Artificial Intelligence in Health Care: Have We Made the Transition from Fiction to Reality?

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“Man’s reach exceeds his grasp,” a familiar phrase been put to test more often in contemporary world than in the previous. With the advent of modern computational sciences, humans have empowered machines with intimidating intelligence, so much so that the science fictions of yesterdays are palpable realities of present times. Smart homes and office spaces are equipped with devices that could run and function with precision and without human intervention. All this has been made possible by technologies that make use of digitized data, cloud storage, and artificial intelligence (AI). While digitized data and cloud computing have been talked about for a long time, AI surfaced to prominence recently with advent of deep neural networking (DNN) algorithms. The researcher trio of Yoshua Bengio, Geoff Hinton, and Yann LeCun developed the fundamentals of deep learning and neural networking for speech recognition and machine vision. They were awarded the 2018 Turing award, recognized as the “Nobel prize of computing” substantiating the importance of this technology in today’s world.

AI is an imitation of human intellect by a machine to analyze and decipher patterns in voluminous data and create useful insights. However, in the mid-1980s when AI system was in its initial stages, it was recognized as a rigid, rule-based system requiring human-directed updates and hand-holding of the system’s features. With the passage of time, leveraging on machine-learning techniques, AI research has progressed by leaps and bounds. The system can now identify features and patterns from data by taking into account highly complex interactions without explicit human involvement. These machine-learning methods broadly fall into two categories: supervised and unsupervised. The “supervised machine-learning” method analyzes a large set of training data, which is well labeled with both input and output variables. On the other hand, “unsupervised machine-learning method” has only the input variable as labeled and its objective is to identify structure or distribution in the unlabeled data to further discover the clustering or association of the original data.

This resurgence in AI has largely been accelerated due to progression in pattern recognition abilities pointing toward successful application of DNN, comprising input, output, and numerous other hidden layers of processing. New age processors and availability of digital data in abundance have enabled these cognitive machines with better sensitivity and specificity. With every business sector eyeing to reap benefits from this technology, health-care industry is poised to extract most out of this innovation primarily due to the availability of large amount of digital data.

The DNNs have the potential to help identify and interpret patterns in medical scans, electrocardiograms, and pathology slides; perform automatic skin lesion detection; and assess retinal images. The AI-driven interpretations have been applied in the field of imaging to the greatest extent and have attained high-level accuracy and precision. The Food and Drug Administration (FDA) approval of proprietary algorithms for image interpretation powered by AI has been rising rapidly with increasing number of technology giants and startups joining the race. A large number of clearances have also been given in the field of omics, where machine-learning methods have the potential to identify molecular patterns associated with disease status and disease subtypes. These data-driven molecular biomarkers have multiple implications in trial designing, clinical management, and guiding treatment selection.

Finally, the most ambitious application and an overarching goal of AI could be to provide millions of people with primary health-care benefits through telemedicine. The primary health-care benefits through telemedicine.
AI systems will perform electronic health record (EHR) assessments and offer medical advice to patients in remote areas where health-care facilities are not easily available. Although there are numerous challenges pertaining to standardization and optimization, prominent players such as IBM, Google, and Microsoft along with young enterprises such as Curai and Ayasdi have already made headways in addressing them.

In 2017, the National Health Policy of India recognized the importance of integrating the health information system and aimed at having standardized and interoperable EHRs.[4] A year later, the proposed National Health Stack by the National Institution for Transforming India Aayog recommended having a centralized electronic health registry of service providers and beneficiaries, locked with a digital health ID.[5] However, the task of digitizing all health records in a country like India will be humungous owing to its large population and lack of adequate information and communication technology infrastructure, particularly in rural and backward areas. Hence, driving the digitization process with natural language processing algorithms will be crucial in scaling the language barriers and reducing the burden on doctors. In addition, to make health professionals/service providers a part of this digital revolution, some of the best strategies of EHR adoption from countries such as Germany, USA, and UK could be leveraged to successfully implement the EHR system across India. Currently, hospitals and clinics in the states of Maharashtra, Delhi, and Andhra Pradesh are leading in terms of EHR adoption.[6] Despite the envisaged benefits of EHRs, their adoption is limited to metropolitan cities and some prominent health-care providers such as Max Health and Apollo Hospitals.[7]

CONCERNS

Although the FDA published a fast-track approval plan for AI medical algorithms in 2018, there have been few peer-reviewed publications on clinical validation. As AI continues to incorporate itself in health-care domain, it is becoming critical for these neural networks to explain their internal workings. However, the black-box models that perform complex data analysis (displaying nonlinear relationship) to arrive at accurate predictions lack explainability. This blend of usefulness and opaque nature of such models is often referred to as the “Black Box Paradox.” Thus, appropriate checks are required to further integration of AI technologies in health care and AI systems should not be implemented in patient care with exceptions. Algorithms based on synthetic and nonreal cases could render potentially unsafe and erroneous recommendation to patients.[3] The legal liabilities in such scenarios and in malpractice needs to be discussed, debated, and defined, else fear would overshadow the trust and confidence of masses in AI technologies. The challenges offered by AI systems are though not in proportion to the promises, but are formidable.

The idea of robots being primary health-care providers seems a far-fetched reality, but it is time to put these cognitive machines to the “Turing test.”

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