Editorial

Impact of Artificial Intelligence on Clinical Decision-Making in Health Care

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In Stanley Kubrik's 1968 classic movie *2001: A Space Odyssey,* H-A-L, a humanized computer more formally known as HAL 9000, utilizes artificial intelligence (AI)-based technology to oversee, and ultimately fight for, control of a space mission in search of extraterrestrial life. When questioned about the accuracy of its technology, H-A-L responds simply, "The 9000 series is the most reliable computer ever made. No 9000 computer has ever made a mistake or distorted information. We are all, by any practical definition of the words, foolproof and incapable of error."[1]

Although futuristic in concept at the time, the use of AI in anticipating, assessing, and circumventing problems is becoming increasingly ubiquitous. AI is now considered a mainstream approach, having become integrated across a wide variety of disciplines. From informing decision-making at retail giants such as Amazon and Apple, to at-home personal assisting (eg, Siri), to taking part in health care breakthroughs, AI has changed the landscape of nearly every aspect of our lives. Simultaneously, the extent to which these approaches are "foolproof and incapable of error" in the development of targeted clinical therapies (ie, therapies based on an individual's biology) is being assessed worldwide.

The term *AI* was coined in 1956 by John McCarthy via the Dartmouth Summer Research Project on Artificial Intelligence, and was based on the premise that machines could learn, and ultimately predict, human behavior.[2,3] The conference was held, in part, in response to the research of Dr. Alan Turning, a British mathematician who had explored the ability of machines to "think" using the Turning Test.[2,3] Perhaps surprising to some, the use of AI in health care was contemporaneous with the premiere of *2001: A Space Odyssey* so many decades ago. By the early 1970s, AI was being applied to biomedical problems.[3] Today, data acquisition, health care outcomes, response to therapy, and even health care cost reductions are reaping the benefits of this technology. Machine-based learning techniques have been designed for clinically relevant data and imaging extraction, subsequently "learning" and providing highly precise clinical feedback for the purposes of enhancing care and improving outcomes. To date, much has been written about the past, present, and future of AI in health care,[4–8] and dozens of companies have been generated for developing technologies that suggest precision therapies based on a patient's biology.

In this month's *Clinical Therapeutics,* we are excited to publish our newest Conversations with the Editor piece, which highlights the use of AI-based techniques in surgical care. Topic Editor Dr. Carlo Federici leads the discussion, sitting down with two experts in the field who are utilizing AI approaches to guide clinical practice.[9] Dr. Thomas Scheeren has been applying AI not only to better predict which patients are at risk for hypotension in the perioperative period but also to identify the root cause of patients' low blood pressure in real time. In turn, his team can inform surgeons, anesthesiologists, and intensivists about individualized therapeutic approaches to restoring normotension. In parallel, Dr. Luciana Ravara has incorporated AI approaches to improve both the diagnostic yield of colon cancer beyond the limitations of conventional endoscopy and the accuracy of computed tomography for use in monitoring the progression of pulmonary disease. Expanding beyond inpatient treatments, Dr. Ravara advocates the use of AI in home-care settings both to empower and reassure the patient of his/her own clinical status, and to alert the caregiver of impending deterioration mandating hospitalization.

Our interviewees describe the integration of AI technologies into the health care system,[9] which represents a worldwide transformation. The emergence and integration of large-scale data analyses, combined with complex supervised and unsupervised machine-learning algorithms, have enormous potential not only to provide precision-based medicine but also to reduce health care costs and morbidities. As we embark on this next odyssey in health care, we all share in the responsibility of ensuring that these approaches remain "foolproof," while recognizing the ethical considerations potentially associated with deriving the data required for generating care-informing algorithms.

While some may argue that AI is "incapable of error," we must ensure that the humanity of the approach always remains.

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