INTERNATIONAL JOURNAL OF PROGRESSIVE RESEARCH IN ENGINEERING MANAGEMENT AND SCIENCE (IJPREMS)
(Int Peer Reviewed Journal)
Vol. 06, Issue 07, July 2026, pp : 558-573
www.ijprems.com
editor@ijprems.com
e-ISSN : 2583-1062
Impact Factor : 7.001

TRANSFORMING MEDICAL IMAGING THROUGH ARTIFICIAL INTELLIGENCE: APPLICATIONS, CHALLENGES, AND FUTURE OUTLOOK

Abir Majumder[1], Muskan Kumari[2], Rahul Kumar[3], Satya Prakash Himanshu[4]

[1,2,3]Assistant Professor, Department of Allied & Healthcare, Jharkhand Rai University, Raja Ulatu, Namkum, Ranchi, Jharkhand, India.

[4]Assistant Professor (H.O.D), Department of Allied & Healthcare, Jharkhand Rai University, Raja Ulatu, Namkum, Ranchi, Jharkhand, India.

Corresponding Author: Abir Majumder

Email: majumderabir039@gmail.com

DOI: https://www.doi.org/10.58257/IJPREMS54204

ABSTRACT

Artificial Intelligence (AI) is revolutionizing medical imaging, offering unprecedented opportunities to enhance diagnostic accuracy, efficiency, and patient outcomes in radiology. Since the discovery of X-rays, medical imaging has evolved significantly with modalities such as computed tomography (CT), magnetic resonance imaging (MRI), ultrasound, positron emission tomography (PET), and digital mammography. The integration of machine learning and deep learning, particularly convolutional neural networks (CNNs), has enabled automated analysis of complex medical images, addressing the growing workload on radiologists amid rising imaging volumes. **Objective:** This review synthesizes current evidence on AI applications in medical imaging, highlighting technological foundations, clinical implementations, challenges, and future directions. **Main findings:** AI demonstrates strong performance across key tasks including image segmentation, computer-aided diagnosis (CAD), abnormality detection (e.g., lung nodules, breast cancer, brain metastases, and diabetic retinopathy), predictive analytics, and workflow optimization. Meta-analyses report high diagnostic accuracy with AUC values often ranging from 0.86 to 1.0 in specialized tasks, frequently matching or surpassing expert radiologists in narrow domains. Applications span X-ray, CT, MRI, ultrasound, and nuclear medicine, supporting early disease detection, personalized treatment planning, and reduced reporting times. However, significant challenges persist, including data quality issues, model bias, limited generalizability, the “black box” problem of deep learning models, ethical concerns, regulatory hurdles, and integration barriers into clinical workflows. **Conclusion:** While AI acts as a powerful augmentative tool for radiologists, realizing its full potential requires advances in explainable AI (XAI), robust validation, ethical frameworks, and multidisciplinary collaboration. Future prospects include multimodal integration, personalized medicine, and AI-driven smart radiology systems that enhance precision healthcare while maintaining human oversight.

Keywords: Artificial Intelligence, Medical Imaging, Radiology, Deep Learning, Convolutional Neural Networks, Computer-Aided Diagnosis, Explainable AI.

1. INTRODUCTION

Medical imaging stands as a cornerstone of modern healthcare, providing non-invasive visualization of the human body’s internal structures, functions, and pathological processes. Since Wilhelm Roentgen’s groundbreaking discovery of X-rays in 1895, the field has undergone remarkable evolution [1]. Today, advanced modalities such as computed tomography (CT), magnetic resonance imaging (MRI), ultrasound, positron emission tomography (PET), and digital mammography generate vast amounts of high-resolution data that play a pivotal role in disease detection, diagnosis, treatment planning, monitoring, and prognosis assessment [2]. These imaging techniques have transformed clinical decision-making by offering detailed anatomical, physiological, and molecular insights, thereby enabling precision medicine andsignificantly improving patient outcomes [3].

However, the rapid growth in imaging utilization has created substantial challenges [4]. The exponential increase in imaging volume, driven by aging populations, rising chronic disease prevalence, and expanded screening programs, has placed immense pressure on radiologists. Radiologists are expected to interpret increasingly complex, high-dimensional datasets under time constraints, leading to fatigue, diagnostic variability, and potential errors [5].

Traditional manual interpretation, while highly effective, struggles to keep pace with these demands, highlighting the need for intelligent technological support [6].

Artificial Intelligence (AI) refers to the simulation of human intelligence in machines, enabling them to perform tasks that typically require human cognition, such as perception, learning, reasoning, and decision-making. Within medical imaging, AI—particularly its subfields of **machine learning (ML)** and **deep learning (DL)**—has emerged as a transformative force [7]. Deep learning, powered by convolutional neural networks (CNNs) and other advanced architectures, can automatically extract hierarchical features directly from raw pixel data, excelling in complex pattern recognition tasks where traditional computer-aided diagnosis (CAD) systems previously relied on hand-engineered features [8].

The integration of AI in radiology addresses critical needs by enhancing diagnostic accuracy, improving efficiency, reducing workload, and facilitating early disease detection. For instance, AI systems have demonstrated high performance in detecting lung nodules on CT scans, breast cancer on mammograms, diabetic retinopathy on fundus photographs, and brain metastases on MRI [9]. Beyond detection, AI supports image segmentation, reconstruction, predictive analytics, workflow optimization (e.g., triage of urgent cases), and even report generation [10]. These capabilities are particularly valuable in resource-limited settings where specialist availability is scarce [11].

Current global trends reflect accelerating adoption and research momentum [12]. The last decade has witnessed an explosion of AI applications in medical imaging, fueled by increased computational power, availability of large annotated datasets, and breakthroughs in neural network architectures. Commercial AI tools (such as those for chest X-ray triage and mammography) have received regulatory approval from bodies like the FDA, marking a shift from experimental research to clinical implementation [13]. Emerging areas include explainable AI (XAI), multimodal learning that integrates imaging with clinical and genomic data, federated learning for privacy-preserving model training, and vision-language models for automated reporting [14]. Systematic reviews and meta-analyses consistently report impressive diagnostic performance, with area under the curve (AUC) values frequently exceeding 0.85–0.96 across various pathologies [15].

Despite these advances, several gaps remain. Much of the literature consists of siloed studies focusing on narrow tasks with limited external validation. Challenges related to data bias, model generalizability, interpretability of “black-box” algorithms, ethical implications, and seamless clinical integration continue to hinder widespread adoption [16]. Moreover, while individual reviews exist on specific modalities or techniques, a comprehensive synthesis that balances technological foundations, real-world applications, critical limitations, and forward-looking perspectives is essential for guiding clinicians, researchers, and policymakers [17].

This review is important because it consolidates insights from recent high-quality literature to provide a balanced, clinically relevant overview at a crucial juncture when AI is transitioning from promise to practice in radiology [18]. By critically examining both successes and barriers, it aims to foster informed implementation and responsible innovation in the field [19].

2. METHODOLOGY / LITERATURE SEARCH STRATEGY

This review was conducted following a systematic approach to identify, select, and synthesize relevant literature on artificial intelligence applications in medical imaging. A comprehensive search strategy was designed to ensure the inclusion of high-quality, recent, and representative studies while maintaining transparency and reproducibility [20].

Databases Searched: The literature search was performed across multiple prominent academic databases, including **PubMed**, **Scopus**, **ScienceDirect**, and **Google Scholar**. These databases were selected to cover a wide spectrum of biomedical, engineering, and multidisciplinary research publications in the field of radiology and medical imaging [21].

Keywords and Search Strategy: A combination of keywords and Medical Subject Headings (MeSH) terms were used with Boolean operators. The primary search terms included: “artificial intelligence”, “machine learning”, “deep learning”, “convolutional neural networks”, “radiology”, “medical imaging”, “computer-aided diagnosis”, “diagnostic imaging”, “X-ray”, “CT”, “MRI”, “ultrasound”, “PET”, “explainable AI”, and “XAI”. These terms were combined using OR and AND operators (e.g., (“artificial intelligence” OR “deep learning”) AND (“medical imaging” OR “radiology”)). Additional searches were conducted by reviewing the reference lists of selected articles (snowballing technique) to identify relevant papers not captured in the initial database search.

Inclusion Criteria:

- Peer-reviewed original research articles, systematic reviews, meta-analyses, and narrative reviews focusing on AI/ML/DL applications in medical imaging.

- Studies published in English language.
- Articles published between **2020 and 2026**.
- Studies reporting on technical aspects, clinical applications, diagnostic performance, challenges, or future perspectives of AI in radiology and medical imaging.
- High-quality reviews and key studies providing comprehensive insights into applications across major imaging modalities (X-ray, CT, MRI, ultrasound, PET).

Exclusion Criteria:

- Non-peer-reviewed articles, preprints, conference abstracts, editorials, letters, and commentaries.
- Studies unrelated to medical imaging or focusing solely on non-radiological AI applications.
- Articles published before 2020.
- Duplicate publications and studies with insufficient methodological details or lacking relevance to clinical applications or challenges.
- Papers not available in full text.

A comprehensive set of relevant records was initially retrieved from the selected databases. After removing duplicates, titles and abstracts were screened, followed by full-text assessment of potentially eligible articles. From the provided high-quality review articles and meta-analyses, multiple comprehensive papers were selected as core references for in-depth synthesis due to their broad coverage, methodological rigor, and recency.

This narrative review adopts a qualitative synthesis approach, focusing on thematic organization rather than quantitative meta-analysis. All selected literature was critically appraised for relevance, methodological quality, and contribution to the field.

Basics of Artificial Intelligence in Medical Imaging

Artificial Intelligence (AI) has emerged as a powerful computational paradigm that is fundamentally transforming medical imaging. This section provides foundational knowledge of the key concepts and technologies driving this revolution [22].

Artificial Intelligence

Artificial Intelligence refers to the simulation of human intelligence processes by machines, particularly computer systems. These processes include learning, reasoning, problem-solving, perception, and decision-making. In the context of medical imaging, AI systems are designed to analyze complex visual data, recognize patterns, and support clinical decision-making with speed and consistency that often rivals or surpasses human experts in specific tasks [23].

AI in radiology leverages large volumes of imaging data to extract clinically relevant information. Unlike traditional rule-based systems, modern AI approaches learn directly from examples, enabling them to handle the high variability and subtlety inherent in medical images [24].

Machine Learning

Machine Learning (ML) is a core subset of AI that enables systems to learn and improve from experience without being explicitly programmed. ML algorithms identify patterns in training data and apply these patterns to new, unseen data [25].

There are three main types of ML:

- **Supervised Learning**: Uses labeled datasets to train models for classification or regression tasks (e.g., classifying a chest X-ray as “pneumonia” or “normal”).
- **Unsupervised Learning**: Discovers hidden patterns in unlabeled data, useful for clustering or anomaly detection.
- **Reinforcement Learning**: Learns optimal actions through trial and error with reward feedback.

In medical imaging, traditional ML often relies on **radiomics** — the extraction of quantitative features such as texture, shape, and intensity from images — which are then fed into classifiers like Support Vector Machines or Random Forests [26].

Deep Learning

Deep Learning (DL) is an advanced subset of ML inspired by the structure and function of the human brain. It utilizes multi-layered artificial neural networks to automatically learn hierarchical feature representations directly from raw data, eliminating the need for manual feature engineering [27].

DL has achieved remarkable success in medical imaging due to its ability to process high-dimensional pixel data. It excels in handling the complexity of medical images where subtle differences (e.g., early-stage tumors) are critical for diagnosis. Key advantages include superior performance on large datasets and the capacity to integrate multi-modal data [28].

Neural Networks

Neural networks form the backbone of deep learning. The most prominent architecture in medical imaging is the **Convolutional Neural Network (CNN)** [Figure1]. CNNs are specifically designed for grid-like data such as images. They use convolutional layers to detect local patterns (edges, textures), pooling layers for dimensionality reduction, and fully connected layers for final classification or segmentation [29].

Other important architectures include:

- U-Net and its variants for image segmentation
- Generative Adversarial Networks (GANs) for data augmentation and image synthesis
- Vision Transformer (ViT) models and Vision-Language Models (VLMs) for advanced multimodal understanding

These networks are trained on massive annotated datasets using backpropagation and optimization algorithms like Adam.

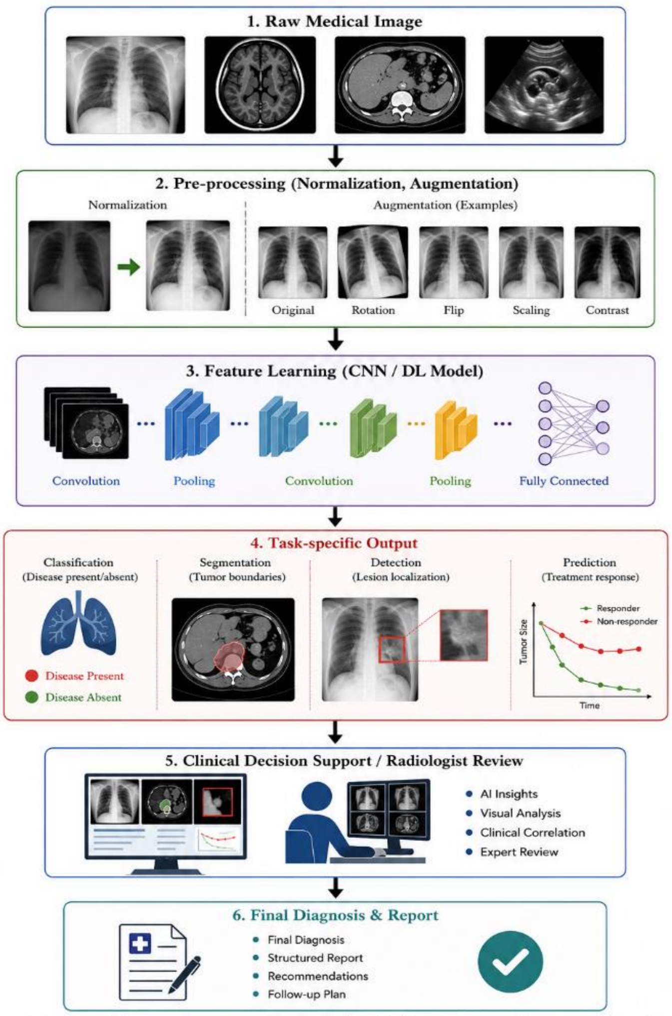

Figure 1. Overview of a deep learning–based medical image analysis pipeline. The process begins with raw medical images, followed by pre-processing (normalization and augmentation), feature learning using CNN/DL models, and task-specific outputs including classification, segmentation, detection, and prediction. The results are then used for clinical decision support and radiologist review, leading to the final diagnosis and report generation.

Figure 1: Simplified AI Workflow in Medical Imaging [30]

Computer-Aided Diagnosis (CAD)

Computer-Aided Diagnosis (CAD) systems represent the practical application of AI/ML techniques in clinical radiology. Traditional CAD systems (pre-DL era) used hand-crafted features and statistical models. Modern AI-powered CAD systems use deep learning for end-to-end analysis, offering higher sensitivity and specificity [31].

Current CAD applications include:

- Detection of pulmonary nodules on CT
- Breast cancer screening on mammography
- Brain lesion segmentation on MRI
- Diabetic retinopathy grading on retinal images

These systems function as “second readers,” flagging abnormalities, prioritizing urgent cases, and reducing radiologist workload.

Table 1: Comparison of AI Techniques in Medical Imaging [32]

Aspect	Traditional ML	Deep Learning (CNNs)	Explainable AI (XAI)
Feature Extraction	Manual (Radiomics)	Automatic (Hierarchical)	Enhanced interpretability
Data Requirements	Moderate	High (Large labeled datasets)	Similar to DL + explanation data
Performance on Complex Images	Moderate	Excellent	Good (with some accuracy trade-off)
Interpretability	High	Low (Black-box)	High
Computational Demand	Low	High	High
Clinical Adoption	Limited	Growing (FDA-approved tools)	Emerging (Promising)
Best Use Cases	Simple classification	Segmentation, Detection	Trust-building in clinical use

The transition from traditional ML to deep learning has significantly improved accuracy, but it has also intensified the need for explain ability, which XAI [Table 1] techniques aim to address.

Applications of AI in Medical Imaging

Artificial Intelligence, particularly deep learning, has demonstrated transformative potential across all major medical imaging modalities. This section synthesizes key applications drawn from recent literature, highlighting how AI enhances detection, segmentation, classification, and clinical decision support [33].

AI in X-ray Imaging

X-ray radiography remains the most widely used and accessible imaging modality worldwide. AI applications here focus primarily on chest X-rays, the most common examination, and musculoskeletal imaging [34].

Pneumonia Detection: AI models have shown exceptional performance in detecting pneumonia and other pulmonary pathologies on chest X-rays[Table 2]. Deep learning systems can rapidly triage cases, distinguishing bacterial/viral pneumonia from normal or other conditions with high sensitivity. Commercial tools have been deployed for COVID-19 screening and general pneumonia detection, often achieving AUC values above 0.90 [35].

Fracture Detection: In musculoskeletal radiology, CNN-based models effectively identify fractures in extremities, spine, and pelvis on plain radiographs. These systems reduce missed diagnoses, particularly in high-volume emergency settings, and assist less experienced readers [36].

Chest X-ray Analysis: Beyond specific pathologies, AI excels in comprehensive chest X-ray interpretation, including detection of nodules, cardiomegaly, pleural effusion, tuberculosis, and pneumothorax. AI-powered triage systems prioritize critical findings (e.g., tension pneumothorax or large effusions), significantly reducing reporting turnaround time and improving workflow efficiency. Studies report that AI can match or exceed radiologist performance in specific binary classification tasks while serving as a reliable second reader [37].

AI in Computed Tomography (CT)

CT scanning generates high-resolution 3D volumetric data and is central to oncology, emergency, and cardiovascular imaging.

Tumor Detection: AI algorithms demonstrate strong capabilities in detecting and characterizing tumors across organs, particularly in the lungs, liver, pancreas, and kidneys. Deep learning models can identify small lesions that may be overlooked by human readers [38].

Lung Screening: Low-dose CT (LDCT) for lung cancer screening has benefited enormously from AI. Models excel at pulmonary nodule detection, classification (benign vs. malignant) [Table 2], and growth monitoring. Meta-analyses show high diagnostic accuracy, with AI reducing false positives and supporting risk stratification in screening programs [39].

Low-dose CT: AI enables substantial radiation dose reduction while maintaining or improving image quality through advanced reconstruction algorithms (e.g., denoising networks). This is particularly valuable for pediatric imaging and repeated scans in chronic patients. AI also supports automated segmentation of organs and lesions for precise treatment planning in radiation oncology [40].

AI in Magnetic Resonance Imaging (MRI)

MRI provides excellent soft tissue contrast without ionizing radiation, making it ideal for neurological, musculoskeletal, and pelvic imaging.

Brain Tumor Analysis: Deep learning models achieve outstanding results in brain tumor segmentation, classification (e.g., glioma grading), and treatment response assessment on multi-parametric MRI [Table 2]. U-Net architectures and their variants are widely used for accurate delineation of tumor core, edema, and necrosis, supporting surgical planning and radiotherapy [41].

Stroke Diagnosis: AI enables rapid detection of acute ischemic stroke on MRI (including diffusion-weighted imaging) and CT perfusion. Automated tools identify large vessel occlusions and estimate infarct core/penumbra mismatch, facilitating time-critical decisions for thrombolysis or thrombectomy [42].

Image Reconstruction: AI accelerates MRI acquisition through undersampled reconstruction, reducing scan times dramatically while preserving diagnostic quality. This improves patient comfort and scanner throughput. Generative models also help in motion correction and artifact reduction [43].

AI in Ultrasound Imaging

Ultrasound [Table 2] is non-invasive, real-time, radiation-free, and cost-effective, leading to broad applications in obstetrics, cardiology, and abdominal imaging.

Obstetric Imaging: AI supports fetal biometry measurement, anomaly detection, and gestational age estimation. Automated tools improve consistency and reduce operator dependency, which is especially beneficial in low-resource settings [44].

Organ Assessment: In abdominal and cardiac ultrasound, AI assists in liver disease grading (e.g., steatosis, fibrosis), thyroid nodule characterization, breast lesion classification, and ejection fraction estimation. Point-of-care ultrasound (POCUS) benefits significantly from AI guidance, enabling non-experts to obtain diagnostic-quality images and interpretations in emergency and critical care [45].

AI also enhances ultrasound image quality through speckle reduction and automated protocol guidance.

AI in Nuclear Medicine and PET Imaging

Nuclear medicine and PET provide functional and metabolic information complementary to anatomical imaging.

Oncology Imaging: PET/CT is revolutionized by AI for tumor detection, staging, and therapy response assessment (e.g., using FDG or PSMA tracers). Models improve lesion segmentation, standardize uptake value (SUV) quantification, and predict treatment outcomes. Hybrid PET/CT benefits from AI-driven registration and noise reduction [46].

INTERNATIONAL JOURNAL OF PROGRESSIVE RESEARCH IN ENGINEERING MANAGEMENT AND SCIENCE (IJPREMS)
(Int Peer Reviewed Journal)
Vol. 06, Issue 07, July 2026, pp : 558-573
e-ISSN : 2583-1062
Impact Factor : 7.001
www.ijprems.com
editor@ijprems.com

Functional Imaging: AI supports analysis of myocardial perfusion, brain metabolism (e.g., in neurodegenerative diseases), and receptor imaging. Predictive models integrate PET [Table 2] data with clinical information for personalized prognosis [47].

Additional Applications across Modalities

Beyond core detection tasks, AI contributes significantly to:

- **Image Segmentation**: Precise delineation of organs-at-risk and tumors for radiotherapy planning.
- **Predictive Analytics**: Forecasting disease progression, treatment response, and survival.
- **Workflow Optimization**: Automatic protocol selection, study prioritization, and report generation.
- **Multimodal Integration**: Combining imaging with pathology, genomics, and electronic health records.

Table 2: Summary of AI Applications by Imaging Modality [48]

Modality	Key Applications	Typical Performance Highlights	Clinical Benefits
X-ray	Pneumonia, fracture, chest analysis	AUC 0.85–0.95+	Triage, workload reduction
CT	Lung nodules, tumor detection, LDCT	High sensitivity for small lesions	Early cancer detection, dose reduction
MRI	Brain tumor, stroke, reconstruction	Excellent segmentation accuracy	Precision planning, faster scans
Ultrasound	Fetal biometry, organ assessment	Reduced operator variability	Accessibility in point-of-care
PET/Nuclear	Oncology staging, functional analysis	Improved quantification	Personalized treatment monitoring

AI applications consistently demonstrate the ability to augment radiologists rather than replace them, excelling in repetitive, high-volume tasks while humans retain oversight for complex or ambiguous cases.

Advantages of AI in Medical Imaging

The integration of Artificial Intelligence in medical imaging offers numerous clinical and operational benefits that address longstanding challenges in radiology. By leveraging deep learning and advanced algorithms, AI serves as a powerful augmentative tool that enhances radiologist performance rather than replacing human expertise. The following subsections highlight the primary advantages supported by recent literature [49].

Faster Diagnosis AI systems can analyze medical images in seconds, dramatically reducing interpretation time compared to traditional manual review. For instance, AI-powered triage tools can immediately flag critical findings such as pneumothorax, intracranial hemorrhage, or pulmonary embolism on chest X-rays or CT scans. This acceleration enables faster [Table 3] clinical decision-making, which is particularly vital in emergency and time-sensitive conditions like stroke or trauma. Studies consistently show that AI can reduce reporting turnaround time by 20–50% in high-volume settings [50].

Reduced Workload Radiologists face increasing workloads due to rising imaging volumes. AI automates repetitive and routine tasks such as image quality assessment, organ segmentation, and preliminary report generation. By prioritizing urgent cases and filtering normal studies, AI allows radiologists to focus their expertise on complex or ambiguous cases. This reduction [Table 3] in cognitive burden helps mitigate burnout and fatigue, ultimately improving overall departmental efficiency and radiologist well-being [51].

Improved Accuracy Deep learning models have demonstrated high diagnostic performance across multiple modalities. Meta-analyses report AUC values ranging from 0.86 to 0.99 [Table 3] for tasks such as diabetic retinopathy detection, breast cancer screening on mammography, lung nodule identification on CT, and brain metastases detection on MRI. In many narrow tasks, AI achieves sensitivity and specificity comparable to or exceeding experienced radiologists. When used as a second reader, AI reduces diagnostic errors and inter-observer variability, leading to more consistent and reliable interpretations [52].

Automation AI enables end-to-end automation of several workflow steps, including image preprocessing, lesion detection, segmentation, quantification, and even preliminary structured reporting. Modern CAD [Table 3] systems and commercial AI solutions seamlessly integrate with PACS (Picture Archiving and Communication Systems), providing automated measurements, 3D reconstructions, and quantitative biomarkers. This level of automation standardizes processes and minimizes manual errors [53].

Early Disease Detection One of the most significant advantages of AI is its ability to detect subtle abnormalities at earlier stages than traditional methods. AI excels at identifying [Table 3] small lung nodules, early-stage cancers, microcalcifications in breast imaging, and early signs of diabetic retinopathy — conditions that are often missed in busy clinical environments. Early detection facilitates timely intervention, improves treatment outcomes, reduces mortality, and supports precision medicine approaches through better risk stratification and personalized treatment planning [54].

Additional benefits include enhanced image quality (via denoising and reconstruction), radiation dose reduction in CT [Table 3], improved accessibility in underserved regions through point-of-care AI tools, and facilitation of predictive analytics for disease progression and treatment response [55].

Table 3: Key Advantages of AI in Medical Imaging [56]

Advantage	Description	Clinical Impact	Supporting Evidence
Faster Diagnosis	Rapid image analysis and triage	Reduced turnaround time, faster treatment decisions	Emergency radiology, stroke & trauma
Reduced Workload	Automation of routine tasks and prioritization	Decreased radiologist burnout, higher throughput	High-volume screening & daily practice
Improved Accuracy	High sensitivity/specificity in detection & classification	Fewer missed diagnoses, reduced variability	AUC 0.86–0.99 across modalities
Automation	End-to-end processing, segmentation & reporting	Standardized workflows, fewer human errors	CAD systems & PACS integration
Early Disease Detection	Identification of subtle early-stage pathologies	Better prognosis, timely intervention	Lung cancer, breast cancer, retinopathy
Additional Benefits	Dose reduction, image enhancement, predictive analytics	Safer imaging, personalized medicine	Low-dose CT, multimodal analysis

In summary, AI transforms medical imaging from a purely interpretive discipline into a more efficient, accurate, and proactive component of modern healthcare. These advantages collectively contribute to improved patient outcomes, optimized resource utilization, and a more sustainable radiology practice. However, these benefits are best realized when AI is implemented as a collaborative tool [Figure 2] alongside experienced radiologists.

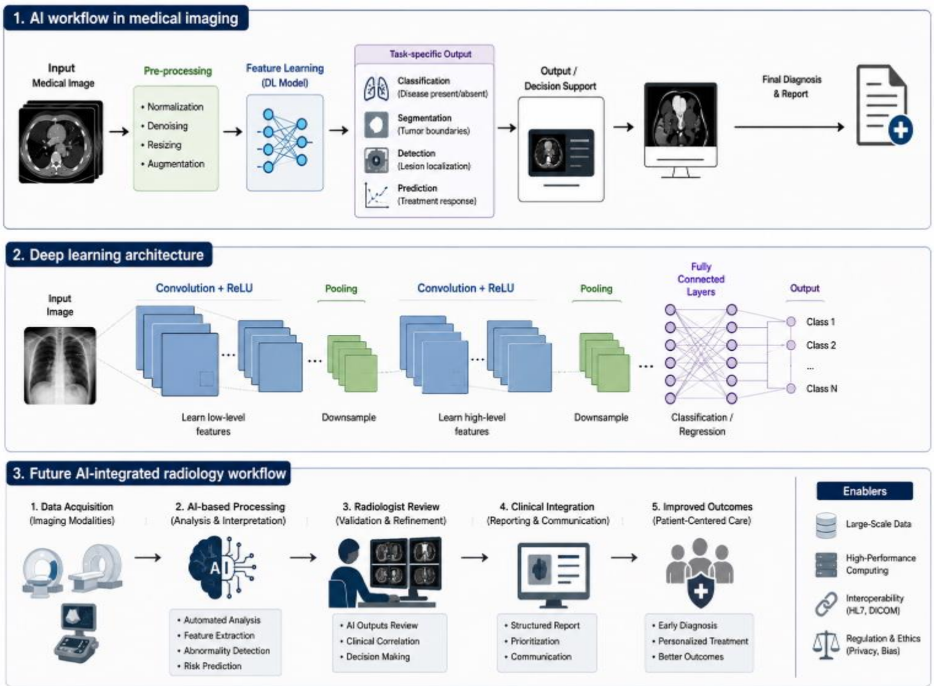

Figure 2: Conceptual Framework of Artificial Intelligence in Medical Imaging and Radiology [57]

Challenges and Limitations

Despite the promising advancements of Artificial Intelligence in medical imaging, several significant challenges and limitations hinder its full-scale clinical adoption. Addressing these barriers is crucial for safe, equitable, and effective integration of AI into routine radiology practice [58].

Data Privacy and Security Concerns

Medical imaging data contains highly sensitive patient information. Training robust AI models requires large-scale datasets, raising serious concerns regarding data privacy and security. Compliance with regulations such as GDPR in Europe and HIPAA in the United States adds complexity to data sharing and model development. Federated learning has emerged as a potential solution, allowing models to be trained across institutions without sharing raw patient data [Table 4]. However, risks of data breaches and re-identification remain significant obstacles [59].

Ethical Issues

The deployment of AI in healthcare raises profound ethical questions. Who is accountable when an AI system misses a critical diagnosis — the radiologist, the developer, or the hospital? Issues [Table 4] of transparency, informed consent, and potential over-reliance on AI tools also emerge. There is growing concern that AI may exacerbate existing healthcare disparities if not carefully monitored. Ethical frameworks must ensure that AI augments rather than undermines the human elements of patient care [60].

Lack of High-Quality Datasets

One of the biggest bottlenecks in AI development for medical imaging is the scarcity of large, diverse, well-annotated datasets. Medical images require expert annotation, which is time-consuming and expensive. Most available datasets are limited in size, lack diversity [Table 4] (predominantly from Western populations), or focus on narrow pathologies. This scarcity leads to models that perform well on training data but fail to generalize to real-world clinical scenarios. Data quality issues, including noise, artifacts, and inconsistent acquisition protocols, further complicate model training [61].

Bias in AI Models

AI models can inherit and even amplify biases present in training data. Demographic biases [Table 4] related to age, sex, ethnicity, and socioeconomic status are well-documented, potentially leading to poorer performance in underrepresented populations. For example, models trained primarily on data from one geographic region may underperform in different healthcare settings. Algorithmic bias can result in healthcare disparities, making fair and equitable AI development a critical challenge. Techniques such as diverse dataset curation and bias auditing are essential but remain underdeveloped [62].

INTERNATIONAL JOURNAL OF PROGRESSIVE RESEARCH IN ENGINEERING MANAGEMENT AND SCIENCE (IJPREMS)
(Int Peer Reviewed Journal)
Vol. 06, Issue 07, July 2026, pp : 558-573
www.ijprems.com
editor@ijprems.com
e-ISSN : 2583-1062
Impact Factor : 7.001

High Implementation Cost

Developing, validating, and deploying AI systems requires substantial financial investment. High-performance computing infrastructure, data storage, regulatory approval processes, and integration with existing hospital systems (PACS/RIS) are expensive. [Table 4] Many hospitals, particularly in low- and middle-income countries, cannot afford these technologies. Maintenance, continuous model updating, and cybersecurity measures add to long-term costs, limiting widespread accessibility [63].

Need for Trained Professionals

Successful AI adoption demands a new breed of professionals skilled [Table 4] in both radiology and data science. Most practicing radiologists currently lack sufficient training in AI principles, interpretability, and limitations. There is an urgent need for continuous education programs and interdisciplinary collaboration between radiologists, data scientists, and engineers. Without proper training, there is a risk of misuse or overconfidence in AI outputs [64].

Legal and Regulatory Concerns

Legal liability for AI-generated errors remains unclear. Regulatory bodies like the FDA classify many AI tools as Software as a Medical Device (SaMD), requiring rigorous approval [Table 4] processes. However, the rapid evolution of AI makes traditional regulatory pathways challenging. Issues of intellectual property, model explainability for legal defensibility, and post-market surveillance need clearer guidelines. Inconsistent international regulations further complicate global deployment [65].

Additional Challenges The "black box" nature of deep learning models severely limits trust and clinical acceptance. Limited external validation, poor generalizability across different scanners and populations, and integration difficulties with existing clinical workflows are persistent issues. Many studies also suffer from methodological heterogeneity, making direct comparisons difficult [66].

Table 4: Major Challenges and Limitations of AI in Medical Imaging [67]

Challenge	Description	Impact	Potential Solutions
Data Privacy	Sensitive patient information	Regulatory compliance burden	Federated learning, anonymization
Ethical Issues	Accountability, fairness, consent	Erosion of trust	Ethical guidelines, oversight committees
Lack of Datasets	Scarcity of diverse annotated data	Poor generalization	Synthetic data, international collaboration
Bias in Models	Demographic and algorithmic bias	Healthcare disparities	Bias detection tools, diverse datasets
High Implementation Cost	Infrastructure and maintenance expenses	Limited accessibility	Cloud solutions, open-source models
Need for Trained Professionals	Skills gap in radiology workforce	Slow adoption	Education programs, interdisciplinary teams
Legal & Regulatory Concerns	Liability and approval uncertainty	Delayed deployment	Clearer policies, standardized reporting

In conclusion, while AI holds tremendous potential, these challenges must be systematically addressed through technological innovation, robust governance, interdisciplinary collaboration, and investment in education. Overcoming these limitations will determine whether AI becomes a truly reliable and equitable tool in the future of radiology.

INTERNATIONAL JOURNAL OF PROGRESSIVE RESEARCH IN ENGINEERING MANAGEMENT AND SCIENCE (IJPREMS)
(Int Peer Reviewed Journal)
Vol. 06, Issue 07, July 2026, pp : 558-573
www.ijprems.com
editor@ijprems.com
e-ISSN : 2583-1062
Impact Factor : 7.001

Future Perspectives

The future of Artificial Intelligence in medical imaging is poised to move beyond current narrow applications toward more integrated, intelligent, and human-centric systems. As technology matures, AI is expected to become an indispensable partner in radiology, driving a paradigm shift toward precision, efficiency, and personalized healthcare [68].

Explainable AI (XAI)

A major priority for the coming years is the development and adoption of **Explainable Artificial Intelligence**. Current deep learning models often function as "black boxes," limiting clinical trust. Future advancements in XAI techniques — such as saliency maps, Grad-CAM, attention mechanisms, SHAP, and LIME — will provide transparent, human-interpretable explanations for AI decisions. This will enable radiologists to understand why a model flagged a particular lesion or made a specific prediction. Regulatory bodies are increasingly demanding explainability for approval, and XAI will be critical for legal accountability and ethical deployment [69].

AI-Assisted Radiologists

Rather than replacing radiologists, the future envisions a collaborative **AI-assisted radiology** model. Radiologists will evolve into "information architects" who oversee AI outputs, integrate contextual clinical knowledge, and make final decisions. AI will handle routine tasks, triage urgent cases, and provide quantitative support, allowing radiologists to focus on complex diagnostics, patient consultation, and multidisciplinary discussions. This hybrid human-AI approach is expected to enhance diagnostic accuracy while reducing burnout [70].

Personalized Medicine

AI will play a pivotal role in advancing **personalized medicine**. By integrating multimodal data — medical images, genomics, electronic health records, and clinical parameters — future AI systems will generate patient-specific risk profiles, treatment response predictions, and tailored therapeutic recommendations. Radiomics and deep learning will enable precise tumor characterization, treatment planning in radiation oncology, and monitoring of disease progression at an individual level [71].

Robotic Imaging and Automation

Robotic imaging systems guided by AI are expected to become more prevalent. AI can optimize scan protocols in real-time, guide robotic ultrasound or biopsy procedures, and ensure consistent image quality. In interventional radiology, AI-powered robotics will enhance precision, reduce procedure time, and minimize radiation exposure to both patients and staff [72].

Smart Hospitals and Integrated Systems

The concept of **smart hospitals** will be realized through fully AI-integrated ecosystems. AI will manage end-to-end imaging workflows — from scheduling and protocol optimization to acquisition, interpretation, and reporting. Predictive analytics will forecast equipment maintenance needs and patient no-show risks, improving operational efficiency [73].

AI-Integrated PACS Systems

Future **Picture Archiving and Communication Systems (PACS)** will be deeply embedded with AI capabilities. These next-generation systems will offer real-time decision support, automated structured reporting using vision-language models, seamless multimodal data fusion, and longitudinal patient tracking. AI will automatically compare current and prior studies, highlight interval changes, and generate preliminary reports for radiologist review [74].

Emerging Trends Several transformative trends are clearly visible on the horizon:

- **Multimodal and Federated Learning**: Combining imaging with other data types while preserving privacy across institutions.
- **Generative AI**: For synthetic data generation, image enhancement, and automated report writing.
- **Vision-Language Models (VLMs)**: Enabling natural language interaction with imaging data.
- **Edge Computing and Real-time AI**: Bringing AI inference closer to the scanner for faster results.
- **Global Health Equity**: Development of lightweight AI models for low-resource settings to reduce diagnostic disparities [75].

The successful realization of these future perspectives depends on sustained interdisciplinary collaboration between radiologists, AI developers, ethicists, regulators, and policymakers. Investment in large-scale, diverse datasets, standardized evaluation frameworks, and continuous education will be essential.

In the coming decade, AI is expected to evolve from a supportive tool into a core component of intelligent radiology departments, ultimately leading to earlier diagnoses, more precise treatments, reduced healthcare costs, and significantly improved patient outcomes worldwide [76].

3. CONCLUSION

Artificial Intelligence has emerged as a transformative force in medical imaging, fundamentally reshaping the practice of radiology. This review has synthesized the evolution, core technologies, diverse clinical applications, key advantages, and persistent challenges of AI integration across major imaging modalities including X-ray, CT, MRI, ultrasound, and PET. Deep learning models, particularly convolutional neural networks, have demonstrated remarkable capabilities in image segmentation, computer-aided diagnosis, abnormality detection, workflow optimization, and predictive analytics [77].

The clinical importance of AI in medical imaging lies in its ability to enhance diagnostic accuracy, accelerate reporting times, reduce radiologist workload, and support early disease detection. By acting as a reliable second reader and triage tool, AI helps mitigate diagnostic errors, improves consistency, and enables more efficient use of healthcare resources. These improvements ultimately translate into better patient outcomes, timely interventions, and more personalized approaches to care [78].

Looking ahead, the future potential of AI in radiology is substantial. Advances in explainable AI, multimodal integration, AI-assisted workflows, and smart hospital systems promise to create a more intelligent, efficient, and patient-centered imaging ecosystem. When properly implemented, AI has the capacity to augment radiologists' capabilities rather than replace them, allowing clinicians to focus on complex decision-making and direct patient care [79].

In conclusion, while significant challenges related to data quality, bias, interpretability, ethics, and implementation remain, the integration of artificial intelligence represents a pivotal advancement in modern radiology. With continued research, multidisciplinary collaboration, robust ethical frameworks, and rigorous validation, AI will play an increasingly vital role in delivering precision healthcare. The successful synergy between human expertise and artificial intelligence holds the promise of revolutionizing diagnostic imaging and improving health outcomes for patients worldwide [80].

Declarations

Funding: No funding was received for this study.

Ethics Declaration: Not applicable. This review article did not involve human participants, animal subjects, or patient data.

Conflict of Interest: The authors declare that they have no conflict of interest.

Author Contributions: A.M. conceived the study, conducted the literature review, and drafted the manuscript. M.K. contributed to literature screening, data organization, and manuscript revision. R.K. assisted with critical review, interpretation of findings, and final editing. All authors read and approved the final manuscript.

4. REFERENCES

[1] Graves MJ. Shadows and signals: a brief history of medical imaging. InJournal of Physics: Conference Series 2024 Oct 1 (Vol. 2877, No. 1, p. 012113). IOP Publishing.

[2] Barragán-Montero AM, Javaid U, Valdés G, Nguyen D, Desbordes P, Macq B, et al. Artificial intelligence and machine learning for medical imaging: A technology review. Phys Med. 2021;83:242-256. doi:10.1016/j.ejmp.2021.04.016.

[3] Pinto-Coelho L. How Artificial Intelligence Is Shaping Medical Imaging Technology: A Survey of Innovations and Applications. Bioengineering (Basel).2023;10(12):1435. doi:10.3390/bioengineering10121435.

[4] Obuchowicz R, Strzelecki M, Piórkowski A. Clinical Applications of Artificial Intelligence in Medical Imaging and Image Processing—A Review. Cancers (Basel). 2024;16(10):1870. doi:10.3390/cancers16101870.

[5] Avakian A, Barfoot G. Artificial intelligence in radiology: a narrative review of current methods, clinical impact, and future directions. BMC Artif Intell. 2026;2:1. doi:10.1186/s44300-025-00020-7.

[6] Aggarwal R, Sounderajah V, Martin G, Ting DSW, Karthikesalingam A, King D, et al. Diagnostic accuracy of deep learning in medical imaging: a systematic review and meta-analysis. npj Digit Med. 2021;4:65. doi:10.1038/s41746-021-00438-z.

[7] Zhou SK, Greenspan H, Davatzikos C, Duncan JS, van Ginneken B, Madabhushi A, et al. A review of deep learning in medical imaging: Imaging traits, technology trends, case studies with progress highlights, and future promises. IEEE Rev Biomed Eng. 2021;14:4-32. doi:10.1109/RBME.2020.2971021.

[8] Ahmed F, Naz NS, Khan S, Rehman AU, Ismael WM, Khan MA. Explainable artificial intelligence (XAI) in medical imaging: a systematic review of techniques, applications, and challenges. BMC Med Imaging. 2026;26:37. doi:10.1186/s12880-026-02118-w.

[9] Houssein EH, Gamal AM, Younis EMG, Mohamed E. Explainable artificial intelligence for medical imaging systems using deep learning: a comprehensive review. Cluster Comput. 2025. doi:10.1007/s10586-025-04628-5.

[10] European Society of Radiology (ESR). What the radiologist should know about artificial intelligence. Insights Imaging. 2022;13(1):44.

[11] Brady AP, Bello JA, Derchi LE, Fuchsjäger M, Goergen S, et al. Radiology in the era of artificial intelligence. Insights Imaging. 2023;14(1):12.

[12] Langlotz CP, Allen B, Erickson BJ, Kalpathy-Cramer J, Bigelow K, et al. A Roadmap for Foundational Research on Artificial Intelligence in Medical Imaging. Radiology. 2019;291(3):781-791.

[13] Rajpurkar P, Chen E, Banerjee O, Topol EJ. AI in health and medicine. Nat Med. 2022;28(1):31-38.

[14] McKinney SM, Sieniek M, Godbole V, Godwin J, Antropova N, et al. International evaluation of an AI system for breast cancer screening. Nature. 2020;577(7788):89-94.

[15] Ardila D, Kiraly AP, Bharadwaj S, Choi B, Reicher JJ, et al. End-to-end lung cancer screening with three-dimensional deep learning on low-dose chest computed tomography. Nat Med. 2019;25(6):954-961.

[16] Topol EJ. High-performance medicine: the convergence of human and artificial intelligence. Nat Med. 2019;25(1):44-56.

[17] Esteva A, Kuprel B, Novoa RA, Ko J, Swetter SM, Blau HM, et al. Dermatologist-level classification of skin cancer with deep neural networks. Nature. 2017;542(7639):115-118.

[18] Litjens G, Kooi T, Bejnordi BE, Setio AAA, Ciompi F, et al. A survey on deep learning in medical image analysis. Med Image Anal. 2017;42:60-88.

[19] Shen D, Wu G, Suk HI. Deep Learning in Medical Image Analysis. Annu Rev Biomed Eng. 2017;19:221-248.

[20] Yamashita R, Nishio M, Do RKG, Togashi K. Convolutional neural networks: an overview and application in radiology. Insights Imaging. 2018;9(4):611-629.

[21] Erickson BJ, Korfiatis P, Akkus Z, Kline TL. Machine Learning for Medical Imaging. Radiographics. 2017;37(2):505-515.

[22] Willemink MJ, Koszek WA, Hardell C, Wu J, Fleischmann D, et al. Preparing Medical Imaging Data for Machine Learning. Radiology. 2020;295(1):4-15.

[23] Kelly CJ, Karthikesalingam A, Suleyman M, Corrado G, King D. Key challenges for delivering clinical impact with artificial intelligence. BMC Med. 2019;17(1):195.

[24] Varoquaux G, Cheplygina V. Machine learning for medical imaging: methodological failures and recommendations for the future. NPJ Digit Med. 2022;5(1):48.

[25] Nagendran M, Chen Y, Lovejoy CA, Gordon AC, Komorowski M, et al. Artificial intelligence versus clinicians: systematic review of design, reporting standards, and claims of deep learning studies. BMJ. 2020;368:m689.

[26] Hosny A, Parmar C, Quackenbush J, Schwartz LH, Aerts HJWL. Artificial intelligence in radiology. Nat Rev Cancer. 2018;18(8):500-510.

[27] Chartrand G, Cheng PM, Vorontsov E, Drozdzal M, Turcotte S, et al. Deep Learning: A Primer for Radiologists. Radiographics. 2017;37(7):2113-2131.

[28] Choy G, Khalilzadeh O, Michalski M, et al. Current Applications and Future Impact of Machine Learning in Radiology. Radiology. 2018;288(2):318-328.

[29] LeCun Y, Bengio Y, Hinton G. Deep learning. Nature. 2015;521(7553):436-444.

[30] Samek W, Montavon G, Vedaldi A, Hansen LK, Müller KR. Explainable AI: Interpreting, Explaining and Visualizing Deep Learning. Springer; 2019.

[31] Rudin C. Stop explaining black box machine learning models for high stakes decisions and use interpretable models instead. Nat Mach Intell. 2019;1(5):206-215.

[32] Holzinger A, Langs G, Denk H, Zatloukal K, Müller H. Causability and explainability of artificial intelligence in medicine. Wiley Interdiscip Rev Data Min Knowl Discov. 2019;9(4):e1312.

[33] Yu KH, Beam AL, Kohane IS. Artificial intelligence in healthcare. Nat Biomed Eng. 2018;2(10):719-731.

[34] Ker J, Wang L, Rao J, Lim T. Deep Learning Applications in Medical Image Analysis. IEEE Access. 2018;6:9375-9389.

[35] Mazurowski MA, Buda M, Saha A, Bashir MR. Deep learning in radiology: An overview of the concepts and a survey of the state of the art. Magn Reson Imaging. 2019;57:1-14.

[36] Titano JJ, Badgeley M, Schefflein J, Pain M, Su A, et al. Automated deep-neural-network surveillance of cranial images for acute neurologic events. Nat Neurosci. 2018;21(9):1265-1272.

[37] Norgeot B, Glicksberg BS, Butte AJ. A call for deep-learning healthcare. Nat Med. 2019;25(1):14-15.

[38] Sendak MP, Gao M, Brajer N, et al. Presenting machine learning model information to clinical end users with model facts labels. NPJ Digit Med. 2020;3:41.

[39] Kaul D, Rajan SP, et al. Challenges of AI in medical imaging. Diagnostics. 2023;13(12):2105.

[40] Pesapane F, Codari M, Sardanelli F. Artificial intelligence in medical imaging: threat or opportunity? Radiologists again at the forefront of innovation in medicine. Eur Radiol Exp. 2018;2(1):35.

[41] Recht MP, Dewey M. Artificial intelligence in diagnostic imaging: status and future opportunities. J Med Imaging Radiat Oncol. 2023;67(1):3-7.

[42] Oren O, Gersh BJ, Bhatt DL. Artificial intelligence in medical imaging: the move from pixels to phenotypes. Eur Heart J. 2020;41(25):2339-2341.

[43] Currie G, Hawk KE, Rohren E, Vial A, Klein R. Machine Learning and Deep Learning in Medical Imaging: Intelligent Imaging. J Med Imaging Radiat Sci. 2019;50(4):477-487.

[44] Montagnon E, Cerny M, Cadrin-Chênevert A, et al. Deep learning workflow in radiology: a primer. Insights Imaging. 2020;11(1):22.

[45] Soffer S, Ben-Cohen A, Shimon O, Amitai MM, Greenspan H, Klang E. Convolutional Neural Networks for Radiologic Images: A Radiologist's Guide. Radiology. 2019;290(3):590-606.

[46] Neri E, de Souza N, Brady A, et al. What the radiologist should know about artificial intelligence and radiomics. Eur Radiol. 2023;33(2):907-915.

[47] Wang R, et al. Artificial intelligence in radiology: current status and future directions. Quant Imaging Med Surg. 2022.

[48] Huang S, et al. Artificial intelligence in radiology: opportunities and challenges. Front Med. 2023.

[49] Chen X, et al. Deep learning for medical image analysis: a review. Comput Biol Med. 2022.

[50] Li X, et al. Explainable artificial intelligence in healthcare: a review. Artif Intell Med. 2024.

[51] Johnson KB, et al. Precision medicine in radiology. J Am Coll Radiol. 2021.

[52] Thrall JH, et al. Artificial Intelligence and Machine Learning in Radiology. Radiology. 2018.

[53] Kahn CE Jr. Artificial Intelligence in Radiology: The Radiologist's Role. Radiology. 2020.

[54] Dreyer KJ, Geis JR. Artificial Intelligence for the Radiologist. Radiology. 2017.

[55] Reiner BI. Artificial Intelligence in Radiology: The Journey So Far. J Digit Imaging. 2022.

[56] Obuchowicz R, Strzelecki M, Piórkowski A. Clinical applications of artificial intelligence in medical imaging and image processing—A review. Cancers. 2024 May 14;16(10):1870.

[57] Xian T, Constantinides P, Mehandjiev N. Interpretable artificial intelligence systems in medical imaging: review and theoretical framework. Research Handbook on Artificial Intelligence and Decision Making in Organizations. 2024 Mar 19:240-65.

[58] Bradshaw TJ, Huemann Z, Hu J, Rahmim A. A guide to cross-validation for artificial intelligence in medical imaging. Radiology: Artificial Intelligence. 2023 May 24;5(4):e220232.

[59] Bakare¹ SS, Adeniyi AO, Akpuokwe CU, Eneh⁴ NE. Data privacy laws and compliance: a comparative review of the EU GDPR and USA regulations.

[60] Marey A, Arjmand P, Alerab AD, Eslami MJ, Saad AM, Sanchez N, Umair M. Explainability, transparency and black box challenges of AI in radiology: impact on patient care in cardiovascular radiology. Egyptian Journal of Radiology and Nuclear Medicine. 2024 Sep 13;55(1):183.

[61] Tajbakhsh N, Roth H, Terzopoulos D, Liang J. Guest editorial annotation-efficient deep learning: the holy grail of medical imaging. IEEE transactions on medical imaging. 2021 Sep 30;40(10):2526-33.

[62] Veenhuizen M, O'Malley A. Demographic biases in AI-generated simulated patient cohorts: a comparative analysis against census benchmarks. Advances in Simulation. 2025 Dec;10(1):58.

[63] Marolla C. ICT Transformation in Healthcare: A Risk-Based Approach for Climate Adaptation in Low and Middle-Income Countries.

[64] Coppola F, Faggioni L, Gabelloni M, De Vietro F, Mendola V, Cattabriga A, Cocozza MA, Vara G, Piccinino A, Lo Monaco S, Pastore LV. Human, all too human? An all-around appraisal of the "artificial intelligence revolution" in medical imaging. Frontiers in psychology. 2021 Sep 28;12:710982.

[65] Aluthge Don Y. Regulatory Perspectives of AI as Medical Device: a scoping review.

[66] Raposo H. Artificial Intelligence-Enabled Medical Imaging for Early Disease Detection: Methodological Advances, Clinical Validation, and Translational Challenges. Clinical Validation, and Translational Challenges (December 15, 2025). 2025 Dec 15.

[67] Krichen M, Aoun NB. AI-Driven Medical Image Analysis: Challenges and Limitations. InAI for Medical Image Analysis: Reconciling Innovation and Ethical Considerations 2025 Aug 24 (pp. 213-232). Cham: Springer Nature Switzerland.

[68] Li X, Zhang L, Yang J, Teng F. Role of artificial intelligence in medical image analysis: A review of current trends and future directions. Journal of Medical and Biological Engineering. 2024 Apr;44(2):231-43.

[69] Bhati D, Neha F, Amiruzzaman M. A survey on explainable artificial intelligence (XAI) techniques for visualizing deep learning models in medical imaging. Journal of Imaging. 2024 Sep 25;10(10):239.

[70] Katzman BD, van der Pol CB, Soyer P, Patlas MN. Artificial intelligence in emergency radiology: a review of applications and possibilities. Diagnostic and interventional imaging. 2023 Jan 1;104(1):6-10.

[71] Khan SN, Danishuddin, Khan MW, Guarnera L, Akhtar SM. Multi-modal AI in precision medicine: integrating genomics, imaging, and EHR data for clinical insights. Frontiers in Artificial Intelligence. 2025;8:1743921.

[72] Razek A. Image-Guided Autonomous Robotic Surgery in the Context of Therapies Managed by Intelligent Digital Technologies: A Narrative Review. Surgeries. 2026 Feb 16;7(1):26.

[73] von der Heyden Y. AI in Healthcare: Analysis of AI Impact in the Domain of Medical Diagnosis (Master's thesis, Universidade NOVA de Lisboa (Portugal)).

[74] AlSaad R, Abd-Alrazaq A, Boughorbel S, Ahmed A, Renault MA, Damseh R, Sheikh J. Multimodal large language models in health care: applications, challenges, and future outlook. Journal of medical Internet research. 2024 Sep 25;26:e59505.

[75] Singh B, Nayyar A, Kaunert C. Multi-modal Legal Application on Advanced Federated Learning Technique for Healthcare Industry 4.0: Applications, Taxonomies, and Security-Privacy Issues. InConvergence of AI, Federated Learning, and Blockchain for Sustainable Development 2025 Aug 9 (pp. 89-101). Cham: Springer Nature Switzerland.

[76] Bhandari A. Revolutionizing radiology with artificial intelligence. Cureus. 2024 Oct 29;16(10).

[77] Giansanti D. Revolutionizing medical imaging: the transformative role of artificial intelligence in diagnostics and treatment. Diagnostics. 2025 Jun 18;15(12):1557.

INTERNATIONAL JOURNAL OF PROGRESSIVE RESEARCH IN ENGINEERING MANAGEMENT AND SCIENCE (IJPREMS)
(Int Peer Reviewed Journal)
Vol. 06, Issue 07, July 2026, pp : 558-573
www.ijprems.com
editor@ijprems.com
e-ISSN : 2583-1062
Impact Factor : 7.001

[78] Vanaparthi R, Rao SV. Revolutionizing health care: ai-enabled disease diagnosis, outcome prediction & operational efficiency. Turkish Journal of Computer and Mathematics Education. 2023;14(3):993-1001.

[79] Khosravi P, Fuchs TJ, Ho DJ. Artificial intelligence–driven cancer diagnostics: enhancing radiology and pathology through reproducibility, explainability, and multimodality. Cancer Research. 2025 Jul 2;85(13):2356-67.

[80] Najjar R. Redefining radiology: a review of artificial intelligence integration in medical imaging. Diagnostics. 2023 Aug 25;13(17):2760.