The Future of Medicine with Artificial Intelligence

As AI continues to be used in healthcare settings, it is predicted those who don't embrace it could soon be out of touch with the medical industry.

By Meredith Whitmore

TO UNDERSTAND THE effect artificial intelligence (AI) will have on medicine, consider the following: Thirty-seven percent of healthcare professionals are using a form of AI in their work today. Eighty-eight percent of those who use it say AI improves patient care. Fifty-four percent expect widespread adoption of AI within the next five years.[1] The healthcare AI market is expected to surpass $34 billion by 2025.[2]

To put things another way, healthcare professionals who do not understand the monumental influence AI is beginning to wield will eventually find themselves out of touch with the industry. As one specialty publication elegantly states, for example: "Artificial intelligence will not replace radiologists, but radiologists who use AI will replace radiologists who don't."[3]

When considering AI in the medical industry, many might imagine iconic images from popular science fiction. After all, tricorders from the original "Star Trek" television series and medical robots from movies such as "Big Hero 6," "Interstellar" and "Star Wars: Episode III — Revenge of the Sith" are a bit advanced for today's AI capacities (more on that later). Still, AI is playing more and more of a role in healthcare, and often in ways that physicians do not always understand or recognize.

Today, much of the existing AI intricately synthesizes machine learning, complicated algorithms and software to approximate and even anticipate human thinking. As William Grambley, chief operating officer of Allazo Health, explains: "AI is not just creating a single formula. It's creating a complex set of relationships and then dynamically adjusting the formula based on any new data." Allazo Health, an AI-based company in New York City, helps healthcare stakeholders such as pharmacies, health plans and pharmaceutical companies to "intelligently drive their clinical outreach programs to improve clinical results."

Basics of AI

"There are so many places that AI is impacting people's lives that they may not even realize," Grambley explains. "The way Allazo uses it is primarily to analyze people's reactions to different kinds of clinical outreaches and programs, and therefore make predictions about what will happen if we run a certain clinical outreach program. As a piece of that, we're also predicting a clinical outcome independent of any outreach. I think there are a lot of places in healthcare where you'll start to see that. Examples include hospital readmissions or emergency room usage or things that in the near term impact utilization — but longer-term could be used to predict your individual risk of developing certain conditions based on how frequently you go to the doctor, the kinds of procedures you've had done in your life, the lab results you've gotten over time. If you can get that data over a large enough population and start to analyze it, you can create these types of machine-learning and AI models.

"You can imagine five or 10 years from now, when a doctor plugs in recent information about you into a system, and then the doctor says, 'The likelihood of you developing a certain disease is increased since last time, and here's what we could do differently.' That becomes a very different interaction than today, where I think most exchanges between physicians and others in the healthcare system are driven based on their training and knowledge, and not necessarily some kind of dynamic perspective of large population studies and other things that end up influencing an AI engine."

Yet, with emerging AI engines come ethical questions. "At what point do biases need to be controlled for or prevented from entering those kinds of engines?" Grambley asks. "You could imagine that demographic factors such as what ZIP code you live in, for example, could be a predictor of many things. Do you want that predictor to be used as part of a recommendation on a treatment path or recommendation of lifestyle changes?

"In healthcare, as in many other industries, there's always the question of: 'Are you focused on the maximum outcome, or are you focused on the most cost-efficient outcome?' I think that becomes particularly relevant in healthcare, where those two might not lead to the same answer. When you start to use these machine-learning or AI type of engines to decide things, the outcome you're trying to solve for needs to be very clear and understood. If you're trying to solve for the maximum outcome, then you're going to have a different set of expectations of a program than you may if you're trying to achieve the most cost-effective outcome. Again, as you're thinking about implementing an AI-type program, the trade-offs, in our case at Allazo, the client side, need to be really explicit, because if you don't explicitly make those decisions then the engine is going to try to maximize for what you tell it to. If you don't explicitly make a lot of decisions up front, it may not actually lead to what you're trying to do. When we work with clients, we end up spending a lot of time asking those questions. I think, just broadly in healthcare [with regard to AI] if you aren't explicit about what you're trying to do, then you may run into issues."

"For example," says Grambley, "if a client was trying to avoid patient emergency room usage, there are a lot of ways to address that. If you address it by somehow limiting access to it, that's not the right answer. You have to address it in a way that supports overall health for people and better decision-making about where they go, and lots of other things. Again, you need to be explicit about the constraints you're going to put on whatever the AI is going to produce. I think that becomes even more important in healthcare where you can get to unintended consequences if you don't think about what those could be explicitly up front."

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Upcoming and Progressing AI Technologies

Beyond the technical and ethical discussions are research and development. Other companies are pioneering AI technology in addition to Allazo Health. Following are some of the most recent and exciting developments.

Early sepsis detection. With the assistance of AI, doctors at HCA Healthcare-affiliated hospitals are now detecting sepsis 18 hours earlier than the best clinicians at other facilities unaided by the same technology. The technology, called SPOT (Sepsis Prediction

and Optimization of Therapy), utilizes machine learning and manages algorithms based on patient vital signs, tests, nursing reports and other data that can prevent the dreaded, life-threatening condition from spreading. SPOT can identify at least one-third more sepsis cases that would not previously have come to caregivers' attention until it was too late. As a result, more than 5,500 lives have been saved over the last three years, and more than one million patients have been monitored by the technology. Considering sepsis is the 11th-leading cause of death in the U.S., the ninth-leading cause of death in all hospitals and the third-leading cause of death in intensive care units, SPOT is a remarkable and much-needed technology.[4]

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Breast cancer screening. In Europe, London-based Kheiron Medical Technologies recently launched Mia, a breast cancer screening tool that uses deep learning software. Mia is designed to analyze standard full-field digital mammograms and serve as a second reader for radiologists.[5] Kheiron claims clinicians will receive results "within seconds," directly into their existing workflows. Mia will also enable radiologists to "triage imaging studies before review so they can prioritize studies based on findings." A clinical study has shown Kheiron's software performs above the current average British benchmark for breast screening radiologists. The company is now launching new clinical evaluations across Europe and in the United States to improve its technology and assess the software's potential impact on breast screening around the world.[6]

Predicting medication side effects. Decagon is a cutting-edge AI-based technique developed to foresee potential side effects from millions of drug combinations.[7] As developers Marinka Zitnik, PhD, and Jure Leskovec, PhD, state: "Decagon's predictions have the potential to provide doctors with guidance on how to prescribe safe treatments by taking into account the patient's pharmacy and all drugs the patient currently takes. Predictions give clues about whether it is a good idea to prescribe a particular combination of drugs to a particular patient. Beyond giving clues and providing guidance to doctors, such predictions are also of interest to patients. That is because predictions about side effects associated with a particular combination of drugs can aid in self-care as patients can recognize unwanted effects early on. Ultimately, techniques like Decagon have the potential to give scientists and researchers guidance on designing new combinatorial drug therapies with fewer adverse side effects."

According to Drs. Zitnik and Leskovec, "Since the publication of Decagon, we have started working with Massachusetts General Hospital and Newton-Wellesley Hospital to test the utility of some of Decagon's predictions on real patient data. This clinical validation is currently ongoing, and we are validating predictions against classic drug-drug interaction markers, lab values and other surrogate measurements that are available in hospital clinics."

Upgrades to Decagon's machine learning algorithm are continually fine-tuned. "Decagon's algorithm is based on deep network embeddings, a flexible and recently invented computational paradigm that enables us to generate biologically meaningful machine-readable embeddings of drugs from large biomedical data," explain Drs. Zitnik and Leskovec. "We are now investigating those learned embeddings to provide interpretation for Decagon's predictions, and we are developing new means to design explainable models whose predictions are accurate and can be interpreted in the context of several decades worth of biomedical knowledge."

Diabetic retinopathy. Researchers using a deep machine learning algorithm are paving the way to detect diabetic retinopathy and macular edema in retinal fundus photographs. That's an exciting possibility in a world in which diabetic retinopathy is the most frequent cause of new cases of blindness among adults aged 20 years to 74 years.[8]

In their study published in the *Journal of the American Medical Association*, researchers said the algorithm had "90.3 percent and 87.0 percent sensitivity and 98.1 percent and 98.5 percent specificity for detecting referable diabetic retinopathy, defined as moderate or worse diabetic retinopathy or referable macular edema by the majority decision of a panel of at least seven U.S. board-certified ophthalmologists." And, at the operating point selected for high sensitivity, the algorithm had "97.5 percent and 96.1 percent sensitivity and 93.4 percent and 93.9 percent specificity in the two validation sets." However, the researchers add "further research is necessary to determine the feasibility of applying this algorithm in the clinical setting and to determine whether use of the algorithm could lead to improved care and outcomes compared with current ophthalmologic assessment."[9]

Television Comes to Life

Getting back to the allusion to science fiction, an emergency room doctor literally developed a once-mythical tricorder first

DxtER, similar to the "Star Trek" tricorder seen in the 1960s television series, is a handheld device that helps doctors diagnose patients based on symptoms. It won the top prize at the Qualcomm Tricorder XPRIZE competition.

seen in the original 1960s "Star Trek" television series. Basil Harris, MD, a Philadelphia-based emergency room physician, decided to undertake a project to create the handheld diagnostic device called DxtER and enter it in the Qualcomm Tricorder XPRIZE competition at which he won the top prize. DxtER contains a digital stethoscope, an EKG sensor, a spirometer to measure lung function and a finger probe that measures glucose, white blood cell count and other blood tests. It continuously monitors a patient's vital signs and then asks questions through its smartphone or tablet app to better understand the symptoms. "It's doing exactly what I do in the ER," Dr. Harris explains. "It uses all of that objective information together in the way your doctor would to come up with a diagnosis." Dr. Harris hopes to keep the price around $200 once the device has received regulatory approval.[10]

The Future of AI?

Who knows what the future holds for AI in medicine. But, as we see here, what was once considered the impossible is no longer unachievable. Virtually anything can be created today with enough human determination, machine learning, technology and algorithms. The sky is no longer the limit. Today, it's more like the universe. And, 30 years from now, we will look back to marvel at how little we know today. ❖

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