EDITORIAL

Potential Role of Machine Learning in Oncology

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Machine learning (ML) is the ability of computers to learn from data autonomously. It is a core branch of artificial intelligence (AI), which is defined as the ability of a machine to replicate the intellectual processes of humans independently.[1,2] The evolution of the microprocessor for home computers resulted in increased computing speed, efficient data collection, storage, and retrieval capacity. Thus AI techniques have evolved, which led to the discovery of artificial neural networks which are computer modeling algorithms mimicking the human brain.[3–6] AI has developed to an extent that it can exceed the human brain in board games such as chess, television games, image recognition, and spam e-mail filtering. In addition to engineering, arts, and finance, extensive progress has been made to integrate ML in the field of medicine, especially oncology.

To generate an algorithm ML uses both fed labeled data also known as supervised learning and unlabeled data also known as unsupervised learning, based on which ML formulates diagnostic, prognostic and therapeutic protocols. A prime example of ML-based application is disease risk stratification. ML-based artificial neural networks on 440 non-small cell cancer had shown 83% accuracy in risk stratification which is far superior to any conventional techniques available.[7] Neural networks have also been used in pathologic diagnosis and grading of several cancers including gliomas, cervical and breast cancer. Data from ML has shown greater accuracy in predicting the survival rate among stage 1 adenocarcinoma patients than conventional tumor grading.[8] Apart from diagnosis and risk assessment, ML is also used to assess the responses to treatment, and to formulate predictive models for post-therapeutic morbidity. ML has been used to generate customized treatment strategies, and to optimize therapeutic dosage in high-risk treatment modalities such as radiation therapy.

ML has also been explored in the field of drug discovery and development. Neural networks are used to predict molecular docking of a test compound into a specified biologic target. ML helps in screening for molecules more effectively and significantly reducing the cost and speed up the research process. Computational cancer biology laboratories have shown the application of ML derived algorithms to predict cell migration patterns in ovarian cancer. ML has also shown success in pharmacogenomics drug classification, cancer subtyping, and identification of predictive and prognostic markers.[9,10] Large-scale artificial intelligence platforms like IBM Watson for oncology, integrate neural networks to process natural language, generate hypotheses, and integrate this information with medical databases to formulate customized recommendations.

Strengths of ML include processing extensive amounts of data at incredible speed, complex nonlinear relationships between variables, and update themselves as new data emerges. Despite the numerous advances, ML incurs several limitations. ML accuracy is relatively inferior in segmenting objects with poorly recognizable boundaries such as parotid glands, submandibular glands and the optic chiasma.[11] Further, as machine learning algorithms get progressively more accurate in analyzing the data, results become less generalizable to the larger population. Other drawbacks include maintaining electronic health records, cost, and acceptance by medical professionals and patients.[12] Though there are several limitations, the role of ML in oncology continues to expand. Steps should be taken to prepare our healthcare systems for the arrival of ML, which will increase research productivity and ultimately improving our ability to diagnose, prognosticate and make treatment decisions and improve patient care.[13]

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