Radiologist's Role in Artificial Intelligence Era

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ABSTRACT

Artificial intelligence (AI) in radiology is recently a rapidly growing subject. Much literature about AI in radiology has been launched within 5 years, as well as commercial AI companies. This phenomenon makes some old radiologists feel worried about losing their jobs, and junior doctors hesitate to choose radiology as a specialty. Currently, implementations of proprietary AIs in clinical practice are limited, with a default setting for a convenient human overwrite. The AIs in clinical imaging largely remain either investigational as part of clinical/pre-clinical trials or being developed for commercialized purposes. Radiologists have an important role in all AI processes from the beginning to the end and vital in training the machine, as well as to validate its added benefit for outcome prediction/prognostication. This article will discuss the importance for radiologists to develop, implement, and monitor AI in clinical imaging, together with some ethical considerations. We would like to encourage radiologists to use AI as an adjunct tool, to save time and have better performance.

Keywords: Artificial intelligence; performance; radiologist; radiology (Siriraj Med J 2022; 74: 891-894)

INTRODUCTION

Artificial intelligence (AI) is a human intelligence simulation on a computer. AI has been applied in many industries, including medicine. Generally, AI means that a computer can think and learn. Machine learning is a more advanced AI subset, and deep learning is a form of machine learning that model patterns in data as a complex, multilayered network. The advanced deep learning technique mimics the human brain behavior as we call neural networks. One of the famous neural networks is the convolution neural networks (CNN) used for complex tasks, such as pattern recognition, object detection, image segmentation, and other image processing-based problems, especially for medical data analysis.[1] However, this article used the term "AI" instead of "CNN", because of its familiarity.

Radiology is among the three recent major signs of progresses in AI apart from dermatology and robotics[2] because a major task in radiology involves many images.[3] AI does not only interpret images but also can help in many radiology workflow steps, e.g., scheduling, reporting, and billing.[4] However, most literature about AI in radiology have studied image interpretation task.[5] Literature related to implications of AI in radiology has been presented since 1994[1] and has been rapidly growing since 2018.[6] Performing AI in radiology looks promising. Rodriguez-Ruiz et al.[7] reported that AI had comparable accuracy with breast radiologists in breast cancer screening. This result causes anxiety among radiologists, as well as junior doctors that AI may replace them shortly.[6] This review aims to explain the importance of radiologists' role in AI production and implementation, the current situation, the process of working with AI, and its ethical considerations.

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Radiologists' roles in AI development

AI development uses a dataset with the diagnosis results from an expert, called "ground truth", regarding the systemic approach of a product that includes input, process, output and feedback. There are two sets of data, namely, (1) the training dataset to train the AI and (2) the testing dataset to evaluate the output. Supervised and unsupervised learnings are two AI training methods.[8] Nowadays, supervised learning is used in radiology.[1] The computer receives labeled data and learns and predicts the new input labels in supervised learning. The labeled data require radiologists to label, and its quality depends on the labeling of radiologist as such.[9] Other datasets, including validation and test sets, are fed again to validate after finishing the learning process. External validation by independent cohort and from real-life data from several institutions is advised.[10] Wataganara T.[11] suggested to supervise AI by human experts to minimize the overt sensitivity and false positive results. AI performance needs radiologists to also give feedback. This training method is dependent on the amount and variability of the labeled data. The more data, the better the performance, but with extensive labor as the drawback. The variability of labeled data has two meanings. First is the population variability in which the training images for a given task may be biased because of the sampled population.[12] Its generalizability also requires confirmation from radiologists. Second, labeled data quality variability, particularly, the quality of the image that is produced by different techniques or machines. This type of variability makes an unnecessary complexity for the computer to normalize data.[9] Unsupervised learning learns the dataset on the basis of data patterns without using ground truth and as in the developmental process.[13] Hybrid learning that uses partially labeled data and unlabeled data is the other future option.[11]

Radiologists' roles in AI implementation

AI has various vendors in the market.[14] Radiologists are the key persons who select the choices; however, they should listen to their administrators because it increases hospital costs. Additionally, information technology supports should be available. Moreover, one dataset is used to train limited specific tasks.[3] Thus, AI cannot detect uncommon diseases or other tasks.[15] As implied, hospitals will have higher costs for multiple tasks and radiologists will have time for the other tasks. A single AI application for multiple tasks has been scantly reported.[16] Concerning AI performance, radiologists should confirm AI results at the initial AI software implementation in their departments and continue monitoring.[17] Additionally, AI cannot correlate the exam with the patients' clinical results as radiologists can.[12] Hence, AI should be used in simple tasks but high in quantity while radiologist works on more sophisticated tasks. Hence, radiologists will have more time to pay attention to clinical correlation and interact with patients[18] and have more personalized imaging. Contrastingly, some hospitals cannot afford the cost of AI, especially in developing countries where radiologists' fee are not too high. Hospital administrators have to compare hiring human radiologists and AI cost-effectiveness.

Current situations

The four tasks of AI in diagnostic radiology include image classification, object detection, semantic segmentation, and instance segmentation[11], e.g., liver mass classification, microcalcification detection in mammography, and brain structure segmentation.[3] AI has been applied in radiological practice in various fields and modalities. Computed tomography (CT), magnetic resonance imaging, and plain radiographs are the most common modalities, whereas ultrasonography (US) and mammography are the least.[19] The operator-dependent styles and the lack of standardized US images are the major causes of slower AI progression in US than the other modalities.[20] The two most common fields are neuroradiology and chest radiology.[5] Regarding chest radiology, both radiographs and CT are interesting in the market because chest radiographs are the most common imaging in the hospitals, especially in the coronavirus disease-2019 (COVID-19) infection era.[21-23] Additionally, the amount of lung involvement in patients with COVID-19 for treatment planning and prognosis prediction is important for AI to have higher and faster accuracy in calculation.[21] Much AI research has launched recently; however, a few researchers have tested AI systems in real-world clinical settings,[16,24] and research about AI's true benefits to patients has not been exactly explored.[14]

Patients preferred AI in other areas than in medicine. Among medicine, some specialties were more trusted than others depending on subject areas and patient demographics. Dermatology received slightly more trust than radiology and surgery, whereas women, lower-educated persons, and non-Western immigrants showed less trust in AI.[2] In the radiologist community, those who preferred AI and who came up against it, talk about the same topic but different aspects. Radiologists who liked AI, are interested in the AI capabilities, whereas radiologists who disliked AI focused on ethical and legal aspects.[25] However, radiologists would like to know the training methods for AI and the standard used for

them give more trust to AI. This means to change AI to explainable/interpretable AI or to turn a black box into a glass box. Instead, the recent experiment found that seeing the model's prediction had no effect on people's behavior or might have adverse effects due to information overload.[26]

How to work with AI

Radiologist workflow usually begins with searching for abnormalities, interpreting the lesion, and making a tentative diagnosis. Diagnostic errors may occur at every step. The workflow could change in the presence of AI. Some radiologists use AI for the initial lesion detection and confirm the AI diagnosis if there is no discordant conclusion. Other radiologists work the same as they usually do and with AI to finally make sure that they do not miss any lesions. In other words, humans confirm AI or AI confirms humans. Both ways waste more time than radiologists alone, especially when conflicts occur between AI and humans. Surprisingly, literature has shown that the reading time decreased when the results were normal and increased when the results were abnormal.[14] Nevertheless, most radiologists were satisfied with AI assistance although it prolongs their report time.[16] Do remember, automation bias may occur and their skills may decline with regularly AI use[24], especially students who may lose the ability to learn.[10] Sand et al.[24], reported that radiologists should mention the sensitivity and specificity of AI systems in their reports, and the use of AI tools as well as its version should be mentioned in the patient's file.[10]

Ethical and legal considerations

The law about AI in radiology practice is not available yet.[1] Only half of the commercial AI has been approved by the Food and Drug Administration or Conformite Europeenne.[19] During mistakes, the responsibility of radiologists, administrators, or AI product providers is questioned. Generally, administrators and radiologists should share their ideas when selecting AI software, set steps for using AI, and define who takes the responsibility in each step before applying AI in routine practice. Biases should be considered because they can occur in all stakeholders.[27] AI developers want to make a profit and want their systems to be commercially used. Administrators may like the cheapest AI and thus pay less attention to AI performance. Researchers want their research to be published and may put result biases. Some radiologists, especially in areas with radiologist shortages, who have work overload may be happy to welcome AI to help with their work. Other radiologists who have a high income and high prestige in the hospitals would not prefer AI to share their situations. Both radiologist kinds may have biases on AI either support or blockage. Di Basilio et al.[23], demonstrated that the individuals who obtained direct on-the-job training on AI, had positive opinions on the use of AI. The regulatory approval process should be discussed and implemented at both the local and national levels. A recent proposal for the use of AI among French radiologists suggests that AI can be used to assist radiologist decision-making but not replace it.[10] Radiologists use AI to save time and enhance their performance.

CONCLUSION

Radiologists play important roles in both AI development and implementation. AI can imitate the human brain and thought, but it has no feeling like humans, which is an important part of patient care. Therefore, AI cannot replace the radiologist who uses it, but it may replace the radiologist who does not. Radiologists should be familiar with AI and let them help in their routine practices.

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