

Transforming Oncology Care Through Medically Integrated Collaboration 2025 NCODA INTERNATIONAL SPRING FORUM

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The Future of Oncology: How AI Will Shape the Next Decade

Ravi B. Parikh, MD, MPP

Associate Professor of Medicine Department of Hematology and Medical Oncology Emory University School of Medicine



OBJECTIVES

- 1. Define artificial intelligence (AI) and related concepts in oncology practice
- 2. Identify discrete use cases of AI in treatment decision-making and clinical decision-support
- 3. Recognize ethical or methodological challenges surrounding the use of AI
- 4. Discuss concrete next steps to facilitate responsible use of AI within health care settings



DISCLOSURES

The following relevant financial relationships from the past 24 months have been identified and disclosed for the following faculty of this CE activity:

- Ravi B. Parikh, MD, MPP
 - Grants from the National Institutes of Health, Department of Defense, Prostate Cancer Foundation, National Palliative Care Research Center, NCCN© Foundation, Conquer Cancer Foundation, Humana, Emerson Collective, Schmidt Futures, Arnold Ventures, Mendel.ai, and Veterans Health Administration; Personal fees and equity from GNS Healthcare, Thyme Care, and Onc.AI; Personal fees from the ConcertAI, Cancer Study Group, Mendel.ai, Biofourmis, Archetype Therapeutics, CreditSuisse, G1 Therapeutics, Humana, and Nanology; Honoraria from Flatiron and Medscape; Has board membership (unpaid) at the Coalition to Transform Advanced Care and American Cancer Society; Editor at the Journal of Clinical Oncology; and serves on a leadership consortium (unpaid) at the National Quality Forum, all outside the submitted work.

There are no relevant conflicts of interest to disclose for this presentation for the following planners of this CE activity:

- Apiew Ojulu, PharmD, MS
- Daisy Doan, PharmD



My first experience with Al...

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Disclaimer: Authors' own mockup, no real patient names

Definitions

Artificial intelligence (AI): Systems that display intelligent behavior by analyzing their environment and taking actions – with some degree of autonomy – to achieve specific goals.¹

Autonomous Al:

Al systems that can operate independently, analyze data, make decisions, and execute tasks without constant human oversight.

Assistive Al:

Al systems that support human users by providing information, suggestions, or assistance in completing tasks.

Generative AI:

Al systems that can create new content rather than simply analyzing or categorizing existing information

Large Language Models: Al systems trained on vast amounts of text data to understand and generate human language



1. European Commission: "A Definition of Artificial Intelligence"

Al Biomarkers are Proliferating in Cancer Care

Al Biomarker Positive



"...multimodal artificial intelligence (MMAI) biomarker test to predict whether a patient with prostate cancer will benefit from hormone therapy and estimate long-term outcomes."



Al Biomarker Negative

Al Diagnostics are Proliferating in Cancer Care



 "... Smart Ultrasound software providing early and accurate breast cancer diagnosis."



We pretend like all AI is autonomous...

	Assistive A	l algorithms		Autonomous AI algorithms			
	Level 1 Level 2		Level 3	Level 4	Level 5		
	Data presentation	Clinical decision-support	Conditional automation	High automation	Full automation		
Event monitoring	AI	AI	AI	AI	AI		
Response execution	Clinician	Clinician and AI	AI	AI	AI		
Input ECGs	Deep neural netw	ork approach	Output Low EF Type of heart rhythm	What Mat Autonomo	ters for ous AI?		
	Convolutional Fully connected		 Atrial fibrillation Atrioventricular block Supraventricular tachycardia 	Accur	acv 🔇		

2025 NCOE

...when instead most current AI is assistive

	Assistive Al	algorithms	Autonomous AI algorithms			
	Level 1	Level 1 Level 2		Level 4	Level 5	
	Data presentation	Clinical decision-support	Conditional automation	High automation	Full automation	
Event monitoring	AI	AI	AI	AI	AI	
Response execution	Clinician	Clinician and AI	AI	AI	AI	



What Matters for Assistive AI?

Trust



Poll

You are an oncology pharmacist. What percentage of your daily pharmacy workflow do you believe could be partially or completely automated by AI tools in the next 3 years?

- a. Less than 10%
 b. 10-25%
 c. 26-50%
 d. 51-75%
- e. More than 75%



Poll

In your experience, which part of oncology medication management would benefit most from AI support?

- a. Drug interaction checking across complex regimens
- b. Identifying candidates for dose modification
- c. Oral oncology therapy monitoring and adherence
- d. Supportive care optimization
- e. Inventory management and cost optimization



Examples of Successful Implementation of AI in Oncology Practice



Use Case: Serious Illness Communication

- Early communication is key to reducing oncology patient experience
 - Reduced end-of-life utilization
 - Reduced anxiety and depression
 - Improved caregiver satisfaction
- Identifying appropriate patients is key, but there is a lack of clarity in prognosis
 - Oncologists overestimate survival by **5.4x**



Developing the Algorithm



Clinician perspectives on machine learning prognostic algorithms in the routine care of patients with cancer: a qualitative study

Original Investigation | Oncology

Machine Learning Approaches to Predict 6-Month Mortality Among Patients With Cancer

JAMA Oncology | Original Investigation

Validation of a Machine Learning Algorithm to Predict 180-Day Mortality for Outpatients With Cancer

Variables	Examples	Features		
Demographics	Age, Gender			
Comorbidities	33 Elixhauser comorbidities	Total countRecent*		
Cancer-specific	Stage, tumor markers	 Total count First/last value 		
Laboratories	CMP, CBC, LDH	 Min/Max Proportion ordered 		
Recent utilization	Outpatient visit number	STAT		

1. Parikh RB, et al. Support Care Cancer. 2022;30(5):4363-4372. 2. Parikh RB, et al. JAMA Netw Open. 2019;2(10):e1915997. 3. Manz CR, et al. JAMA Oncol. 2020;6(11):1723-1730.

Developing Interfaces to Embed into Clinician Workflow

Use Case: Predicting mortality to prompt more serious illness communication

Next week's high-risk pa	tients for Serious Illness Conversations	Conversatio	on Connect ~	🐺 Penn M	edicine & Welcome Corey!
		Lorem ipsum dolo veniam, quis nostr	sit amet, consectetur adipiscing elit, se ud exercitation ullamco laboris nisi ut ali	d do eiusmod tempor incididunt ut labor iquip <u>www.conversationconnect.pennme</u>	e et dolore magna aliqua. Ut enim ad minim dicine.upenn.edu
Thursday, July 18, 20 Show Details	119 at 8:05 AM	Doe, John 12 Augustanum: Mar 3, 2019	Age 54 34567890 7:43:00 AM	SICP Author Nam Jan 5, 2019	e Select for SCP Register Reminder
Dear :		Doe, John 1: 1000414491 Meetinee: Feb 27, 2019	34567890 Age 70 4:34:00 AM		Select for SICP Register Reminder
The ACC is working to help oncol- weeks, you have documented 2 c	ogists have earlier Serious Illness Conversations with patients. In conversations.	the past four Doe, John 12 Feb 21, 2015	Age 73 10:43:00 AM		Select for SICP Register Reminder
18 oncology clinicians have docu	mented more conversations than you during that time.	Doe, John 1 Automation Mar 4, 2019	Age 58 234567890 2:24:00 AM	SICP Author Nam Jan 5, 2019	Ne Select for SICP Register Reminder
<u>Click here</u> to view your list (you n	nust be connected to the UPHS network).	Doe, John 1 Automatic Feb 12, 2018	Age 66 234567890 4:13:00 PM		Select for SICP Register Reminder
Sincerely,		Doe, John 🔢	Age 50 34567890		Select for SICP
Peer Compa	rison Performance	ML high-risk l	ist Pre-co	ommitment	Default Text
	Кероп				Messaye



Studying Impact



	Control	Intervention
Chemo last 14 days	10.4%	7.5%
Savings in last month of life	~\$1	500



Insights from Clinicians

Population: 25 oncology clinicians (13 high, 12 low responders)

Facilitators:

- Prompting better documentation of conversations in the electronic health record
- Peer comparisons & performance reports
- Validating norms around early conversations

Barriers:

Cancer-specific heterogeneity in algorithm performance
 Frequency and tone of automated text messages

"In blood cancers, we do so many scheduled admissions and things like stem cell transplants, there are a lot of patients who would have recently been in the hospital twice...So actually, **[the algorithm-based lists] were] often inaccurate** in terms of who needed to have a discussion ..."



Use Case: Clinical Trial Prescreening

Assess whether Human-AI teams leveraging large language model output can more efficiently and/or accurately extract a set of 13 common clinical criteria from deidentified **unstructured** electronic health records (EHRs)



Traditional Clinical Trial Workflow for Oncology Clinical Trials



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Prescreening is a Key Bottleneck for Cancer Trials

- Only 5-8% of adult cancer patients participate in trials, with many subpopulations underrepresented
- Yet 55% of adult cancer patients do participate when offered a trial (Unger et al., JNCI 2021)





Study Design





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Human+AI Collaboration to Improve Prescreening

(1) Abstractor is presented with a patient's EHR containing a batch of scanned documents, including both structured and unstructured data sources.





Human+AI Collaboration to Improve Prescreening

(1) Abstractor is presented with a patient's EHR containing a batch of scanned documents, including both structured and unstructured data sources.

"Human-alone" Workflow

Abstractor scans documents and extracts prespecified criteria, populating a "Clinical Event" panel from scratch. This simulates the current workflow for EHR review for specific clinical criteria.



"Human+AI" Workflow

Abstractor is provided with a pre-populated "Clinical Event" panel, linked to the location within the EHR of each piece of clinical evidence. This list is reviewed, edited and refined by the abstractor.

9=	Panel	Objects	Events	Objects & Events	View			₹	Filters				
Filter	or search b	y type or nam	e										*
	Events: 27 of 27												Add
											Sort	15	÷۱ 🖸
	Surgery				Tł	Thoracic Incision							
	Surgery				Co	Colotomy							
	Lab Finding				W	WBCs							
	Lab Finding				Pl	Platelets							
	Lab Finding				Ec	Eosinophil							
	Lab Finding Lab Finding Lab Finding				He	ematocrit	Value						
					He	Hemoglobin							
					M	Mcv Rbc							
C	Diagnostic Procedure				Po	Positron Emission Tomography							
	Diagnos	stic Procedu	re		บเ	trasound							

Accuracy and Time Gains from an Al-inthe-Loop Workflow



Accuracy is greatest in the Human+AI arm

No difference in timeliness of prescreening

Criteria-Specific Accuracy

	Onitonia	Ac				
	Human- Alone Human + A		Human + Al	Al-Alone	p-value	
Diamankan	Was Biomarker Tested?	84.6	93.2	88.1	<0.001*	
Biomarker	Categorical Value	67.9	79.0	32.5	<0.001*	
	Interpretation	80.8	91.3	35.7	<0.001*	
	Cancer Type	86.9	86.4	73.3	0.797	
	Stage Group	71.7	73.4	57.0	0.573	
Neoplasm	M Stage	43.9	57.0	60.2	<0.001*	
	N Stage	50.5	66.3	52.6	<0.001*	
	T Stage	56.3	71.6	54.3	<0.001*	
	Outcome	23.7	35.9	55.2	0.004*	
	Response	47.1	51.7	60.4	0.195	
Other	ECOG Status	84.7	78.1	34.4	0.096	
	Medication Concept	89.0	89.1	59.4	0.915	



ECOG, Eastern Cooperative Oncology Group.

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Vaccaro M, et al. Nat Hum Behav. 2024;8:2293–2303.

Poll

You have just seen 2 examples of clinical decision support in oncology practice. In your oncology pharmacy practice, which of the following AI applications would be most valuable to implement?

- a. Automated chemotherapy dosing recommendations based on patient-specific factors
- b. Prediction of adverse events from specific drug combinations
- c. Clinical trial matching for patients with rare genomic alterations
- d. Medication adherence tracking and personalized interventions
- e. None of the above



Principles of Trustworthy Al

CHAI Releases Recommendations for Trustworthy AI in Health





Coalition for Health AI (CHAI). https://chai.org/wp-content/uploads/2024/05/blueprint-for-trustworthy-ai_V1.0-2.pdf. Accessed April 2025.

Deloitte. https://www2.deloitte.com/us/en/pages/deloitte-analytics/solutions/ethics-of-ai-framework.html. Accessed April 2025.

Explainability





When explainability goes wrong...

Prompt:

Write a radiology report for this image as an expert radiologist..



GPT-4V:

Report: Date: 6/25/2021 Study Type: Chest CT Subject: 42-year-old male

Findings: The chest CT images demonstrate a nodular opacity in the left upper lobe, measuring approximately 1.3 cm in diameter. The opacity appears to have spiculated margins and is located adjacent to the pleura. There is no evidence of mediastinal or hilar lymphadenopathy.

Impression: The findings are concerning for a primary lung malignancy. Further evaluation with a biopsy is recommended to confirm the diagnosis.



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Evaluation from Professionals:

Correct study type and identification Mensions nodule but in the left rather than in the right. Gives measurements (hallucination)

Source: arXiv/2309.17421



Reliability in AI Models

Static models



Refreshed models

Proactive monitoring can prevent expected performance drift



Siva S. https://medium.com/data-science/stoend-to-end-data-science-life-cycle-6387523b5afc. Accessed April 2025.

Performance Drift in Mortality Prediction Al



- AI models notably "drifted" during the COVID pandemic
- Many of these models failed to return to normal until well into the pandemic



Parikh et al, JAMIA, 2023. TPR = True positive rate

Bias in AI Algorithms

- Biases in Electronic Health Record Data due to Processes within the Healthcare System: Retrospective Observational Study
 o Biased data generation → biased algorithms
- Health Care Segregation, Physician Recommendation, and Racial Disparities in BRCA1/2 Testing Among Women With Breast Cancer
 - Likelihood of genetic testing among African-American women with breast cancer

Analysis	Odds Ratio (95% CI)
Overall	0.40 (0.34-0.48)
Adjusted for mutation risk	0.66 (0.53-0.81)
Adjusted for physician recommendation	0.76 (0.57-1.02)

"The presence of a laboratory test order, regardless of any other information about the test result, has a significant association (P<0.001) with the odds of survival in 233 of 272 (86%) tests. "



Can AI Mitigate Disparities?

	Pre-intervention, %	Post-intervention, %	Absolute Percentage- point Difference
Non-Hispanic White	3.9 (58/1494)	14.2 (201/1417)	10.3
Non-Hispanic Black	3.6 (17/467)	16.9 (69/408)	13.3
Other*	1.2 (2/164)	19.5 (34/408)	18.3

In a trial of a machine learning-based nudge to perform end-of-life conversations, there was a significantly higher impact for non-White minorities



Poll

Which barrier do you see as most significant to implementing AI in oncology pharmacy practice?

a.Cost of implementation and maintenance
b.Integration with existing electronic health record systems
c.Liability concerns and unclear accountability
d.Lack of pharmacy-specific AI training and expertise
e.Patient/provider acceptance of AI recommendations



SUMMARY

- Al in Oncology: Al applications can be assistive or autonomous, with most current applications being assistive
- Proven Use Cases: AI systems have demonstrated value in decision support and augmenting human processes
- Core Challenges: Key issues include explainability limitations, algorithmic bias, performance drift over time, and variable accuracy across different cancer types
- Path Forward: Responsible implementation requires proactive monitoring, comprehensive model documentation, human-in-the-loop workflows, and transparent integration into clinical processes



QUESTION & ANSWER

The Future of Oncology: How AI Will Shape the Next Decade

Ravi B. Parikh, MD, MPP Associate Professor of Medicine

Department of Hematology and Medical Oncology

Emory University School of Medicine

Ravi.bharat.parikh@emory.edu

www.haclab.org

@ravi_b_parikh



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