

# Artificial intelligence in radiology education

## Abstract

**Objectives:** Artificial intelligence can learn without explicit instructions and has multiple applications in radiology. Whereas many publications have focused on teaching radiologists about artificial intelligence, our goal in this study is to focus on how artificial intelligence can teach radiology trainees better.

**Key Findings:** Although the idea of using artificial intelligence to improve education is not new, the application of artificial intelligence to radiology education remains limited. Based on the limited research that has been published on its current status we highlight some of the developments that have occurred in this field.

**Conclusion:** Artificial Intelligence can be used to enhance radiology education.

**Implication for practice:** Radiologists and radiographers should know the latest trends in Artificial Intelligence to utilize in departmental education.

**Keywords:** artificial intelligence, radiology, education

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**Abbreviations:** AI, artificial intelligence, ARIES, adaptive radiology interpretation and education system

## Background

Artificial intelligence has changed radiology in multiple ways. There is an increasing consensus that radiology education for residents and medical students should include understanding artificial intelligence. While there are many papers on educating radiologists about the use of artificial intelligence the purpose of this review article is instead to focus on the use of artificial intelligence for radiology reeducation of residents and medical students. There are very few articles published on this particular topic.

Artificial intelligence is a computer system that can emulate human performance for a particular task without being programmed for the task. In radiology, artificial intelligence has been widely applied for abnormality detection, anatomic segmentation, image quality assessment, and natural language processing. Artificial intelligence has been used in education but not significantly in the field of radiology education. AI has been utilized to forecast student performance and dropout rates. AI applications to radiology education are significantly limited and there is much scope for research in this particular field. Few publications were found on Pubmed and Google Scholar on this topic. Most of the published literature is not exclusively focused on this topic and is actually general papers on Artificial Intelligence with a few words on this particular application of Artificial Intelligence.

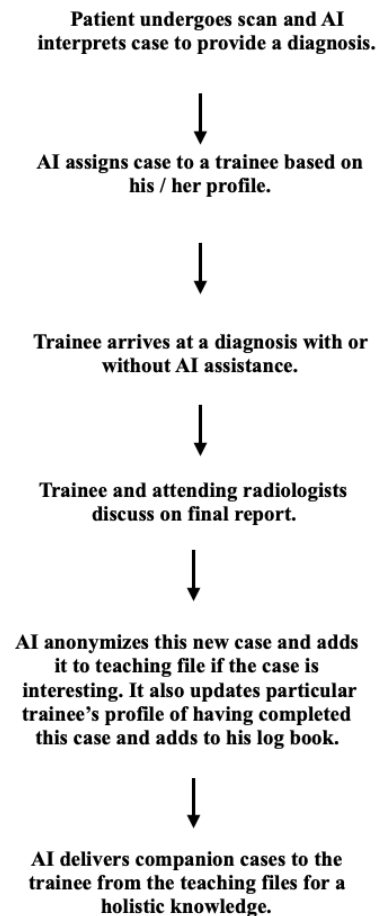
Here we explore the potential use of artificial intelligence in the education of radiology residents and fellows.

## Main text

### Precision radiology education

Duong et al, describe a term called “precision medical education”<sup>1</sup> that is a potential utility of artificial intelligence to give customized knowledge to the radiology trainee based on his abilities and prior knowledge. For example, a trainee encounters an MRI of a patient or simulated case with a lesion in the liver showing restricted diffusion and T2 hyperintensity. He or she generates a differential diagnosis based on his knowledge and interpretive skills. The artificial intelligence then compares the trainee’s differential diagnosis with the

actual differential diagnosis and gives feedback to the trainee. The algorithm can get even more complex when artificial intelligence also compares the trainee’s description of the findings with the standard description of such a lesion and gives appropriate feedback. The AI can also prompt the trainee on the findings that were missed. (Figure 1)



**Figure 1** Algorithm for AI application in Radiology trainee education.

The artificial intelligence can also sort out the daily caseload based on the complexity of the case and assign it to trainees based on their year of training. This can lead to medication distribution of resources and education.<sup>2</sup> Also, the number of cases per trainee allotted can be determined based on the trainee's years of experience and year of education. Specific "must-see" cases can be assigned based on rotations to reduce inconsistency in individual training experiences. For example, all trainees need to know and diagnose pneumothorax, appendicitis, and fractures. An equal distribution of such cases by artificial intelligence daily will ensure homogeneity in the training of all the residents. Case-based educational resources can be provided by artificial intelligence based on the diagnosis of that particular case, thus reducing the time and effort to search for those resources and better utilizing time for learning those resources.

### Bottoms Up approach to learning

Bottoms Up approach is when students get firsthand experience with the cases by diagnosing the cases themselves. Whereas the top-down approach is when the attending diagnoses the case and then teaches the students the relevant learning points. The bottom-up approach is a better learning tool for radiology trainees.<sup>3-5</sup> Similar to an attending physician the artificial intelligence can select and assign cases to the residents based on their rarity and complexity and then use them for teaching the residents. These systems have been present for a few years, often termed "intelligent tutoring systems".<sup>6</sup> In one study, it was found that US residents spent about 24 minutes reviewing a brain MRI and creating a report, and AI supervision may assist in optimizing time spent.<sup>7</sup> AI can reduce the time to diagnosis and increase the number of cases studied per day by the resident thus improving his knowledge base and decision-making skills.

### High and low-level supervision

Artificial intelligence can provide low-level education whereas attending physicians will provide high-level supervision. Artificial intelligence can customize low-level learning experiences with trainees. For example, it can provide similar case reports to the trainee radiologist, relevant to the case that the trainee is seeing, in addition to relevant clinical literature and normal quantitative measures such as normal size, volume, and lesion count. This is called "intelligent navigation". Automatic updates to the trainee's logbook and an assessment of the trainee's skills by analyzing the logbook can also be done by artificial intelligence.

For high-level training, the residents can still do direct FaceTime with the attending radiologist however they can now focus only on the refined knowledge that Artificial Intelligence did not provide. This will lead to better utilization of time both for the residence and the attending radiologist.

Alternately artificial intelligence can provide basic knowledge to residents at home, whereas attending radiologists can then focus on real-time case-based training. This is called flipped learning.

### Creating teaching files using artificial intelligence

Teaching files are a very important part of radiology education and are a must in the radiology libraries of teaching hospitals. However, maintaining and creating new content in these files are labor-intensive. Also sorting out interesting and rare cases and then curating those files so that they can be used as a teaching file later takes a lot of time. Using artificial intelligence these files can be sorted and curated automatically which then can be used by residents. Also, a real-time search through these files can be done if they are created by artificial intelligence. Artificial intelligence can also selectively assign

these teaching files based on knowledge of the prior experience of a particular resident, thus making sure that all the residents get to see all the teaching files and that there is no repetition or omission.

### Recent implementations

Some artificial intelligence algorithms have been developed which are currently being used for radiology resident education. An example is Adaptive Radiology Interpretation and Education System (ARIES). This is an open-source software developed at the University of Pennsylvania as a tool for combining imaging and clinical features to arrive at a diagnosis. The radiology resident gets the probability of the differential diagnosis based on clinical features and radiological features separately and then can decide on the final diagnosis based on both. Although not an entire artificial intelligence software it is a significant step toward radiology education using artificial intelligence.

### Conclusion

Recent development in artificial intelligence demonstrates its ability to augment radiology resident education. There are various ways in which artificial intelligence can enhance radiology education. Artificial intelligence is especially helpful in providing customized learning to individual student needs. Some of them have been highlighted in the article above. This is an area of new research and significant future development as Artificial Intelligence becomes a part of our daily lives.

Artificial intelligence (AI) has the potential to assist radiologists in their work, but it is unlikely to completely replace them. Radiologists are trained medical professionals who have a deep understanding of medical imaging and the ability to interpret the results. AI, on the other hand, can be used to analyze medical images and make suggestions, but it relies on the expertise of radiologists to make final diagnoses.<sup>8</sup> AI can help radiologists by analyzing images quickly and accurately, which can save time and improve the efficiency of the diagnostic process. It can also help identify patterns and abnormalities that may be missed by human radiologists, which can improve the accuracy of diagnoses. However, AI is not yet advanced enough to completely replace the expertise and judgement of radiologists.

Additionally, AI systems need to be trained on large amounts of data and be constantly updated to improve their performance, which requires radiologists to be involved in the development and validation of the AI models.<sup>9</sup>

Therefore, AI is seen as a tool that can assist radiologists in their work, but it is not currently advanced enough to replace them entirely.

### Competing Interests

"The author has no relevant financial or non-financial interests to disclose."

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