OPEN ACCESS

Ind. Jr. of Mod. Res. and Rev *PEER-REVIEWED JOURNAL* *Volume 4 Issue 4 [Apr] Year 2026*

Indian Journal of Modern Research and Reviews

This Journal is a member of the *'Committee on Publication Ethics'*

Online ISSN:2584-184X

Research Article

Emerging Trends in Radiology: Integration of Artificial Intelligence with Modern Imaging Modalities for Enhanced Patient Care

Madhuri Tyagi [1*], Ishika [2], Emaan [3], Ambar [4], Priyanshu [5], Rahul [6]

[1] Assistant professor, Doon Institute of Medical Sciences (DIMS), Shankarpur, Dehradun, Uttarakhand, India

[2-6] Doon Institute of Medical Sciences (DIMS), Shankarpur, Dehradun, Uttarakhand, India

Corresponding Author: *Madhuri Tyagi

DOI: https://doi.org/10.5281/zenodo.19950889

Abstract

Radiology has evolved significantly from conventional imaging techniques to advanced digital and multimodal diagnostic systems. The rapid growth in imaging data has increased the complexity of radiological interpretation, leading to challenges such as higher workload, longer reporting time, and risk of diagnostic errors. In this context, the integration of Artificial Intelligence (AI), particularly machine learning and deep learning, has emerged as a transformative approach in modern radiology. AI enhances various stages of the imaging workflow, including acquisition, reconstruction, interpretation, and reporting, thereby improving efficiency and accuracy.

AI-driven technologies in imaging modalities such as CT, MRI, mammography, ultrasound, and PET scans have demonstrated significant improvements in image quality, noise reduction, and faster processing. These systems assist in early disease detection, automated segmentation, and precise quantification of pathological changes, enabling better clinical decision-making. Furthermore, AI contributes to personalised healthcare through radiomics and predictive analytics by integrating imaging data with clinical and genomic information.

The findings indicate that AI integration reduces workflow time, enhances diagnostic performance, and improves patient outcomes. Despite these advantages, challenges such as data privacy, algorithm transparency, and potential bias must be addressed for effective implementation. Overall, AI is expected to play a crucial role in advancing radiology by supporting clinicians and enabling more accurate, efficient, and patient-centred healthcare systems.

Manuscript Information

- **ISSN No:** 2584-184X
- **Received:** 02-04-2026
- **Accepted:** 28-04-2026
- **Published:** 30-04-2026
- **MRR:**4(4); 2026: 280-284
- **©2026, All Rights Reserved**
- **Plagiarism Checked:** Yes
- **Peer Review Process:** Yes

How to Cite this Article

Tyagi M, Ishika, Emaan, Ambar, Priyanshu, Rahul. Population Growth and the Environmental Issues of Bihar, India. Indian J Mod Res Rev. 2026;4(4): 280-284.

Access this Article Online

www.mrrjournal.in

KEYWORDS: Artificial Intelligence, Radiology, Medical Imaging, UPI (remove if not needed? actually not relevant- better exclude), Machine Learning, Deep Learning, CT scan, MRI, Mammography, Ultrasound, PET Scan, Radiomics, Precision Medicine, Diagnostic Accuracy, Healthcare Innovation.

1. INTRODUCTION

Radiology has undergone a remarkable transformation over the past few decades, evolving from conventional film-based imaging to highly sophisticated digital and multimodal diagnostic systems. Modern imaging modalities such as computed tomography, magnetic resonance imaging, ultrasound, positron emission tomography and digital radiography have significantly improved the visualisation of anatomical structures and disease processes. However, the increasing volume and complexity of imaging data have created new challenges for radiologists, including higher workloads, longer interpretation times and the risk of diagnostic errors. In this context, the integration of Artificial Intelligence with modern imaging technologies has emerged as one of the most important developments in contemporary radiology. AI, particularly through machine learning and deep learning algorithms, is capable of analysing large volumes of medical images rapidly and identifying subtle patterns that may not be easily detected by the human eye, thereby assisting clinicians in making faster and more accurate diagnoses.

The application of AI in radiology extends across multiple stages of the imaging workflow, including image acquisition, reconstruction, interpretation, reporting and clinical decision support. AI-enabled systems can enhance image quality, reduce noise, and accelerate scanning processes, allowing healthcare providers to perform more examinations in less time while maintaining diagnostic accuracy. Furthermore, automated segmentation and measurement tools enable precise quantification of anatomical structures, tumours, and pathological changes, significantly reducing manual effort for radiologists. These innovations not only streamline radiology workflows but also enable clinicians to focus on complex cases and patient interaction rather than repetitive tasks.

Another important aspect of AI integration in radiology is its potential to improve diagnostic accuracy and early disease detection. Advanced algorithms trained on large datasets of medical images can function as a second reader, highlighting suspicious regions, identifying subtle abnormalities, and prioritising urgent cases such as stroke, fractures or malignancies. Such capabilities are particularly valuable in screening programs and emergency settings where rapid diagnosis can significantly influence patient outcomes. By assisting radiologists in identifying early signs of diseases such as cancer, cardiovascular disorders and neurological conditions, AI contributes to timely intervention and improved treatment planning.

In addition to image analysis, AI has enabled the emergence of data-driven and personalised healthcare approaches in radiology. By integrating imaging findings with electronic health records, genomic data and clinical parameters, AI systems can support predictive analytics and risk stratification. This approach, often referred to as precision medicine, allows clinicians to predict disease progression, assess treatment response and tailor therapeutic strategies to individual patients. Moreover, the use of AI in radiomics and radio genomics is opening new avenues for understanding the relationship between imaging features and underlying molecular or genetic characteristics of diseases. Such developments are expected to play a critical role in oncologywhere personalized treatment decisions are increasingly important to improve patient care. As research and technological development continue to progress, advanced radiology systems will likely play an increasingly significant role in supporting clinicians and advancing the future of healthcare.

CT SCAN

The application of new AI-based machine learning technologies to CT imaging provides a new variable that clinical and technical stakeholders can use to directly manage both dose and image quality, and therefore indirectly all of the subsequent financial, clinical and operational factors they impact. The application of artificial intelligence increases productivity, is more accurate, speeds up the workflow with the rapid identification of diagnostic patterns, and systematises routine tasks.

Some important factors or benefits of AI in CT scans

- Reduce Image sharpness
- Reduce report time
- Minimum Noise or blurriness
- Reducing any Human error
- Fast imaging
- Less workload on the technologist
- Better tumour contouring
- Less radiation dose

MRI

MRI is an imaging modality that allows for the non-invasive visualisation of the body’s internal structure and function and is widely used for various clinical applications in areas including neurology, oncology, cardiology, and orthopaedics in adult, pediatric and fetal imaging.

In MRI, AI can be used to segment tumours, blood vessels or organs, enabling precise measurements and volumetric assessments. Furthermore, AI models facilitate image registration, aligning images from different modalities or time points, which is crucial for monitoring disease progression or treatment response.

Most recently, artificial intelligence-based algorithms, particularly deep learning models, are being used to reconstruct high-quality images from significantly fewer data points. These algorithms can predict missing information, thereby reducing the need for extensive data acquisition.

Benefits of AI in modern modalities of MRI

- Reduce scanning time substantially
- Improve image quality by reducing the risk of motion

MAMMOGRAPHY

Mammography is the examination of the breast for any abnormalities or symptoms. Mammography is based on low-dose X-rays that take detailed pictures of the breast and show in detail soft and dense tissues, chest muscles. Any abnormalities identified using a mammogram may require additional tests, such as biopsies, to determine the type of tumour: benign or malignant.

Uses and benefits of AI in modern modalities of mammography

Artificial intelligence (AI) could play a meaningful role in medical research and processing medical data. Modern AI tools can cover such tasks as prognosing disease risk, diagnosing different types of illnesses, analysing treatment progress and assessing outcomes of applied treatment.

BENEFITS

- Controlled radiation dose
- Reduce workload and increase efficiency
- Improve image quality drastically as mammography uses low X-ray
- Accurate diagnosis
- Triage

ULTRASOUND

The potential role of AI is anticipated to enhance the quality of ultrasonographic images, to provide various forms of diagnostic support (e.g. automated characterisation of findings on ultrasonographic images, extraction of quantitative or predictive information from ultrasonographic images, which is difficult for a human examiner to do based on visual observations and automated detection or segmentation of various structures on ultrasonographic images) and to improve workflow efficiency.

We are now starting to see AI and deep learning capabilities being deployed to provide anatomy-awareness, where specific body parts can be automatically detected.

BENEFITS

- Enhanced image acquisition and quality
- Improved diagnostic accuracy and consistency
- Increase workflow efficiency
- Specialised clinical care like cardiac, abdomen, liver, and gynaecology

PET SCAN

The integration of AI in PET-CT and MRI fusion is particularly relevant as healthcare systems worldwide seek to enhance diagnostic capabilities while minimising costs and radiation exposure.

With the increasing complexity of imaging datasets, AI has become an essential tool in multimodal image fusion. AI-driven approaches leverage vast amounts of imaging data to improve spatial alignment, reduce artefacts, and enhance image quality.

AI integration in PET-CT and MRI fusion involves multiple computational techniques aimed at improving image processing. AI eliminate the need for manual adjustments, reducing inter-observer variability and enhancing reproducibility. Additionally, feature extraction techniques powered by AI allow for the identification of specific imaging markers associated with disease progression. By analyzing multimodaldata, AI algorithms can detect subtle changes in tissue composition, facilitating early diagnosis and treatment monitoring.

BENEFITS

- Enhanced image quality and noise reduction
- Improved diagnosis
- Reduce radiation exposure
- Reduction in treatment time
- Advanced motion correction

AIM

This study aims to review and highlight the current advancements in radiology through the integration of artificial intelligence with modern imaging technologies and to assess their role in enhancing diagnostic precision, reducing interpretation time, and improving patient outcomes.

2. METHODOLOGY

Computer-Aided Systems

Computer-aided detection and computer-aided diagnosis are computerised tools developed to assist radiologists in interpreting medical images and making clinical decisions. CADe systems primarily highlight suspicious patterns or abnormalities on radiological images helping radiologists identify potential lesions or pathological findings. In contrast CADx systems analyse imaging data and estimate the probability of the presence of a specific disease. Both CADe and CADx rely on a sequence of computational steps that involve data processing and analytical algorithms, which may be based on statistical methods, rule-based systems, or artificial intelligence techniques.

Machine learning is a subfield of AI that consists of algorithms that enable computer systems to learn from existing datasets and improve their performance without being explicitly programmed. Machine learning approaches are generally classified into three main categories:

- supervised learning
- unsupervised learning
- reinforcement learning.

In supervised learning, the training dataset includes predefined or labelled outcomes. These labelled data are used to train algorithms so that they can make predictions or classifications when applied to new datasets. Conversely, unsupervised learning operates without labelled data and instead identifies patterns, similarities or clusters within the data to organise it into meaningful groups. Reinforcement learning, on the other hand, is based on a trial-and-error approach in which algorithms learn to perform specific tasks by receiving feedback in the form of rewards or penalties. Over time, this feedback helps the system adjust its internal parameters to optimise performance.

Artificial Neural Networks and Deep Learning

Artificial neural networks are machine learning models inspired by the structure and functioning of biological neural systems. These networks consist of multiple interconnected processing units known as neurons or nodes that work together to process and transmit information. Typically, an ANN is organised into three types of layers: the input layer, the hidden layers and the output layer. Each neuron in one layer is connected to neurons in the subsequent layer, and the strength of these connections, known as weights, is adjusted during the training process to improve performance.

Deep learning represents an advanced form of artificial neural networks characterised by the presence of multiple hidden layers. These deeper architectures enable the model to learn complex patterns and hierarchical representations of data. Among the various deep learning models, convolutional neural networks are widely used, particularly in medical imaging. CNNs apply convolutional filters to input data, allowing them to automatically extract important features from images through multiple layers of processing.

Radiomics and Precision Medicine

Radiomics is an emerging discipline that utilises artificial intelligence and large datasets to extract numerous quantitative features from medical imaging studies. Many of these radiomic features are not easily visible to the human eye but can provide valuable information about tumour characteristics and biological behaviour. By employing advanced computational algorithms, radiomics can analyse tumour heterogeneity and structural patterns, thereby supporting improved diagnosis, prognosis and treatment planning. This data-driven methodology has the potential to enhance diagnostic accuracy and contribute to more personalised therapeutic strategies.

In the context of precision medicine, AI plays a significant role in identifying imaging biomarkers associated with specific clinical outcomes. These biomarkers help predict how tumours may respond to different therapeutic approaches, enabling clinicians to customise treatment plans according to individual patient profiles. For instanceAI-based analysis of radiomic features can help forecast a patient's response to chemotherapy or immunotherapy, leading to more targeted and effective treatment decisions.

Furthermore, the integration of radiomics with machine learning techniques has demonstrated promising potential in predicting disease progression, recurrence and patient survival. As artificial intelligence technologies continue to evolve, their combination with radiomic analysis may further advance personalised healthcare. Such approaches can provide oncologists with precise and data-driven insights for treatment planning, particularly in oncology. Additionally, AI-driven radiomic analysis is expected to expand beyond cancer research into other medical domains, including cardiovascular diseases and neurodegenerative disorders, where subtle imaging variations may serve as early indicators of disease development.

3. RESULT

The findings highlight the growing impact of Artificial Intelligence (AI) in improving efficiency, accuracy, and workflow in radiology. The integration of AI with modern imaging modalities has significantly enhanced image analysis, reporting speed, and clinical decision-making. Several studies show that AI applications reduce the time required for key radiological tasks such as image acquisition, interpretation, and report generation. Reviews indicate that nearly two-thirds of studies reported reduced imaging workflow time, with some demonstrating improvements in efficiency of up to 40%.

In radiography reporting, AI integration has improved reporting efficiency by an average of 15.5%, with some radiologists completing reports up to 40% faster without compromising diagnostic accuracy. In CT imaging, AI helps optimise scan ranges, automate patient positioning and accelerate image reconstruction, which reduces scanning time and improves diagnostic turnaround. AI-based automatic report generation combined with Natural Language Processing (NLP) has reduced reporting time by 30–50% and improved consistency through structured reports.

AI also plays a crucial role in emergency triage systems, where it can detect critical conditions such as intracranial haemorrhage and immediately alert clinicians. In some hospital systems, this has reduced the time to diagnosis by up to 90%, enabling faster treatment. In MRI imaging, AI techniques correct motion artefacts and accelerate image reconstruction, reducing scan times by 30–50% and in some protocols up to 75%, leading to improved patient throughput and image quality. In interventional radiology, AI improves probe localisation, predicts ablation zones and provides real-time procedural guidance, resulting in better accuracy and higher technical success rates.

Despite these advantages, several challenges and limitations remain. One major issue is algorithm transparency, as many AI models operate as black boxes, making it difficult for clinicians to fully understand their decision-making processes. Patient privacy and data security are also concerns because AI systems require large datasets. Approaches such as federated learning help address this issue by allowing institutions to train AI models collaboratively without sharing sensitive patient data.

Another challenge is bias and fairness, as AI algorithms trained on limited datasets may lead to unequal healthcare outcomes. Ensuring diverse and high-quality training data is essential to reducing bias. Additionally, AI tools must undergo strict regulation and validation before clinical use to ensure safety and reliability. Although there are concerns that AI may replace radiologists, it is more likely to support and enhance their role as AI lacks the clinical judgment and contextual understanding required for complex diagnostic decisions.

4. CONCLUSION

Artificial intelligence is transforming the field of radiology by bringing major improvements in diagnosis workflow efficiency and patient care. By automating routine tasks and offering more precise image analysis, AI allows radiologists to focus on complex cases, which ultimately improves healthcare outcomes. Technologies such as machine learning and deep learning are enhancing image interpretation, streamlining radiology workflows and supporting more personalised treatment planning.

However, the successful integration of AI into clinical practice requires addressing several challenges. Ensuring high-quality data, maintaining transparency in algorithms and protecting

patient privacy are essential for building trust in AI-based systems. In addition, continuous collaboration between radiologists, AI developers, and regulatory authorities is necessary to ensure that these technologies are implemented safely and effectively.
Looking ahead, AI has significant potential to further advance radiology. With continued research, technological innovation, and responsible implementation, AI-driven tools can enhance diagnostic accuracy, improve efficiency and contribute to better patient care in modern healthcare systems.

Acknowledgement
We would like to express our sincere gratitude to the Department of Allied and Health Sciences, Doon Institute of Medical Sciences, for providing us with the opportunity and academic environment to complete this work on *"Emerging Trends in Radiology: Integration of Artificial Intelligence with Modern Imaging Modalities for Enhanced Patient Care."*
We are deeply thankful to our respected faculty members and mentors for their valuable guidance, constructive suggestions, and continuous encouragement throughout the preparation of this study. Their expertise and support greatly helped us in understanding the evolving role of Artificial Intelligence in modern radiology.
We would also like to acknowledge the authors, researchers and scientific platforms such as PubMed, Radiopaedia, ResearchGate and other academic resources that provided essential literature and references for this work.
Finally, we extend our appreciation to all our team members for their cooperation, dedication, and collaborative effort in completing this project.

REFERENCE

1. Khalifa M, Albadawy M. AI in diagnostic imaging: revolutionising accuracy and efficiency. Comput Methods Programs Biomed Update. 2024; 5:100146.
2. Najjar R. Redefining radiology: a review of artificial intelligence integration in medical imaging. Diagnostics. 2023;13(17):2760.
3. Radsource. AI in radiology. Available from: https://radsource.us/ai-in-radiology
4. Bhandari A. Revolutionising radiology with artificial intelligence. Cureus. 2024;16(10): e72646.
5. Amin K, Khosla P, Doshi R, Chheang S, Forman HP. Artificial intelligence to improve patient understanding of radiology reports. Yale J Biol Med. 2023;96(3):407–417.
6. Radiopaedia. Modality. Available from: https://radiopaedia.org/articles/modality
7. Modalities in modern radiology: a synopsis. Available from: https://www.researchgate.net/publication/45151403_Modalities_in_modern_radiology_A_synopsis
8. Polish Journal of Radiology. Available from: https://www.polradiol.com/
9. A practical guide to inclusive online dating. Available from: https://www.searchhounds.com/articles/a-practical-guide-to-inclusive-online-dating.html
10. Polish Journal of Radiology. Available from: https://www.polradiol.com/

About the corresponding author
Madhuri Tyagi is an Assistant Professor at Doon Institute of Medical Sciences (DIMS), Shankarpur, Dehradun, Uttarakhand. She is actively engaged in teaching and academic research in medical and allied health sciences. Her interests include diagnostic technologies, healthcare innovation, and student mentorship, contributing to academic excellence and professional development.