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Aiding Decision-Making with Artificial Intelligence

DR. SANDS:
Artificial intelligence-based models have become a growing area of interest in clinical oncology, and they may even aid physician decision-making to improve patient outcomes. What are some of the most recent AI innovations? We're going to focus on that today in *Project Oncology*.

I'm Dr. Jacob Sands. And here to share his insights on this topic is Dr. Benjamin Kann, physician at Dana Farber Cancer Institute, and Assistant Professor of radiation oncology at Harvard Medical School. Dr. Khan, it is a pleasure to welcome you to the program.

DR. KANN:
Thank you so much for having me, Dr. Sands.

DR. SANDS:
Dr. Kann, to start us off, can you give us some background on the current research efforts that are being done on artificial intelligence-based models in cancer care?

DR. KANN:
Absolutely. There's been a lot of really interesting developments in this area over the last 5 to 10 years or so. And a lot of the advances have been driven by a few different things. One is the tremendous amount of data that we're now generating in patient care and that pertains to digitization of electronic medical records, digital pathology, all the radiographic imaging that we're doing and genomic analyses that we're doing as well. This coupled with advances in research in machine learning algorithms, particularly the advent of the deep learning neural network and also big strides in development of computational power and the availability of these computational resources to researchers around the country and around the world have really enabled this rise in interest in AI, as it pertains, and as it can affect medicine.

In the world of oncology, I like to think of the potential AI applications from the lens of the patient and the provider kind of going down the care pathway, starting from things like risk prediction and screening, even before cancer diagnosis, through a diagnostic assessment, or malignancy, risk stratification of that malignancy and prognosis, and guiding treatment decisions, as well as, assessing response for patients on therapy. I think these are all various touch points where AI can have an impact.

DR. SANDS:

So you've described a lot of opportunity for AI in multiple clinical settings. But if we can focus a little now on specifically head and neck cancer, what are some current AI innovations in that space that are worth discussing at this time?

DR. KANN:

There are a number of advances and applications being looked at for artificial intelligence and head neck cancer. And it's an area that I'm personally very interested in our group at the Artificial Intelligence and Medicine Program at Dana Farber, Brigham and Women's. We've been spending a lot of time working on certain applications.

Just to give a little bit of background for head and neck cancers, there's really been an epidemic in what are being seen as viral-related or HPV-related head and neck cancers. And this specifically pertains to oropharyngeal cancer, which now make up over 75 percent of diagnoses. And the good thing is that these tumors tend to respond well to our traditional therapies, such as chemoradiation and sometimes surgery. But the bad news is that our therapies can be very toxic for these patients. And while before this kind of epidemic HPV-related disease, prognosis was generally very poor, now, these patients are surviving for 10, 20, 30 years. And so they're left with a lot of quality-of-life-related issues and toxicities. So there's been a huge push to try to de-escalate therapy for this patient population.

But the big question is, how do we select the appropriate patients for de-escalation? And so here I think artificial intelligence can really help guide a precision approach to patient selection for different de-escalation strategies.

One example of this is transoral robotic surgery is being used a minimally invasive surgery is now being investigated as a way to try to de-escalate patients' therapy. So the idea is that they get surgery and then afterwards they can have a de-escalated adjuvant therapy.

One of the problems can come is if patients undergo surgery and are found on their pathology that have a characteristic of their lymph nodes known as extranodal extension, which occurs when tumor infiltrates outside of the lymph node capsule. Those patients are no longer eligible for a de-escalation strategy and are really thought to need chemoradiation. And so when you put those surgery, chemo and radiation together this is termed as trimodality therapy. And it's important because it's associated with worse outcomes in terms of quality of life and toxicity for patients. But it doesn't actually improve disease control compared to chemo radiation alone. So it's thought that if we had an idea who was going to ultimately have extranodal extension after surgery, those patients really are more appropriate for a non-operative approach.

The problem is that it's very difficult to detect extranodal extension on pretreatment scans at this time. There's been a lot of studies looking at this and our current standards with specialized head and neck radiologists and other diagnosticians, our predictive performance is generally sub-optimal.

So we've developed an algorithm that takes computed tomographies' imaging data as input from head and neck cancer scans pretreatment, and is able to accurately identify if extranodal extension is present in that lymph node. And by utilizing this, we hope to be able to select appropriate patients for a non-operative approach, or on the other hand to find patients who might have very low risk of extranodal extension who may be very appropriate for a surgical approach. So this is just one way where we think we can use artificial intelligence to more intelligently utilize the data that we have within imaging, to try to help guide personalized care in patient selection for various therapies.

DR. SANDS:
For those just tuning in, you're listening to *Project Oncology* on ReachMD. I'm Dr. Jacob Sands, and I'm speaking with Dr. Benjamin Kann about the use of artificial intelligence-based models in head and neck cancer care. Dr. Kann, looking further into the use of these models, give us an idea of how we're doing in terms of clinical implementation. What challenges are we currently seeing?

DR. KANN:
We've made progress. The fact of the matter is this is a very nascent field right now, and artificial intelligence has only really been applied to medicine and oncology over the last several years, 5, 10 years or so. And so, we still remain largely in a research and development phase.

What can often happen is when we're developing these models, we train them on certain data from a data set, maybe at our own institution, or maybe at several institutions. But then we find that they don't generalize as well as we'd like to another situation and another patient population. So there's been a lot of work to try to increase generalizability of these algorithms. And so that's a key challenge that's being addressed.

Another challenge that really needs to be focused on more and more is actual clinical utility of these algorithms. And what I mean by that is the ability of these algorithms to actually improve a clinically meaningful endpoint, like patient quality of life, or disease control or overall survival. Very often we're seeing, particularly in the realm of diagnostics, these algorithms performing with excellent sensitivity and specificity is a metric that's called area under the curve. And these all point to algorithms having very accurate results with the diagnostics, but we're not seeing a downstream look at how this actually affects the clinically meaningful endpoints for patients. And so I

think, to really have adoption of these algorithms en masse, we're going to have to start looking at these endpoints and showing that AI can actually improve, these endpoints that are clinically meaningful.

DR. SANDS:
And what do you foresee as the next steps to overcome some of these challenges?

DR. KANN:
I think one is to conduct prospective trials where we actually incorporate clinically meaningful endpoints. To give one example, there's a group at Duke, that developed a machine learning algorithm based on electronic medical records, to try to predict patients who are at high risk for requiring an ED visit or hospitalization while undergoing radiation therapy or chemoradiation. They then use that algorithm to stratify patients into high- and low-risk groups, and then randomize the high-risk group to escalated supportive care during their treatments. And they found that by doing that, they were able to dramatically reduce the need for emergency department visits and hospitalizations. So that's a study of machine learning being utilized to improve a true clinical endpoint that could be meaningful for patients and providers. And so I think we need to see more studies like that being conducted for these algorithms that are being developed.

DR. SANDS:
As we come to a close today, Dr. Kann, what would be some of your recommendations on top of those as far as moving the AI models further along within the field?

DR. KANN:
Aside from that, there are still a number of issues that I think we need to work on as a community and one is data sharing. So, what we don't benefit from in the medical field now is the type of data collection aggregation and harmonization that the technology industry, or the social media field that they enjoy. And so artificial intelligence has made huge strides in those fields, because they have millions and millions of data points that they can draw on to develop these really robust models.

In healthcare, our data is still currently relatively fragmented from hospital system to hospital system. Even efforts to combine databases, when you look at the potential, we still haven't really done as much as we could be doing. So I think, you know, efforts to really harmonize data and make data available for these model trainings, I think is going to be really important for us to tease out true benefit from artificial intelligence in oncology and in medicine in general.

I think another aspect is developing models that are really clinically usable. So models that fit into the workflow for providers that hopefully increase efficiency, but at the very least, don't create inefficiencies in the workflow and basically are able to become a part of the patient care that helps streamline things. For instance, when we're talking about imaging, a lot of algorithms right now require segmentation manually of the areas of interest. So implementing things like auto segmentation into these algorithms would really help create an incentive to use them among practitioners.

DR. SANDS:
Well, it sounds like a lot of potential with the use of AI. I appreciate the insights on some exciting emerging innovations in cancer care. I want to thank my guest, Dr. Kann, for joining me to discuss his research in artificial intelligence-based models and share his perspective on AI innovations in head and neck cancer and beyond. Dr. Kann, thanks so much for joining me today.

DR. KANN:
Thank you very much for having me. Pleasure to be here.

DR. SANDS:
I'm Dr. Jacob Sands. To access this and other episodes in our series, visit ReachMD.com/ProjectOncology, where you can Be Part of the Knowledge. Thanks for listening.