

Researchers use foundation models to discover new cancer imaging biomarkers

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n = 11,467 Keiner Keiner Kein		Volumes with lesions Contrastiv learning Contrastive learning Random volum without lesion	e mes s Foundation model
Foundation model	Technical validation	Diagnostic biomarker	Prognostic biomarker
	Train $DeepLesion$ n = 2,610	Train LUNA16 <i>n</i> = 338	Train HarvardRT
	Tune DeepLesion n = 1,220	Tune LUNA16 <i>n</i> = 169	Tune HarvardRT n = 88
	Test DeepLesion n = 1,221	Test LUNA16 <i>n</i> = 170	Test LUNG1 n = 420
			Test RADIO n = 133
	Use case 1: lesion anatomical site classification	Use case 2: nodule malignancy classification	Use case 3: classification of NSCLC overall survival
Approach 1: linear classifier on extracted features		Approach 2: transfer learning	
		Initialize weights from foundation model	

General overview of the study. Credit: *Nature Machine Intelligence* (2024). DOI: 10.1038/s42256-024-00807-9

Researchers at Mass General Brigham have harnessed the technology behind foundation models, which power tools like ChatGPT, to discover



new cancer imaging biomarkers that could transform how patterns are identified from radiological images. Improved identification of such patterns can greatly impact the early detection and treatment of cancer.

The research team developed their foundation model using a comprehensive dataset consisting of 11,467 images of abnormal radiologic scans. Using these images, the model was able to identify patterns that predict anatomical site, malignancy, and prognosis across three different use cases in four cohorts.

Compared to existing methods in the field, their approach remained powerful when applied to specialized tasks where only limited data are available. Results are <u>published</u> in *Nature Machine Intelligence*.

"Given that image biomarker studies are tailored to answer increasingly specific research questions, we believe that our work will enable more accurate and efficient investigations," said first author Suraj Pai from the Artificial Intelligence in Medicine (AIM) Program at Mass General Brigham.

Despite the improved efficacy of AI methods, a key question remains their reliability and explainability (the concept that an AI's answers can be explained in a way that "makes sense" to humans).

The researchers demonstrated that their methods remained stable across inter-reader variations and differences in acquisition. Patterns identified by the foundation model also demonstrated strong associations with underlying biology, mainly correlating with immune-related pathways.

"Our findings demonstrate the efficacy of foundation models in medicine when only limited data might be available for training <u>deep</u> <u>learning networks</u>, especially when applied to identifying reliable imaging <u>biomarkers</u> for cancer-associated use cases," said senior author



Hugo Aerts, Ph.D., director of the AIM Program.

More information: Suraj Pai et al, Foundation model for cancer imaging biomarkers, *Nature Machine Intelligence* (2024). DOI: 10.1038/s42256-024-00807-9

Provided by Mass General Brigham

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