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LETTER TO THE EDITOR

The future of diagnosis: artificial intelligence and advancing technologies in radiology

Tanıların geleceği: radyolojide yapay zeka ve gelişen teknolojiler

Ahmet Bozer[1]

[1]Bozyaka Educatıon and Research Hospital, İzmir, Turkiye

To the Editor,

We are at the cusp of a revolutionary transformation that is shaping the future of medicine, with artificial intelligence (AI) and advanced technologies exerting a significant influence on the field of radiology. These developments redefine our understanding of human health and fundamentally reshape and improve the processes of diagnosis and treatment. This article delves into the impact of technologies that enhance the accessibility of radiology to a broader population and provide healthcare professionals with faster and more precise access to information. By concentrating on this exciting transformation within the healthcare sector, we aim to provide insights into the future of diagnostics.

Radiology plays a pivotal role in various facets of medicine, including diagnosis, treatment planning, disease monitoring, surgical assistance, and research. Technological advancements and digitalization in this field have resulted in improved image clarity, streamlined sharing of images, and increased access to radiology through portable imaging devices. Moreover, the integration of AI into radiology significantly contributes to tasks such as swift image analysis, tumor and lesion detection, treatment planning, patient monitoring, and data analysis. Consequently, medical services have become more efficient, leading to enhanced patient care.

AI, a field that seeks to mimic human-like intelligence and learning processes, utilizes various algorithms, among them deep learning, which involves complex data processing through artificial neural networks[1]. AI algorithms encompass mathematical methods and computational processes utilized for data analysis, prediction, recommendation, and automated decision-making.

In radiology, AI employs a spectrum of learning techniques for image processing and analysis. Convolutional Neural Networks (CNNs) excel in processing image data and are commonly employed for tasks such as lesion detection, diagnosis, and the identification of pathological regions. Recurrent Neural Networks (RNNs) prove valuable for processing sequential data, especially in tasks like time series analysis, such as patient tracking. Deep Transfer Learning Models enhance performance by transferring knowledge acquired from pre-trained large datasets to new radiological data, particularly in scenarios with limited labeled data. Learning-based segmentation techniques are used to identify specific structures or regions within an image, known as image segmentation. Additionally, Recursive Deep Learning is applied to detect and characterize complex patterns within image or audio data[1]. In radiology, AI integrates these methodologies to expedite screening and diagnostic processes, minimize errors, and ultimately achieve superior outcomes. These techniques find application across a range of radiological practices, including medical imaging, radiotherapy planning, patient monitoring, and various clinical applications.

AI was first applied in radiology in 1992 for identifying microcalcifications in mammography, a technology commonly known as computer-aided

Address for Correspondence: Ahmet Bozer, Bozyaka Educatıon and Research Hospıtal, Department of Radiology, İzmir, Turkey E-mail: drahmetbozer@gmail.com
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detection (CAD)[2]. It wasn't until approximately the mid-2010s that it began to be considered as a potential solution to the everyday challenges faced by radiologists, such as high workloads[2].

Currently, AI technology achieves success levels comparable to those of expert radiologists. It demonstrates high success rates in various medical applications, including early diagnosis, treatment monitoring, response assessment, surgical selection, post-surgical radiological monitoring, and the detection of residual or recurrent tumors. Extensive literature documents these achievements[3,4]. Moreover, studies indicate that AI successfully determines the molecular subtypes and grades of tumors[5]. AI eases the workload of radiologists in emergency situations and plays a crucial role in saving lives by rapidly delivering accurate results[6].

The utilization of AI in radiology presents important challenges, including data privacy, data representativeness, explainability, cybersecurity, and human factors[7]. Protecting sensitive patient data, addressing gaps in data representativeness within AI algorithms, resolving explainability issues, and ensuring the up-to-date nature of algorithms pose ethical and practical challenges. However, by diligently addressing these challenges, we can better harness the potential of AI in radiology.

The rapid expansion of healthcare data, projected to increase by 36% annually by 2025, presents both opportunities and challenges[8]. AI is considered a critical solution for handling this surge in data. Collaboration between radiologists and the industry holds immense promise. Looking ahead, there is an expectation of reduced burnout for radiologists as AI-driven, data-centric approaches become more widespread. Although the potential for AI in radiology is immense, it is currently in its early stages, mainly focused on optimizing various aspects of the radiology workflow. The ultimate impact of AI might initially revolutionize diagnostic strategies before directly influencing therapeutic decisions, potentially resulting in more efficient biomarker detection in the future.

In conclusion, the transformative impact of AI on radiology, as highlighted in this article, extends across a broad spectrum from emergency cases to chronic diseases and oncological conditions. The documented successes underscore the critical role of ongoing research in this field, emphasizing its paramount importance in enhancing diagnostic accuracy, saving lives, and providing improved services to healthcare professionals. Looking ahead, we recommend that future studies concentrate on the key areas identified in our discussion. Firstly, the continued refinement of AI algorithms should aim to further enhance image analysis speed and accuracy. Secondly, exploring robust solutions to address concerns regarding data privacy and explainability in the integration of AI in radiology is essential. Finally, we emphasize the importance of a multidisciplinary approach in AI studies within healthcare. By incorporating these suggestions into future research endeavors, we can collectively contribute to the foundational elements shaping the future of the medical world.

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