Trends in Artificial Intelligence in Medical Imaging

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INTRODUCTION

- Artificial intelligence (AI) is increasingly integrated into healthcare, particularly in medical imaging, where machine learning (ML) enhances diagnostic accuracy, streamlines workflows, and reduces human error. As AI adoption grows, it is essential to evaluate whether current imaging practices align with best practices from other AI-driven fields and remain effective in optimizing patient outcomes.

- Medical imaging has particularly benefited from AI advancements, with ML algorithms playing a crucial role in pattern detection and the quantification of imaging characteristics. These technologies aim to enhance diagnostic accuracy, streamline healthcare workflows, and reduce human error. However, as AI adoption grows, it is critical to assess whether current imaging practices align with best practices from other AI-driven fields and whether they remain effective in optimizing patient outcomes.

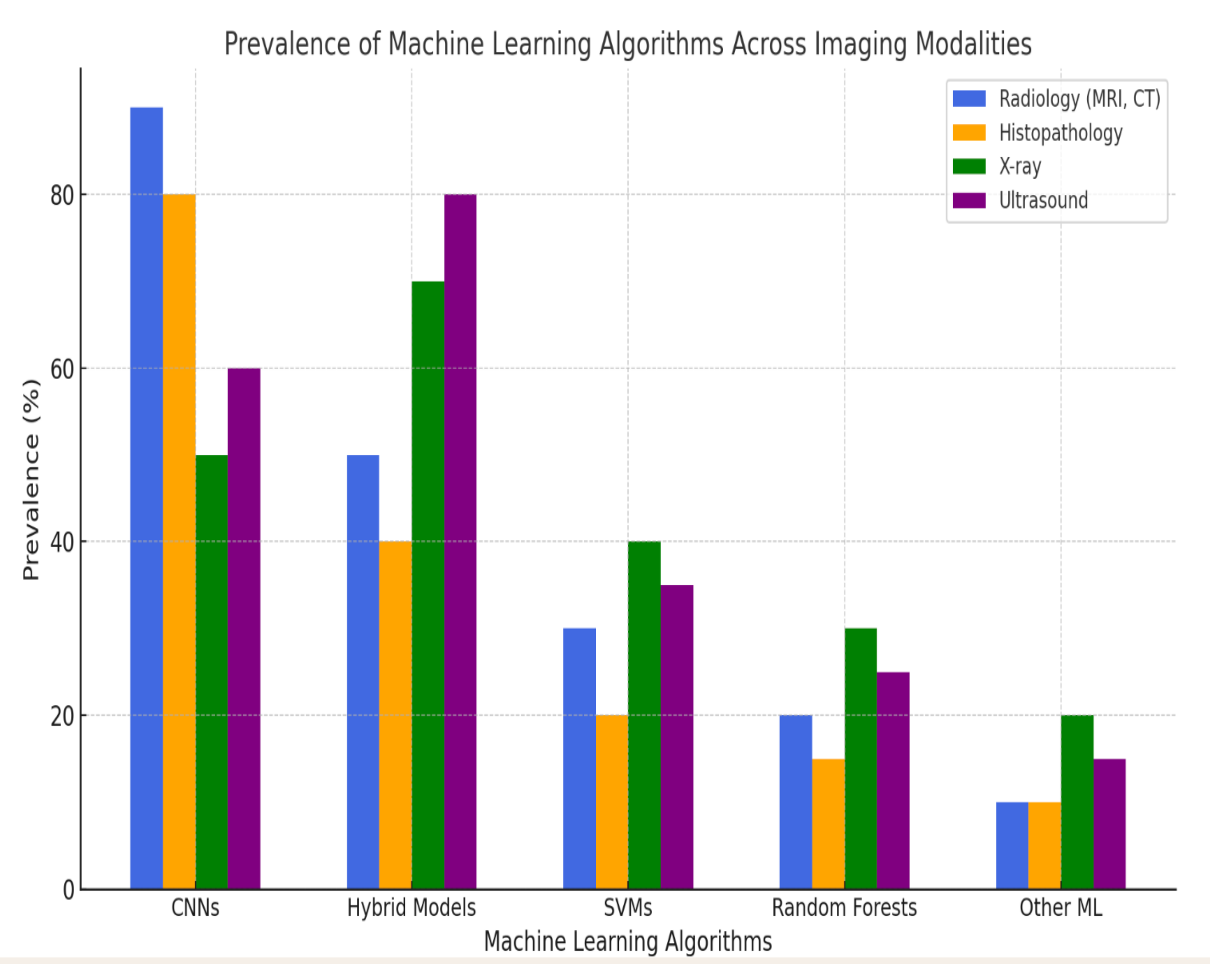
AIMS and OBJECTIVES

- This study explores how AI is applied in healthcare, particularly in medical imaging, by identifying the types of problems it addresses. It seeks to understand which algorithms are commonly used, why they are preferred, and how they compare to AI used in other areas of medicine and beyond.
- By mapping trends in AI-driven medical imaging, this research will highlight the most prevalent algorithms and their effectiveness. The findings may help optimize AI applications, improve diagnostic accuracy, and provide insights into best practices for integrating AI into medical imaging.

METHODS

- A scoping review of peer-reviewed articles (2019–2024) was conducted.
- Studies analyzing AI applications in MRI, CT, X-ray, or ultrasound were included, while those lacking imaging focus or performance metrics were excluded. Data extraction covered algorithm types, diagnostic applications, performance metrics (accuracy, sensitivity, specificity), and key challenges. Findings were synthesized to map trends in AI-driven medical imaging.

Figure 1: Prevalence of Machine Learning Algorithms in Medical Imaging



RESULTS

- Convolutional neural networks (CNNs) are the most widely used ML algorithms in medical imaging, excelling in MRI, CT, and X-ray analysis. Recurrent neural networks (RNNs) aid in time-series imaging, while support vector machines (SVMs), random forests, and decision trees are applied in classification and feature selection. Generative adversarial networks (GANs) are gaining traction for image enhancement.
- Algorithm prevalence varies by modality—CNNs dominate MRI and CT, while hybrid models are effective in X-ray imaging. Deep learning is increasingly adopted for ultrasound interpretation. CNNs achieve 80–95% accuracy in detecting pathologies, but challenges such as data bias, generalizability, and the need for large annotated datasets persist.

CONCLUSION

- Neural networks, particularly CNNs, are the most prevalent AI approach utilized in medical imaging. The adoption of these models varies by imaging modality, with CNNs demonstrating superior performance in high-resolution scans such as MRI and CT, while hybrid models are emerging as effective solutions for X-ray and ultrasound imaging. Despite their widespread use, challenges such as the requirement for extensive datasets, potential algorithmic bias, and concerns regarding interpretability persist. Future research should focus on enhancing model transparency, mitigating bias, and developing robust training datasets to improve the reliability and applicability of AI in medical imaging.

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Table 1: Summary of AI Algorithms in Medical Imaging

Algorithm Type	Primary Applications	Common Imaging Modalities	Reported Accuracy Range
Convolutional Neural Networks (CNNs)	Image classification, segmentation, anomaly detection	MRI, CT, X-ray	80 - 95%
Recurrent Neural Networks (RNNs)	Time-series analysis, sequential image interpretation	Ultrasound, dynamic MRI	75% - 90%
Support Vector Machines (SVMs)	Classification, feature selection	X-ray, MRI	70% - 85%
Random Forests, Decision Trees	Feature selection, classification	Various	65% - 85%
Generative Adversarial Networks (GANs)	Image enhancement, augmentation	MRI, CT, Ultrasound	Varies by application