



## Artificial Intelligence in Radiology and the Growing Applications of Medical Imaging



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Artificial intelligence (AI) in the field of radiology has seen rapid growth, with the success of deep learning. The use of computed tomography (CT), magnetic resonance imaging (MRI), nuclear medicine, and picture archiving and communication systems (PACS) is just a few examples of how computers have changed diagnostic imaging. With the advancement in deep learning, AI systems are now able to recognize and localize complex imaging patterns from different radiological modalities. In certain applications, their performance is now comparable to that of human experts. This has sparked a lot of interest in using AI to improve radiology workflow, increase productivity, and attain more consistency in diagnosis [1].

Chest X-rays (CXRs) are among the most frequently requested imaging studies worldwide. However, overlapping structures and subtle disease patterns make interpretation difficult. The release of large-scale datasets like CXR14, CheXpert, MIMIC-CXR, and PadChest has significantly accelerated the development of AI-based systems. These datasets were obtained from PACS archives and radiology reports and used to train convolutional neural networks (CNNs) for disease classification and localization tasks [2-4].

AI has also proven to be a valuable tool in pulmonary analysis in CT imaging. Deep learning has made significant strides in automated lung, lobe, and airway segmentation. Previous segmentation methods did not perform well in pathological cases with nodules, consolidations, or fibrosis. However, deep-learning methods had high segmentation accuracy even in severe pathological cases. AI is also proving to be useful in the recognition of interstitial lung disease (ILD) patterns. ILD interpretation can be subject to variation among observers, which automated systems can address to be more consistent and accurate [5]. It has been demonstrated that deep-learning models can identify patterns, like ground-glass opacity, consolidation, reticulation, and honeycombing, in CT scans. These imaging features were subsequently highly significant during COVID-19, when a lot of COVID-19 patients had similar appearances on imaging [6]. Analysis of pancreatic cancer shows the problems and possibilities of automated imaging systems. The anatomy of the pancreas is very variable and, therefore, difficult to segment even for the most experienced radiologists. The recent techniques based on deep learning have outperformed traditional segmentation methods for pancreas segmentation. AI systems have also been developed for pancreatic tumor detection and segmentation, such as pancreatic ductal adenocarcinoma (PDAC) and pancreatic neuroendocrine tumors (NET). Beyond that, deep-learning models have also been looked into for the prediction of tumor growth and prognosis evaluation. These predictive methods can aid physicians in treatment planning and patient management [7, 8].

AI applications in pelvic imaging have been primarily focused on fracture detection. Pelvic and hip fractures are extremely common and can lead to serious complications if not diagnosed. Diagnostic errors can occur because pelvic X-rays are difficult to interpret and complex. AI models based on large amounts of data outperformed radiologists in detecting hip



fractures. Further research broadened these systems to enable widespread detection of pelvic fractures. Global to local CNN approaches were effective in localizing fracture patterns while taking into account the entire pelvic radiograph. The advancements suggest that AI could be a valuable tool in emergency and trauma situations. One of the other developments is universal lesion analysis (ULA). Unlike other organ/lesion detection and classification methods, ULA attempts to detect, classify, segment, and quantify lesions across the body. With the help of AI, systems based on CNNs are now able to detect various types of lesions in different parts of the body. Applications include lesion detection, segmentation, RECIST measurement, lesion classification, and retrieval of similar lesions from databases [9-11].

While significant advances have been made, there are also several restrictions. Labels obtained via NLP from radiology reports are required in many datasets and may contain incomplete or inaccurate labels. More detailed and extensive datasets are required to further improve the generalizability across populations and imaging systems. Further research is needed for challenges of explainability, robustness, and clinical integration as well [12]. AI has the potential to transform radiology by increasing efficiency, reducing burden, and improving consistency. AI systems must be further developed in collaboration with radiologists to ensure their reliability and meaningful integration into medical practice.

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