Artificial intelligence in pulmonology

Izya Muriyo

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ABSTRACT

Artificial Intelligence (AI) refers to intelligence incontestable by machines instead of natural intelligence created by animals like humans. Leading AI textbooks outline AI because the studies of "intelligent agents or systems that perceive their surroundings and take actions that increase their possibilities of achieving their objectives. However, outstanding AI researchers reject this definition that uses the term "artificial intelligence" to denote robots that simulate "cognitive" functions that humans connect with the human mind, like "learning and problem resolution." Advanced net search engines (e.g., Google), recommendation systems (e.g., YouTube, Amazon, and Netflix), understanding human speech (e.g., Siri and Alexa), self-driving cars (e.g., Tesla), machine-driven decision-making, and competitor at the best level in strategic game systems (e.g., chess and Go) area unit simply many samples of AI applications. [Requires citation] The AI result could be phenomena that happen as machines grow more adept and jobs believed to need "intelligence" area unit typically eliminated from the thought of AI. Optical character recognition, for instance, is often ignored of AI discussions despite the actual fact that it's become a commonplace technique.

The many sub-fields of AI analysis area unit supported specific aims and also the application of bound techniques. Reasoning, data illustration, planning, learning, linguistic communication process , sensing, and also the ability to maneuver and manipulate objec ts area unit all typical AI analysis aims. One amongst the field's long -run goals is general intelligence (the capability to unravel an y problem). To deal with these problems, AI researchers have tailore d and combined a range of problem-solving techniques, as well as search and mathematical optimization, system of logic, artificia l neural networks, and statistics, likelihood, and social scienc e methodologies. Applied science, psychology, linguistics, philosophy , and a range of alternative disciplines area unit all utilized in AI. Among the recent speedy advancements within the use of compute r science in medication, a slew of analysis demonstrating its utility i n pulmonology. A rising corpus of analysis underlines the relevancy of AI in diagnostic and prognostic imaging for pulmonic disorders, and such technology has the potential to scale back clinicians' burden whereas boosting the speed and accuracy of identification.

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PERSPECTIVE

AI models have incontestable the power to mechanically recognize pulmonic nodules and differentiate between benign and malignant nodules in carcinoma screening. Per a 2018 review revealed in Nature Reviews Cancer, "...studies in Non-Small Cell Carcinoma (NSCLC) used radionics to predict distant metastasis in respiratory organ glandular carcinoma and growth histologic subtypes likewise as illness return, bodily mutations, gene-expression profiles, and overall survival."

In terms of forecasting the onset of pathologic processes and interpreting any test based on pictures, patterns, or numeric data, modern medicine is undergoing a dramatic revolution. The massive amount of technological data generated on a daily basis is difficult for the human brain to handle alone. This is where Artificial Intelligence (AI) plays a crucial role. Although AI was developed in the United States in 1956, it was not until the 1980s that it was used to the field of pulmonary medicine.

The majority of advances in machine learning, which is a subfield of AI, have occurred in the field of imaging. The most common imaging modality that has been tested is Computed Tomography (CT) scan. A multicenter study found that using AI algorithms to evaluate high-resolution computed tomography results in a categorization of fibrotic lung disease with human-level accuracy. Low-Dose CT

Editorial office, Journal of Chest and Lung Research, United Kingdom

Correspondence: Izya Muriyo, Editorial office, Journal of Chest and Lung Research, United Kingdom, E-mail lungresearch@pulsusjournal.com

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(LDCT) is suggested in the United States for persons who are at high risk of lung cancer. A study using three-dimensional deep learning on LDCT to screen for lung cancer found that the AI algorithm not only performed on par with radiologists in certain cases, but also outperformed them in others.

During the recent SARS-CoV-2 epidemic, AI was also used to code CT scans of COVID-19 patients' lungs. Although chest CT scans are very sensitive in detecting lung abnormalities caused by SARS-CoV-2 infection, they lack specificity, resulting in false-positive COVID-19 diagnoses, particularly in individuals with pre-existing lung illnesses. AI has been able to distinguish COVID pneumonia from pneumonia caused by other causes by assisting radiologists. Changes detected on CT scans in severe COVID-19 pneumonia or ARDS have been suggested to improve, persist, or even deteriorate over time. In their clinical practice, pulmonologists and general practitioners are already encountering patients who are post-COVID or who have been on COVID for a long time.

AI can help forecast which patients with a specific cluster of CT scans are likely to deteriorate, allowing prognosis and therapy to be begun earlier in this group of patients. Using an algorithm named Blue Dot; AI also played a key role in the quick detection of the COVID-19 outbreak. By examining travel data from the International Air Transport Association, it was able to forecast early spread. During the early stages of the COVID-19 outbreak, it translated foreign-language news items and official statements that provided advance warnings to avoid hazardous zones like Wuhan.

The use of AI in pulmonology has recently expanded to include cytopathology. During an endobronchial ultrasonography Tran’s bronchial needle aspiration operation, an AI model based on an open-source convolutional neural network was able to categorize on-site cytology samples. The adoption of this approach in practice would assist bronchoscopists in determining not only if they have sampled the target lesion but also in predicting the ultimate histologic diagnosis. The original red–green–blue pattern of bronchoscopic pictures was changed to hue–saturation–value texture in a small group of lung cancer patients. Using these bronchoscopic pictures, a computer-aided diagnosis system was able to distinguish between lung cancer subtypes. The application of AI during bronchoscopy might benefit those patients who are categorized as malignant by machine learning and deep learning algorithms, allowing for more accurate diagnosis.

Another area where AI is assisting clinicians is in the assessment of lung physiology and signs of aberrant respiratory function. The interpretation of a Pulmonary Function Test (PFT) is subject to a number of acceptability and repeatability requirements. PFTs are essentially numerical values of several factors related to respiratory function that may be analyzed using machine learning. Inter-rater agreement among pulmonologists has been shown to vary in several investigations. In the accuracy of reporting PFTs, an AI-based method outperformed pulmonologists.

Polysomnography (PSG) entails the measurement of a wide variety of physiologic signals as well as a thorough examination of sleep quality factors. The vast amounts of data linked with each study necessitate the use of dedicated personnel. The application of AI in this field has sparked a lot of attention. A position paper on this topic has also been published by the American Academy of Sleep Medicine. Because they are electrical signals that can be represented as an array of numbers, they are well-suited for machine learning techniques to be used for reporting. With reasonable sensitivity and specificity, a deep-learning network classified respiratory episodes in PSG.

AI has the ability to interpret complex interrelationships between variables and outcomes that are beyond the reach of traditional statistics and mathematics. Its application in the healthcare sector is still in its infancy. To create a database on which an algorithm can be trained, a huge amount of individual patient data is required. This raises the issue of data privacy, which has given rise to the discipline of AI ethics. Other stakeholders, such as law and policymakers, are involved in governing the usage of all the raw data, in addition to scientists. A defective algorithm output is cause for concern, especially if it is being utilised on a large number of patients. We need to think of AI as a friend who can help us minimize our burden and guide us through difficult clinical circumstances, not as a more clever competition targeted at replacing human contribution. A doctor's human touch, which is an important aspect of medicine, can go a long way in treating a patient who cannot be replaced by machines.

The issue of generalizability/transferability of models is one of the technology's present limitations. Algorithms developed with data from one hospital may not work as well in another or on scanners with different characteristics. One technique to deal with the problem is to use a diverse and representative set of photos while training these algorithms. Because of patient privacy concerns, combining data from several organizations is difficult, but there is a lot of study being done in this area to assure that it can be done safely. For instance, federated learning is a way in which data is kept within the company and only the model weights are shared, so no patient-specific information is shared.

Many difficulties exist, including data quality and research design: The validity of results can be questioned if they are not based on high-quality, curated data with the best possible ground truth and meaningful, well-designed research questions. Another difficulty is data diversity; if it is limited, the generalizability of AI models would suffer. The third challenge is the inherent complexity of lung diseases, which often results in overlapping imaging patterns (for example, many different diseases presenting as the same imaging pattern), as well as the coexistence of different diagnoses, which can result in a variety of patterns in the same patient at the same time.

As a result, AI systems that rely purely on imaging are unlikely to be able to replace an astute physician's integrated reasoning and judgement in the near future. For accurate diagnosis and appropriate patient management, the integration of knowledge and multiple sources of information, as well as longitudinal monitoring of patient data across time, will remain critical.