Barriers to AI-ECG Adoption

Announcer: Welcome to Mayo Clinic's ECG Segment: Making Waves, Continuing Medical Education podcast. Join us every other week for a lively discussion on the latest and greatest in the field of Electrocardiography. We'll discuss some of the exciting and innovative work happening at Mayo Clinic and beyond with the most brilliant minds in the space, and provide valuable insights that can be directly applied to your practice.

Dr. Kashou: Welcome to Mayo Clinic's ECG Segment: Making Waves. In this episode, we'll be diving into the realm of artificial intelligence and ECG analysis. We're excited to have back with us Dr. Adam May as our guest who has put some thoughts into this area. Today we'll look at the current state of AI augmented ECG, analyzing some of the advancements so far, but with a focus on the challenges that still exist. We'll look at the barriers hindering widespread adoption, examining the complexities surrounding algorithm generalizability, and the importance of external validation. We'll also discuss the intricacies of algorithm implementation and their clinical utility to enhance patient care. So get ready for another exciting episode. But before we get started, let's introduce you to our guest. Dr. May is a cardiac intensivist and a assistant professor of medicine at Washington University School of Medicine in St. Louis. Dr. May's research interests are related to the discovery, development, and refinement of innovative processes to enhance the diagnostic capabilities of automated ECG interpretation. More specifically, his work has led to the development of automated methods designed to accurately differentiate wide complex tachycardia. Dr. May thank you so much for joining us today.

Dr. May: Thank you, Anthony. Pleasure to be back.

Dr. Kashou: Yeah, my gosh, I, we love having you and we always appreciate it because I think it's a good discussion and our audience has really enjoyed having you. So today's a little different. We're gonna be looking at AI and mostly on the barriers but I guess before we get there how would you characterize the current state, you know, of AI as it relates to the field of electrocardiology?

Dr. May: Yeah, great question Anthony. I would characterize it as an exciting time. The field of AI ECG has generated significant excitement and I myself am quite enthusiastic about its potential and future. The future possibilities that may arise from ongoing research in this area are truly amazing and I do not doubt that there will be any of chance that AI will not fundamentally change the landscape of computerized ECG technology. However, despite the recent advances, palpable buzz in the space, the development of numerous AI algorithms, only a limited number are currently used in routine clinical practice. Now, I think there are many reasons for this and I'm excited to get to speak with you about some of them. I think there are a few key areas that provide the biggest barriers, however, and for these algorithms to make it into mainstream, into clinical practice, into the hands of clinicians, we as a community need to overcome these barriers.

Dr. Kashou: And that's what I was excited to talk to you about is 'cause we're always looking at, you know, the new discovery and stuff, but there's also those barriers to clinical adoption and to the bedside. And you know, speaking of barriers, challenges that exist, let's talk about those. Where do you see are the key barriers in the field today?

Dr. May: Yeah, specifically I think the areas relate to three things. One would be algorithm generalizability. The second one would be algorithm implementation and the third would be algorithm utility. So let's start with algorithm generalizability. I think there are fundamental questions here, to include one question in this. So one, will the algorithm perform as well when implemented in clinical practice? What will be the impact when we unleash it onto different patient populations, separate from the one to which it was developed? Is there any external validation set or results at all? Are the external validation results markedly different from the original works? And if so, what is the expected impact from poor generalizability, specifically in terms of false positives and negatives, negative predictive value, positive predictive value, sensitivity, and specificity. The second area algorithm implementation also has fundamental questions here. These include how will the algorithm be used? What is the appropriate use case for the new AI algorithm? And how do you propose incorporating the algorithm into clinical workflow and how is it going to take place in the current landscape of existing stakeholders? Specifically thinking of the patients themselves the clinicians, industry partners, and healthcare systems. And then finally but not least, algorithm utility. The fundamental questions here are, is the algorithm in of itself valuable? How is it gonna improve things? Is it better than what is currently in place? Is it better and cheaper? Is there a better and cheaper way to achieve the objective of the algorithm? If it is better, by how much? And does the incorporation of these algorithms make economic sense? Is it just going to make the ECG and clinical care more expensive with adding little to no value? Hopefully that is not the case.

Dr. Kashou: All right. So three kind of key barriers that I heard. The algorithm generalizability, its implementation, and thirdly, the utility of it, you know, how we use it. And I think these are three key components that we really think about beyond the discovery and when we're looking at validation and implementation. But let's look at each one of these and maybe for our audience, we'll start with algorithm generalizability. Could you expand a little bit on this?

Dr. May: Yeah, perfect. Yes, I can. So algorithm generalizability essentially refers to what happens when algorithm is implemented on the general clinical population or subjects different from the group that was used to develop the algorithm. In general, algorithm generalizability can be gauged by external validation, which asked the question, does this algorithm work when applied on a different patient population? And in particular in the realm of deep learning, this is a very, very big issue. Unfortunately, deep learning algorithms that have been developed have a tendency to not do as well on external validation. In other words, some do not generalize particularly well. This is also known as overfitting which means good performance on training data or data that was used to develop the algorithm. But suboptimal performance on new external data. For an algorithm to make it all the way to clinical practice, this barrier needs to be overcome.

Dr. Kashou: Okay, so algorithm generalizability. So you know, that was the key thing. So we've discovered it, you know, we're validating it, we're generalizing it against, you know, across different populations. And let's say we overcome that. Okay, now we have an algorithm that is generalizable. What about implementation?

Dr. May: Yeah, so this is a huge key step. So algorithm implementation, this issue essentially relates to this, these questions. What is the appropriate use case of the algorithm? When do you use it? Who do you use it on? how do you use it in clinical practice? And is there any data-driven science or evidence out there that supports the use case at all? Unfortunately at this point we do not have much data to answer these questions. And as of now, this area largely remains unexplored. There have been a few attempts at figuring out the appropriate use case for any particular algorithm. The only major exceptions that I have seen and can readily point out come from Mayo, specifically the Eagle trial for their low EF algorithm which is a brilliant idea by the way. And then the Beagle trial for their atrial fibrillation prediction algorithm. Another brilliant idea. In my opinion, the proper use case for new AI algorithms have to be established before unleashing them out into the world. And if I could go a step further, if we do not figure this out beforehand, I think it is possible that these new and innovative algorithms can cause more trouble than good.

Dr. Kashou: So now we have something we've discovered, we have something that is now validated externally, validated and generalizable across different populations. The implementation that you just mentioned is important and you were kind of focusing on the use case. And so how would that use case, you know, the third thing was algorithm utility. How does that differ the third aspect here?

Dr. May: Yeah, I think this is the most important aspect of the three. So yes, though it should be patently obvious. Just because something is new and related to AI does not necessarily mean it has any value. The key questions for this are, will the algorithm be valuable to patient care? Is it going to improve existing practice at all? Is it better than what is currently in place? If the answer to these questions is no, or if the answer to these questions is no for any of 'em, well I think you have your answer as to whether the algorithm idea should be given further consideration for broad-based clinical implementation. For example, imagine this scenario, it's a hypothetical scenario. Should we implement an ECG AI algorithm that does an okay job at detecting a certain disease while a cheaper and more readily available assay does a fantastic job at detecting the same disease with very high sensitivity and specificity? In this case, I would argue that the value of this algorithm does not warrant broad-based implementation at all.

Dr. Kashou: So you know how we actually use these algorithms. That's fascinating. Now, you know, we spoke of these three barriers pretty much after the discovery phase of generalizing it, making sure that we can implement it and is, you know, with the use case and then the utility doesn't make sense and maybe that's not always the right order and maybe utility should be the first thing we think about as we're going through that discovery phase. And I don't always like to ask this question, you know, 'cause I know we're coming towards the end and I never know what I'll get. But do you have any final thoughts that you'd like to kind of add on this? Because without going down a rabbit hole.

Dr. May: Well, you know, rabbit holes are everywhere, especially when you're talking about ECG and AI. And well, you know, I would say my final thoughts are this: I think it's a very exciting time. I'm sure that you and I are not the only ones eagerly awaiting to see what the future holds in this space. Innovative AI algorithms are coming at a rapid pace and this rapid pace is only accelerating. Through this development, you know, though it is exciting, we need to figure out how to get beyond existing barriers that impede the adoption of new AI technologies. I discussed only a few big ones, but there are plenty of others. Overall, I think it is very interesting to see or it will be very interesting to see how we respond to these challenges in the upcoming years. So again, very exciting time, but I think that there's a lot of work ahead of everyone.

Dr. Kashou: There certainly is and we're glad you're a part of this field in helping lead it. Our discussion of AI and ECG analysis with Dr. May has shed light on its current state, the barriers it faces, and the critical aspects of algorithm, generalizability, implementation, and utility. While the field holds immense promise, we must navigate through these important challenges. It will be through dedicated research, collaboration, and a commitment to addressing these barriers that we can unlock the full potential of AI enhanced ECG analysis in clinical practice. With continued advancements in collective effort, we stand poised to improve cardiac care, providing more accurate diagnoses, better patient outcomes, and a brighter future for individuals affected by cardiac conditions. Dr. May, we extend our sincere appreciation for sharing your expertise with us. Thanks for coming back and I hope you'll join us again

Dr. May: Anytime, Anthony, the pleasure was all mine.

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