

AI and Melanoma: Innovation for the Future

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July 4, 2024 By [Melanoma Research Alliance](#)

“Artificial intelligence (AI) is going to transform how we diagnose, treat, and eventually overcome melanoma,” says Dr. Veronica Rotemberg, director, Dermatology Imaging Informatics Program at Memorial Sloan Kettering Cancer Center.

Rotemberg believes in the incredible role that AI can play in the detection and treatment of melanoma. Through the [International Skin Imaging Collaboration \(ISIC\)](#), there are more than 75,000 publicly available images of different skin conditions. In addition, ISIC has hosted five yearly challenges related to melanoma—with AI programs in the competition consistently demonstrating better and better performance at diagnosing the disease. It’s an incredible collaboration that has yielded millions of image downloads, advanced published research, and had an extensive ripple effect on the reach and impact of melanoma research.

Rotemberg sees AI playing a number of different roles in melanoma, including:

- Reducing the number of benign [biopsies](#),
- Improving prognosis and treatment selection,
- Identifying more melanomas, and
- Helping to address research voids.

While AI has earned considerable media attention in recent years based on reports of its ability to outperform dermatologists in head-to-head competitions, these competitions have typically been based solely on images of lesions with little additional context. However, like many things the devil is often in the details. In clinical practice, dermatologists have the benefit of seeing patients — and their skin — in real life and up close. Dermatologists also have access to additional information, including patient and family medical history, that can help refine decision making.

Rotemberg’s research, supported by a Michael and Jacqueline Ferro Family Foundation-MRA Young Investigator Award, is working to improve AI by determining what contextual information is most

helpful to improve its performance in specific situations.

“There are certain types of information that might help the models perform better in specific situations, for instance in certain anatomic sites or with certain types of imaging features,” says Rotemberg. “It really depends on the distribution of data that the models are trained on. Ours was one of the first quantitative evaluations of how model performance might change with different [contextual] inputs.”

As a leader in this field, Rotemberg is also assessing and validating existing algorithms, which is a critical area of research, especially as AI becomes more integrated into doctors’ decision making in the clinic. For example, current models were not sufficiently trained using images of diverse skin tones and as a result they aren’t as accurate when applied to people with darker skin.

Rotemberg’s work will help change this by ensuring that models are assessed for bias and that the underlying data is appropriately labeled, making it easier to understand potential benefits and harms of a particular model. This also streamlines the benchmarking and validation process that will be required for wider adoption.

“At some point in the future, AI-enhanced tools for melanoma detection will end up in the clinic. As we usher in this new and exciting era, we need to do the work now to ensure these technologies are actually providing the benefit we intend,” says Rotemberg.

According to Rotemberg, there are more than 500 AI algorithms approved by the FDA today; but none in melanoma. She wants to change this by helping to identify what outcomes are most important to patients and then ensure that there are appropriately validated and benchmarked models that result in marked improvements in those outcomes.

Also helping advance the field is funding, like that from the MRA and the Ferro Foundation. “I think the science was really advanced by the award,” says Rotemberg. “We’ve received numerous subsequent awards building off that initial work and our findings have been published in several journal articles. The collaborative opportunities we’ve identified by being part of MRA’s network have been incredible. I never want MRA’s impact to just be measured by the papers and grants that came directly from a project, because there’s so much more that comes out of being connected with them on a personal and professional level.”

Although the AI field is advancing quickly, Rotemberg thinks more innovations are needed in the following areas:

- Data curation, acquisition, and quality control,
- Standards development, and
- Identifying the right patient outcomes.

“AI research is expensive but when you want to identify something that could be a game changer,

this is the way to go,” says Rotemberg.

A Deeper Look

Dr. Kamran Avanaki, Associate Professor in the Biomedical Engineering and Dermatology Departments at the University of Illinois Chicago agrees. “I think AI in dermatology is a must. It’s not a choice anymore because it really is the result of experts’ accumulated experiences and there is power in that.” Like Rotemberg, Avanaki is trying to harness AI’s abilities to advance melanoma research, improve diagnosis, and determine when or even whether a biopsy is actually needed.

Avanaki became interested in melanoma research during his PhD training, when he realized that non-invasive optical imaging could be used to explore and understand skin health with great accuracy. Avanaki also saw the incredible challenge faced by dermatologists in differentiating between melanoma and benign moles using the naked eye. Studies have shown that the ratio of benign lesions to melanoma biopsies can range from around 10 to 1 up to 50 to 1 depending on the experience of the dermatologist and patient medical record. This means that for every melanoma found, there may be anywhere from 10 to 50 or more benign lesions that were biopsied.

Surgical biopsy isn’t a no-risk procedure for patients. It can result in pain, anxiety, and scarring — not to mention additional healthcare costs. Moreover, identifying malignant lesions in areas of the skin with many pigmented spots, such in the case of a person with many freckles, is difficult with visual inspection alone. “To overcome these challenges, we have developed a computational method that, using a sophisticated algorithm, analyzes the Optical Coherence Tomography (OCT) images of skin and differentiates melanomas from benign nevi,” says Avanaki.

OCT is a non-invasive imaging technique that uses low energy safe infrared light to capture high-resolution, cross-sectional images of body tissues in real-time at a microscopic level. Compared to photo-based AI models, OCT is much less sensitive to patient characteristics such as age, skin color, and gender which would eliminate lots of dataset diversity problems.

Currently, Avanaki’s OCT-based algorithm can differentiate melanoma from benign nevi with 99% accuracy, demonstrating a significant improvement in melanoma detection over other diagnostic technologies.

“We’re now working to further optimize the algorithm to improve accuracy, consistency, and its implementation in the OCT software so we can then launch a preliminary clinical trial,” explains Avanaki.

Avanaki’s hope is that his technology can assist clinicians in accurately diagnosing melanoma while reducing the need for surgical biopsies.

To use this technology, a patient sits down, and the clinician places a probe — resembling what is used for an ultrasound — on the suspected lesion. The system generates a 3D image and

Avanaki's algorithm examines the generated image to determine the probability of the lesion being melanoma (or not) and provides additional technical information that can help inform the clinician's decision making.

In the near future, dermatologists could use this tool as opposed to performing a biopsy and then waiting for results.

"When dealing with patients, I see the huge hope in their eyes when we tell them that we're using this methodology and we don't need to do a [traditional] biopsy," says Avanaki.

Avanaki says that the MRA and the Ferro Foundation funding used to support the development of this algorithm has been incredible in helping refine and validate the work as well as for training the next generation of AI researchers. In the future, Avanaki hopes to make this technology more available to dermatologists, develop a related process to help support clinicians in staging a melanoma lesion, and he wants to develop a low-cost, miniaturized version that patients can use at home on any suspected lesions. The latter would be a gamechanger for people with many moles, a history of melanoma, or those who live in low-resource areas or have limited dermatology access.

As Rotemberg and Avanaki have shown, when it comes to AI's application in melanoma and clinical cancer research, the future is bright and the possibilities are within reach.

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