Artificial Hype

GE HEALTHCARE
SPECIAL SUPPLEMENT

AI is the new reality: the 4th healthcare revolution in medicine

AI: Hype? Rather, augmented intelligence is the fourth healthcare revolution in medicine and will lead to improved patient care.

The future is bright, if we continue to develop creative solutions to improve patient care, in collaboration with deep learning algorithms, then we'll again have succeeded in advancing medicine into a new healthcare revolution, more evolved and sophisticated, to benefit clinicians and patients.

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When George Hinton PhD, noted computer scientist and godfather of neural networks, stood in front of a large crowd at the Creative Destruction Lab in Toronto in late 2016 and proclaimed that, "Radiologists would be out of a job in 5–10 years," his statement was the modern "shot that was heard around the world"(Mukherjee 2017).

Since then, Dr. Hinton has toned down his rhetoric a bit with statements like,"The role or radiologists will evolve from doing perceptual things, that could probably be done by a highly trained pigeon, to doing far more cognitive things."

Faced with the modern-day challenges of healthcare, the pigeon may rue the day that it entered the

medical profession. The reality is that it's becoming increasingly more difficult to practice value-based medicine in today's climate of volume-based medicine. The days of having time to be able to review the patients' chart, compare old films, speak to the referring physician when necessary, communicate critical findings to the patient in timely fashion, and be available to answer questions is falling away with the increasing complexity of imaging, and the multifactorial workload challenges.

Since it is unlikely, in the near future, that administrators will tell radiologists to forget about metrics and relative value units (RVUs), and instead focus on providing a value-based interpretation for the patient, new solutions are needed to deal with the increasing workload challenges while continuing to provide value for the patient and referring clinician.

Fortunately, we now live in an exciting time of deep learning, and solutions are on the horizon. Artificial Intelligence has in fact been around since the 1950's. Isaac Asimov published his "three laws of robotics" in 1950, and the first AI conference was convened at Dartmouth College in 1956. Robby the Robot appeared in the 1956 classic science fiction film, Forbidden Planet, and since then our collective imagination has taken off with dreams of what robots and artificial intelligence can do for human kind.

Machine learning evolved in the 1980's, but it wasn't until high performance computing hardware: graphics processing unit (GPU)/tensor processing unit (TPU)/Quantum-based gaming technology became available to run sophisticated video games like Xbox that deep learning became a reality in 2010. Deep learning (using convolutional neural networks) is now driving advances in medicine in areas of research such as drugs and vaccines, medical devices, medical imaging, and radiogenomics.

Image-omics (radiogenomics or deep learning applied to radiological images) will be a very powerful tool since tissue-based genomics isn't able to sample other parts of the tumour, the phenotype, gene-gene interactions, or the host response. The days of just describing a mass on a study will evolve into a more sophisticated approach, using radiogenomics to detect the molecular and phenotypic properties of the entire tumour, which will improve the patient's treatment.

The number of AI-related publications has increased from less than 500 between 1952-1992 to over 6000 in 2017 (**ncbi.nlm.nih.gov/pubmed**). The increasing number of research publications in

AI is being driven by much more available computational power, improved techniques, critical theoretical advances, large capital investments in technology, and large amounts of available data (cloud and open source). The advantage of deep learning is that it identifies features and connections, versus just connections, that leads to rapid improvements in its performance.

The clinical applications are intriguing. Some examples. Fei Fei Li PhD and her colleagues at Stanford University are focusing on endowing healthcare space with ambient intelligence to assist clinicians and patients. This ambient intelligence will sense the physical space, recognise all activities, while integrating the data into a clinical ecosystem. This application has the potential to decrease and prevent medical errors such as immobility-induced ulcers, retained surgical sponges, hygiene-related infections, bloodstream infections and patient falls (Yeung et al. 2018).

> ❝ THE IMPORTANT THING NOW IS FOR RADIOLOGISTS TO GET INVOLVED, BECOME FAMILIAR WITH AI, AND STAY ENGAGED ❞

Luciano Prevedello, MD, MPH and colleagues at Ohio State University are focusing on augmenting components of the imaging lifecycle. They're working on optimising imaging workflows through triage prioritisation of imaging studies, and on improving image interpretation through lesion detection, characterisation, quantification and comparison.

AI research is moving quickly on a multiplicative logarithmic trajectory. Applications that didn't exist two years ago are now available. Prior challenges are becoming strengths, which are leading to advances in radiology and medicine.

Current challenges of deep learning in medical imaging include data availability and privacy concerns, data annotation and curation, data/algorithm validation and testing (early validation methodologies have not been robust), and length of process (idea to publication to clinical application), which can take many years.

One of the economic challenges will be in overcoming the Gartner Hype cycle as we move into the trench of disillusionment. If vendors can't identify

ways to monetise AI in a timely fashion, venture capitalist's investment in AI technology may start to diminish.

The future strategy in convincing the C-Suite to sign on to AI technology is not to sell AI, but to sell the benefits that AI will bring such as workflow optimisation.

Dr. Li's optimism stresses the importance of human-centered AI. "AI technology should be inspired by human intelligence. The development of AI should be guided by its human impact, and the goal of AI should be in enhancing humanity, not by replacing it" (Fei-Fei 2018).

"THE FUTURE LIES IN THE COMBINED AND COLLABORATIVE EFFORTS OF HUMANS PLUS AI"

The future lies in the combined and collaborative efforts of humans plus AI. To date, the best AI-powered systems have required humans to play an active role in their creation, tending and operation (Mims 2017). Therefore, the term I prefer is augmented intelligence.

Augmented intelligence, powered by deep learning, will optimise our workflow leading to improved patient care. Deep learning will learn to automate certain time-consuming perceptual functions like detecting multiple pulmonary nodules or new multiple sclerosis plaques in the brain while comparing these lesions to prior studies, and generating a value-based qualitative and quantitative representation for the treating referring clinician.

Time saved, will allow the radiologist more latitude to review the chart, consult with the clinician, and speak with the patient. This increased collaboration with the patient will result in improved patient outcomes since patients will be able to ask questions, understand their disease process, and they will become more invested in improving their care.

The important thing now is for radiologists to get involved, become familiar with AI, and stay engaged. It falls upon radiologists to understand AI so that they can inspire future generations of radiologists and clinicians. Fortunately, resources are now available to help radiologists become more comfortable with AI through the American College of Radiology (ACR Data Science Institute). An excellent AI lecture series/journal club was developed by the resident and fellow section (RFS) of the ACR that is helpful for all radiologists. The ACR RFS AI Journal Club now has its own YouTube channel which includes all prior AI Journal Club recordings. The Radiological Society of North America (RSNA) has begun a new series of AI webinars, and the RSNA has just begun to publish a new journal called *Radiology*: Artificial Intelligence to support the growing and exciting work in this area.

The future is bright, and if we can continue to develop creative solutions to improve the care of patients, in collaboration with deep learning algorithms, then we'll again have succeeded in advancing medicine into a new healthcare revolution, more evolved and sophisticated, that will continue to benefit both clinicians and patients. ∎

KEY POINTS

- ✓ It's becoming increasingly more difficult to practice value-based medicine in today's climate of volume-based medicine.

- ✓ AI research is moving quickly on a multiplicative logarithmic trajectory; prior challenges are becoming strengths leading to advances in radiology and medicine.

- ✓ The future strategy in convincing the C-Suite to sign on to AI technology is not to sell AI, but to sell the benefits that AI will bring such as workflow optimisation.

- ✓ It falls upon radiologists to understand AI so that they can inspire future generations of radiologists and clinicians.

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