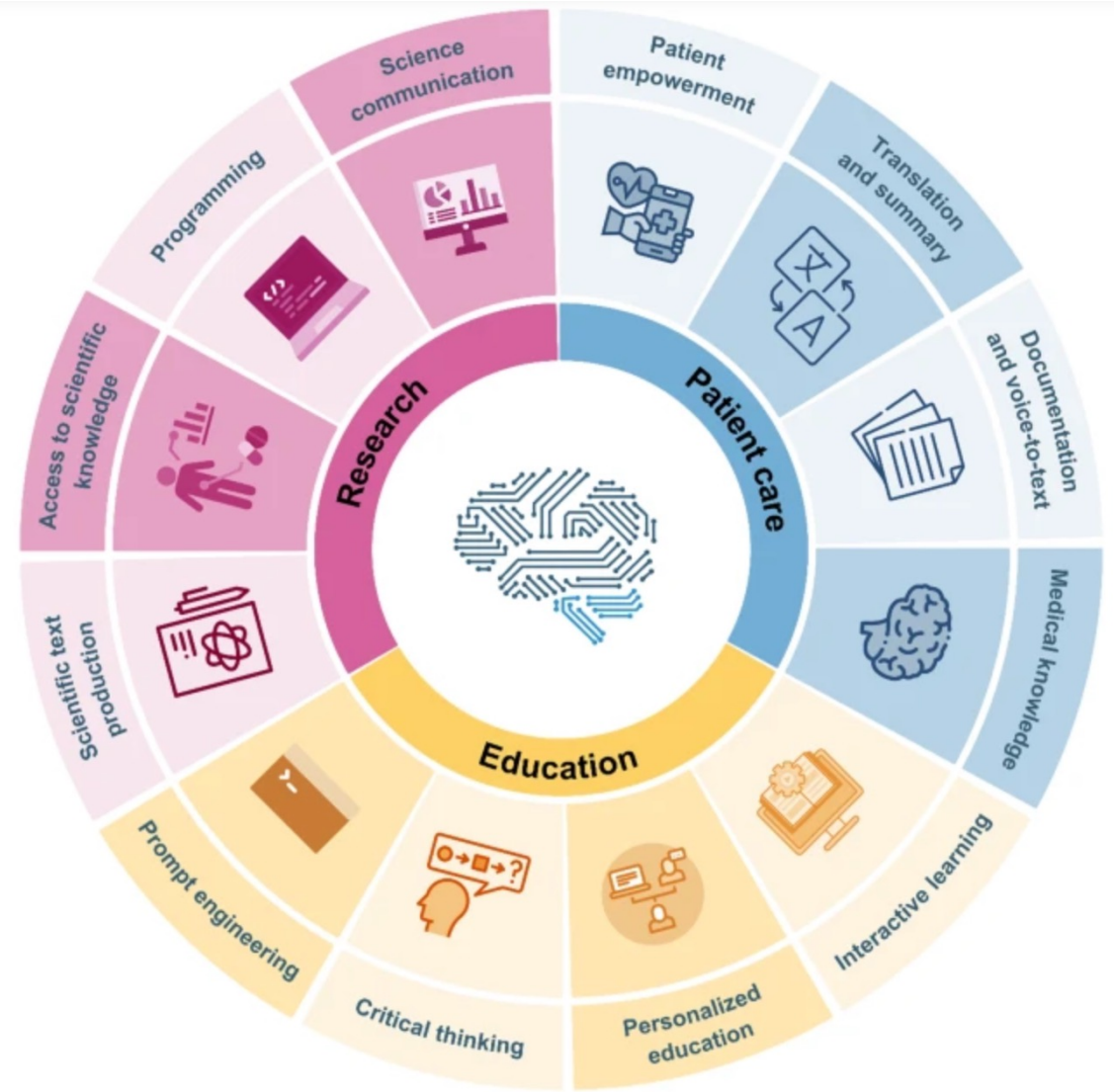


Kuenzi et al., Cancer Cell, 2020

Large Language Models



ChatGPT released November, 2022



<https://www.nature.com/articles/s43856-023-00370-1>

A rapidly-advancing field...

Foundation models for generalist medical artificial intelligence

<https://doi.org/10.1038/s41586-023-05881-4>

Received: 3 November 2022

Michael Moor^{1,6}, Oishi Banerjee^{2,6}, Zahra Shakeri Hossein Abad³, Harlan M. Krumholz⁴, Jure Leskovec¹, Eric J. Topol^{5,7,8,9} & Pranav Rajpurkar^{2,7,8,9}

AI IN MEDICINE

Benefits, Limits, and Risks of GPT-4 as an AI Chatbot for Medicine

Peter Lee, Ph.D., Sebastien Bubeck, Ph.D., and Joseph Petro, M.S., M.Eng.

Health system-scale language models are all-purpose prediction engines

<https://doi.org/10.1038/s41586-023-06160-y>

Received: 14 October 2022

Accepted: 2 May 2023

Published online: 7 June 2023

Open access

Lavender Yao Jiang^{1,2}, Xujin Chris Liu^{1,3}, Nima Pour Nejatian⁴, Mustafa Nasir-Moin¹, Duo Wang⁵, Anas Abidin⁴, Kevin Eaton⁶, Howard Antony Riina¹, Ilya Laufer¹, Paawan Punjabi⁶, Madeline Miceli⁶, Nora C. Kim¹, Cordelia Orillac¹, Zane Schnurman¹, Christopher Livia¹, Hannah Weiss¹, David Kurland¹, Sean Neifert¹, Yosef Dastagirzada¹, Douglas Kondziolka¹, Alexander T. M. Cheung¹, Grace Yang^{1,2}, Ming Cao^{1,2}, Mona Flores⁴, Anthony B. Costa⁴, Yindalon Aphinyanaphongs^{5,7}, Kyunghyun Cho^{2,8,9,10} & Eric Karl Oermann^{1,2,11,12}

Large language models in medicine

Received: 24 March 2023

Accepted: 8 June 2023

Arun James Thirunavukarasu^{1,2}, Darren Shu Jeng Ting^{3,4,5}, Kabilan Elangovan⁶, Laura Gutierrez⁶, Ting Fang Tan^{6,7} & Daniel Shu Wei Ting^{6,7,8} ✉

PERSPECTIVE OPEN

Check for updates

The imperative for regulatory oversight of large language models (or generative AI) in healthcare

Bertalan Meskó^{1,2,8,9} and Eric J. Topol¹⁰

The future landscape of large language models in medicine

Jan Clusmann^{1,2,8}, Fiona R. Kolbinger^{1,3,8}, Hannah Sophie Muti^{1,3,8}, Zunamys I. Carrero¹, Jan-Niklas Eckardt^{1,4}, Narmin Ghaffari Laleh^{1,2}, Chiara Maria Lavinia Löffler^{1,4}, Sophie-Caroline Schwarzkopf³, Michaela Unger¹, Gregory P. Veldhuizen¹, Sophia J. Wagner^{5,6} & Jakob Nikolas Kather^{1,2,4,7,8,9}

To Transformers and Beyond: Large Language Models for the Genome

Micaela E. Consens^{1, 2, 3}, Cameron Dufault¹, Michael Wainberg⁴, Duncan Forster^{2, 5, 6}, Mehran Karimzadeh^{2, 7, 8, 9}, Hani Goodarzi^{7, 8, 9}, Fabian J. Theis^{10, 11, 12, 13}, Alan Moses^{1, 14}, and Bo Wang^{1, 2, 3, 15*}

...with many important questions

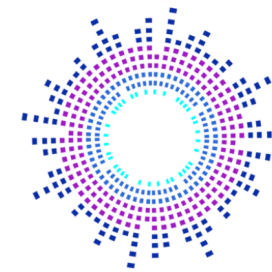
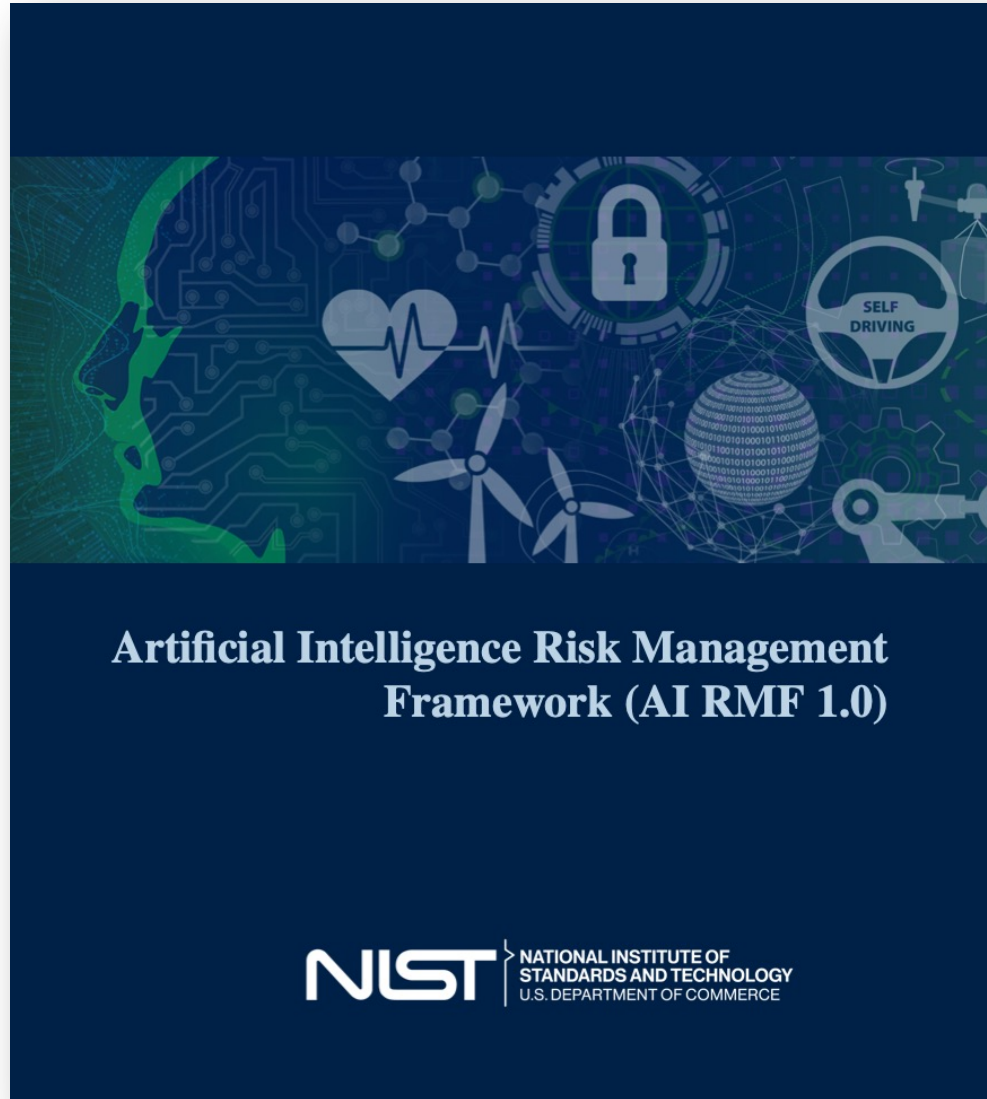
- What is the accuracy and reliability of the AI technology?
- How is sensitive data handled, stored, and shared in the context of AI applications?
- What are the ethical considerations surrounding use of patient data for training AI models?
- How do these complex algorithms work?
- Could there be unintended consequences of applying the AI technology?
- ...

Executive Order on the Safe, Secure, and Trustworthy Development and Use of Artificial Intelligence



- New standards for AI safety and security
- Protecting American's privacy
- Advancing equity and civil rights
- Standing up for consumers, patients, and students
- Promoting Innovation and Competition
- Advancing American leadership abroad
- Ensuring responsible and effective government use of AI

Guidance for the development of trustworthy AI



Health Care Artificial Intelligence Code of Conduct

Toward a Code of Conduct for Artificial Intelligence Used in Health, Medical Care, and Health Science

The Artificial Intelligence Code of Conduct (AICC) project is a pivotal initiative of the National Academy of Medicine (NAM), aimed at providing a guiding framework to ensure that AI algorithms and their application in health, medical care, and health research perform accurately, safely, reliably, and ethically in the service of better health for all. Stewarded by the [NAM Leadership Consortium](#), the project will yield a pioneering AI Code of Conduct framework reflecting best practices to serve as a starting point of reference for follow-on testing, validation, monitoring, and continuous improvement. This project represents a unique opportunity for national leaders across disciplines to work together to advance trustworthy artificial intelligence in health, medical care, and health research.

[Register for Updates](#)

[Steering Committee Biographies](#)

[Read the Project Announcement](#)

Ethics and Equity for AI Workshops

InnovationLab: A Data Ecosystems Approach to Ethical AI for Biomedical and Behavioral Research

Developing social and technical approaches to defining and implementing ethics across the AI data ecosystem

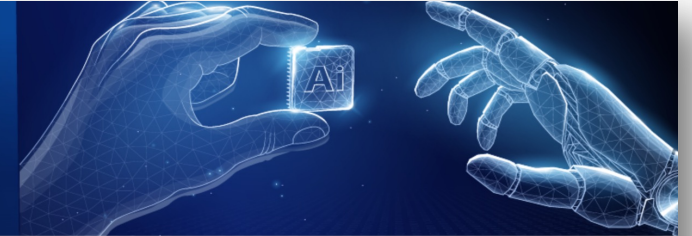
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Creating a culture of ethical inquiry

March 14-18, 2022

United States - European Union:

Artificial Intelligence Engagement Seminar Series



United States (U.S.) and European Union (EU) Artificial Intelligence (AI) Engagement Series: Equitable and Engaged AI to Advance Biomedical Research

July 25th from 9am -12pm EDT

Meeting 1- **Privacy Preserving AI**: This session centers around AI techniques (e.g., federated learning) and ethical considerations that aim to safeguard and uphold the privacy of participants' data.

July 26th from 9am -12pm EDT

Meeting 2- **Community/Patient Engaged AI for Biomedical Research**: This session showcases technologies and tools that foster patient engagement in cancer research. It builds upon the well-established tradition of community-based participatory research in the U.S. and the EU, while incorporating the latest advancements in explainable AI.

July 28th from 9am -12pm EDT

Meeting 3 - **Ethical AI and the Inclusion of Underserved Communities**: This session aims to explore the ethical use of AI and foster the inclusion of underserved communities. It builds upon the principles of explainable AI, trust in AI, and technical strategies to address challenges associated with limited data sets and data annotation.

Toward an Ethical Framework for Artificial Intelligence in Biomedical and Behavioral Research: Transparency for Data and Model Reuse Workshop

January 31 – February 2, 2024

Rockledge II
6701 Rockledge Drive
Bethesda, Maryland 20817

Artificial Intelligence/Machine Learning Consortium to Advance Health Equity and Researcher Diversity (AIM-AHEAD)



Partnerships

Research

Infrastructure

Training

Goals:

- to enhance the **participation** and **representation** of researchers and communities currently underrepresented in the development of AI/ML models
- to address health disparities and inequities using AI/ML
- to improve the capabilities of this emerging technology

Trans-NCI AI Working Group

Mission:

- Provide a hub for communication and coordination for AI-related projects and programs across NCI
- Identify and prioritize trans-NCI cancer research opportunities that can most benefit from the application of AI
- Provide connection with activities external to NCI

Jennifer Couch, DCB
Sean Hanlon, CSSI
Juli Klemm, CSSI
Emily Greenspan, CBIIT
Umit Topaloglu, CBIIT
G. Tom Brown, CCR
Oliver Bogler, CCT
Paul Pearlman, CGH
Kelly Crotty, CSSI
Michele Vos, CSSI
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David Miller, DCB
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Catherine Schweppe, DCP
Amanda Skarlupka, DCP
Janet Eary, DCTD
Ceferino Obcemea, DCTD
Yantian Zhang, DCTD
Vincent Pacileo, OAR
Karen Mowrer, OCGR
Erin Wetzel, OCGR
Lakshmi Grama, OCPL
Brandon Wright, ODS
Jordan Robbins, SBIR
Ming Zhao, SBIR



Cancer AI Conversations

Mar 26, 2024 11:00 AM ET

Title: *Machine Learning in Cancer Care Delivery: Moving from Model Validation to Clinical Workflow*

Moderator: Leah L. Zullig, PhD, MPH, Duke University

Panelists: William Lotter, PhD, Dana Farber Cancer Center; Julian Hong, MD, MS, UC San Francisco

May 28, 2024 11:00 AM ET

Title: *Machine Learning in Cancer Care Delivery: Implementation and Sustainability*

Moderator: Roxanne Jensen, PhD, NCI

Panelists: Tina Hernandez-Boussard, PhD, MPH, Stanford; Katharine Rendle, PhD, MPH, UPenn

Register at:

<https://events.cancer.gov/nci/cancer-ai-conversations/registration>



Artificial Intelligence (AI) in Cancer Research

Recent advances in Artificial Intelligence (AI) have converged to rapidly accelerate activity across the cancer research spectrum. AI can create new models of care, as well as advance our knowledge of cancer biology, in an ever-expanding world of technology.

NCI supports many projects and activities, including funding opportunities and engaging the cancer research and AI communities to help realize the promise of AI in cancer research and care. Extramural researchers are encouraged to check out NCI funding opportunities and resources, as well as the latest seminars and workshops.

Contact the NCI AI Working Group

Email the NCI Artificial Intelligence Working Group at CancerAI@mail.nih.gov.

Funding Opportunities: AI in Cancer Research

NCI funds and supports extramural research to advance the use of AI in cancer research. Find out more about funding opportunities and other ways to engage in advancing AI for cancer research.

Events: AI in Cancer Research

Discover upcoming and past seminars and workshops organized by NCI on AI in cancer research.




<https://www.cancer.gov/research/resources/ai-cancer-research>

Large Language Models to make better use of real world data

ARTICLE OPEN



Large language models to identify social determinants of health in electronic health records

Marco Guevara^{1,2,7}, Shan Chen ^{1,2,7}, Spencer Thomas^{1,2,3}, Tafadzwa L. Chaunzwa^{1,2}, Idalid Franco², Benjamin H. Kann ^{1,2}, Shalini Moningi², Jack M. Qian^{1,2}, Madeleine Goldstein⁴, Susan Harper⁴, Hugo J. W. L. Aerts ^{1,2,5}, Paul J. Catalano⁶, Guergana K. Savova³, Raymond H. Mak^{1,2} and Danielle S. Bitterman^{1,2}✉

Methods to increase the diversity of data for AI models

Article

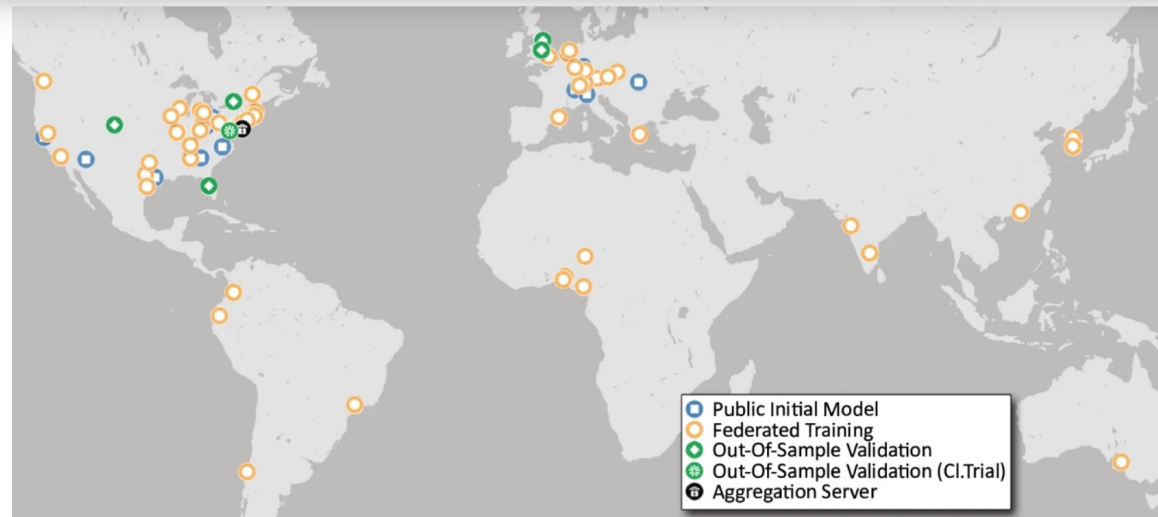
<https://doi.org/10.1038/s41467-022-33407-5>

Federated learning enables big data for rare cancer boundary detection

Received: 7 April 2022

A list of authors and their affiliations appears at the end of the paper

Accepted: 16 September 2022











National Cancer Plan

National Cancer Plan

A plan for the National Cancer Program to align broad societal engagement and focus on critical needs to end cancer as we know it.

EIGHT GOALS

-  Prevent Cancer
-  Detect Cancers Early
-  Develop Effective Treatments
-  Eliminate Inequities
-  Deliver Optimal Care
-  Engage Every Person
-  Maximize Data Utility
-  Optimize the Workforce

EVERYONE HAS A ROLE!

- The White House
- Congress
- National Cancer Institute
- NIH Institutes and Centers
- U.S. Department of Health and Human Services
- Cancer Cabinet
- Professional Societies
- Advocacy Organizations
- Academia
- Industry
- Foundations
- Health Care Providers
- People with Cancer and Other Individuals

CANCER MOONSHOT

Providing the vision and charge for a whole-of-government approach to stimulate collaboration and accelerate progress across the National Cancer Program



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CANCER
INSTITUTE**

www.cancer.gov

www.cancer.gov/espanol