Opinion

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Big Data, Little Time: Deep Learning and Your Practice

Imagine traveling to the ophthalmology office in a self-driving car. I'd drink my coffee, peruse the morning headlines on my iPhone, read email, check Instagram, and maybe even relax (though probably not). It's not difficult to imagine this future. Tesla promotes its self-driving hardware on its website, describing the onboard computer as one that "provides a view of the world that a driver alone cannot access." Last year, Google spun off its self-driving car project to create the company Waymo, which is engaging Phoenix residents in a public pilot program of self-driving vehicles. These cars are an application of artificial intelligence (AI) and deep learning algorithms; according to the industry, they hold the promise of safer driving and nondistracted drivers.

AI is also on the cusp of transforming health care. While AI has had medical applications for decades, recent advances in neural network algorithms, which are loosely modeled on the human brain and are called convolutional neural networks (CNNs), have propelled deep learning into practical patient care. In concert with more powerful graphics processing units (GPUs), more powerful computers, and the explosion of digital data, AI is fast finding a home in health care.

IBM Watson, a well-known player in health care AI, was initially developed by IBM to answer questions on "Jeopardy!" Today, IBM Watson is quickly moving beyond question-answering functions. In 2015, IBM acquired Merge Healthcare, a company that stores and analyzes medical images, for $1 billion. Their goal is for IBM Watson to analyze images, make accurate diagnoses, and provide clinical decision support. Dozens of companies are jumping into the medical AI arena, including Hewlett Packard, Dell, Apple, Sentient Technologies, and Deep Genomics.

Much of our medical data is currently in the form of images and is interpreted by human beings, usually MDs. Because much of the work of radiologists is image based, radiology may be the field with the greatest progress in medical AI. Keith J. Dreyer, DO, PhD, predicts that radiologists will be at the forefront of integrating AI into clinical practice. He advocates for AI as a tool to augment the work of physicians, but not to automate it. Dr. Dreyer is the director of the Center for Clinical Data Science at Massachusetts General Hospital in Boston, which has partnered with Nvidia, a tech company that designs GPUs for gaming. The hospital has a database of 10 billion medical images. The deep neural network supercomputer will compare a patient's history and test results with the data collected from other patient's phenotypic, genetic, and imaging data to provide clinical support to radiologists, oncologists, and other physicians.

But what about ophthalmology? Both Google and IBM have published papers in the last few months about using CNNs to analyze fundus photographs to grade diabetic retinopathy and identify disease that should be referred to an ophthalmologist.

IBM Watson is also engaged in analyzing cup-to-disc ratios. Imagine the day when an app could integrate clinical information, such as visual fields and intraocular pressures, optical coherence tomography data, genomic data, information from our clinical trials, and Kalman filters to generate the risk of progression in 5 years and a suggested target pressure. AI might be able to recommend how often visual field testing should be performed on a particular patient based on the statistical risk of progression.

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Physicians can choose to be skeptical about the role of AI in clinical decision-making or afraid of being replaced by a machine. However, the rate of medical knowledge will soon double every 73 days.[1] The IRIS Registry and other sources of big data provide vast amounts of information. AI and deep learning are necessary tools for physicians who cannot possibly process the explosion of data and medical information. It's important for us to understand the power—and the limitations—of deep learning algorithms and to harness this powerful resource to assist us in applying technology and data to clinical care.

1 Drensen P. *Trans Am Clin Climatol Assoc.* 2011;122:48-58.