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Research Article

Medical Imaging to Precision Care - AI-Based Radiomics and Radiogenomics in Health Care

Pragati [1], Aditya [2], Bhoomi [3], Sanjay [4], Nishi Thakur [5*]

[1-4] Bachelor of Medical Radiology and Imaging Scholars, Department of Allied and Health Sciences, Doon Institute of Medical Sciences, Uttarakhand, India

[5] Assistant Professor (Radiology), Department of Allied and Health Sciences, Doon Institute of Medical Sciences, Uttarakhand, India

Corresponding Author: * Nishi Thakur

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Abstract

Medical imaging has undergone a transformative shift with the integration of Artificial Intelligence (AI), particularly through the emerging fields of Radiomics and Radio genomics. Cancer and other complex diseases demand early, accurate, and non-invasive diagnostic approaches that go beyond the limitations of conventional histopathological and visual interpretation methods. Radiomics enables the extraction of high-dimensional quantitative features — including shape, intensity, texture, and spatial relationships — from standard medical images such as CT, MRI, PET, and ultrasound, converting them into actionable mineable data. Radiogenomics further extends this framework by correlating these imaging phenotypes with genomic and molecular alterations, offering a deeper, non-invasive understanding of disease biology. AI algorithms, particularly Machine Learning (ML) and Deep Learning (DL) models such as Convolutional Neural Networks (CNNs), have demonstrated high accuracy in tumour detection, segmentation, classification, and treatment response prediction. Together, these technologies hold significant promise in oncology for differentiating benign from malignant tumours, predicting patient survival, and guiding personalised therapeutic strategies. However, challenges, including a lack of standardisation, limited high-quality datasets, and data privacy concerns, must be addressed for broader clinical adoption. This review evaluates the current role, clinical applications, and limitations of AI-based Radiomics and Radiogenomics in advancing precision medicine and improving patient outcomes.

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1. INTRODUCTION

Cancer is one of the major causes of death worldwide. It poses a significant burden on healthcare systems. Early detection, correct diagnosis, and effective treatment planning are essential to improve the survival rate of the diseased. Traditional approaches for diagnosis, such as histopathological analysis and biopsy provide significant information about tumour characteristics. However, these methods can be time consuming cost ineffective and sometimes unable to catch the complexity of such tumours. In recent years, medical imaging has played an important role in the diagnosis and prognosis of cancer and other diseases [2, 5].

Medical imaging techniques such as computed tomography (CT) positron emission tomography (PET), magnetic resonance imaging (MRI) and ultrasound have enhanced the ability of clinicians to visualise internal body structures and detect various pathological changes. These imaging modalities provide critical information that supports clinical decision-making and helps guide various strategies for treatment. Traditionally radiologists interpret medical images based on visual and qualitative analysis. Although this approach has been effective it might not fully capture the subtle imaging patterns and quantitative information of the underlying disease. With the rapid advancement of technologies Artificial Intelligence (AI) has emerged as a powerful tool which transforms medical imaging from diagnostic modality to a data drive platform for precision medicine.AI uses its techniques, such as Machine Learning and Deep Learning, to enable computers to analyse large amounts of imaging data and identify complex patterns that can be missed by the human eye. These technologies extract detailed quantitative information from medical images, thereby improving the accuracy of diagnosis and prediction of clinical outcomes [2, 6].

One of the most important developments in this field is Radiomics, which refers to the extraction of quantitative features from medical images. It converts standard medical images into mineable data by analysing characteristics such as shape, intensity, texture, and spatial relationships with tissues.

These features can reveal various important information, such as tumour heterogeneity, its tissue composition and disease progression. By analysing these biomarkers, radiomics can assist in disease identification, classification prognosis and treatment response evaluation. It has shown promising applications, particularly in oncology. Tumours often have significant heterogeneity, meaning different regions of the same tumor may have different biological and molecular characteristics. Conventional methods may not capture such heterogeneities through visual interpretation alone. Radiomics enables more complex analysis from images, which helps reflect the underlying properties of the tumour. This supports clinicians in identifying aggressive tumours and predicting their disease progression for precision treatment [1, 3, 4].

Radio genomics represents an extension of Radiomics that blends imaging features with genomic and molecular data. Radio genomics aims to establish a correlation between genetic alteration and imaging phenotype. This integration allows scholars to explore how genetic mutations influence the imaging appearance of diseases. In cancer research, it has been established a potential to identify specific gene mutations and expressions, as with tumour characteristics allowing a deeper understanding of disease mechanisms. The integration ofAI based Radiomics and Radio genomics is aligned closely with the concept of precision medicine, which focuses on providing characteristic medical treatment to the patient that they require. By combining imaging biomarkers with genomic information, AI-driven models can provide a deeper understanding of disease biology and support the development of concept of personalized therapeutic approaches [1, 5, 6].

In recent years significant research efforts have been made towards improving the accuracy of reliability and clinical applicability of AI based Radiomics and Radio genomics. Advances have been observed in computational power deep learning algorithms and also the availability of large number of imaging datasets. These have significantly accelerated the progress in this field.

Continued research and technological innovation are expected to further expand the role of AI driven Radiomics and Radio genomics in modern healthcare systems [2, 3, 6].

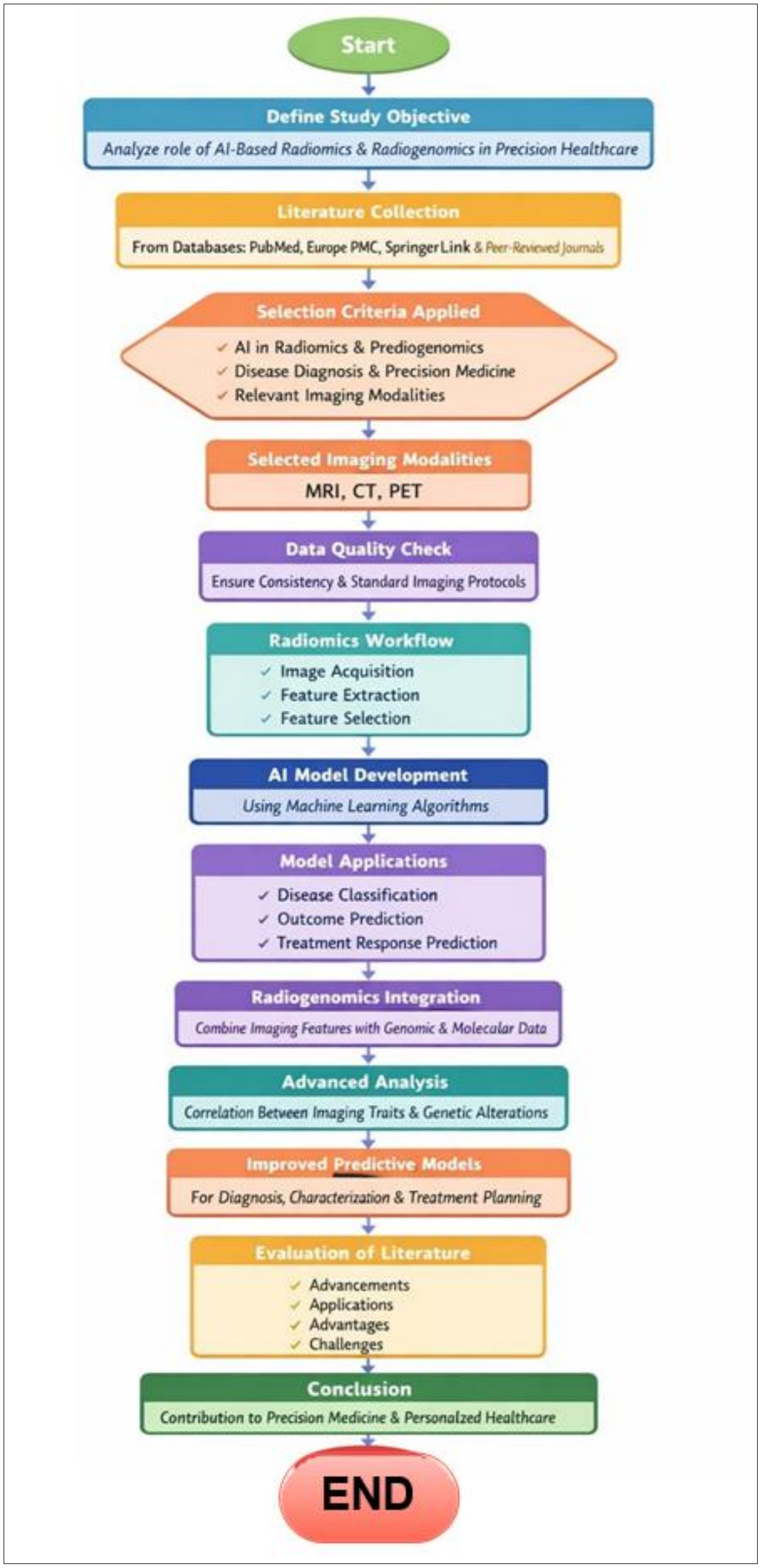
AIM

To evaluate the role of AI-based radiomics and radio genomics in enhancing medical imaging for improved disease detection diagnosis prognosis and advancement of precision medicine.

2. OBJECTIVE

- To understand the fundamental concepts and workflow of AI-based radiomics and radiogenomics in medical imaging.
- To evaluate the advantages and clinical applications, including improved diagnosis, prognosis, and personalised treatment strategies.
- To identify the challenges and limitations affecting their implementation in healthcare systems.

3. METHODOLOGY


Start
Define Study Objective
Analyze role of AI-Based Radiomics & Radiogenomics in Precision Healthcare
Literature Collection
From Databases: PubMed, Europe PMC, SpringerLink & Peer-Reviewed Journals
Selection Criteria Applied
AI in Radiomics & Prediogenomics
Disease Diagnosis & Precision Medicine
Relevant Imaging Modalities
Selected Imaging Modalities
MRI, CT, PET
Data Quality Check
Ensure Consistency & Standard Imaging Protocols
Radiomics Workflow
Image Acquisition
Feature Extraction
Feature Selection
AI Model Development
Using Machine Learning Algorithms
Model Applications
Disease Classification
Outcome Prediction
Treatment Response Prediction
Radiogenomics Integration
Combine Imaging Features with Genomic & Molecular Data
Advanced Analysis
Correlation Between Imaging Traits & Genetic Alterations
Improved Predictive Models
For Diagnosis, Characterization & Treatment Planning
Evaluation of Literature
Advancements
Applications
Advantages
Challenges
Conclusion
Contribution to Precision Medicine & Personalzed Healthcare
END

4. DISCUSSIONS

Artificial intelligence plays a crucial role in enabling advanced analysis of radiomics, Radio genomics. Machine learning algorithms can process large amounts of imaging and genomic data to identify patterns that are difficult for humans to detect. Deep learning techniques particularly convolution neural network (CNN)m have shown significant performance in image analysis task such as tumor detection segmentation and classification. These AI based models can assistclinicians in making more accurate and efficient diagnostic decisions [2, 3].

Despite the promising potential of these technologies, several different challenges must be addressed before their widespread clinical application. One of the major drawbacks is the lack of standardization in Radiomics research. Differences in imaging protocols, segmentation methods and feature extraction techniques can lead to variability in results across different researches. Standardized guidelines and protocols are crucial to ensure the correct use of radiomic analysis. [2, 3, 5].

Another challenge is the need of various large number of high-quality datasets to train the AI models. Machine learning algorithms require large number of extensive data to achieve reliable performance and limited datasets may lead to reduced generalisability [2, 3, 5, 6].

Collaboratvie data sharing initiatives and multi institutional research efforts can help overcome this limitation. Ethical considerations and data privacy issues also need to be carefully addressed when using patient's imaging and genomic data. Ensuring their security and confidentiality of medical data is crucial for maintaining their trust and complying with the standard protocols [2, 6].

Overall the combination of artificial intelligence Radiomics and Radio genomics represents a powerful approach for advancing medical imaging and precision care. Continued research and technological innovation will likely improve the accuracy clinical applicability and reliability of these methods in the future [1, 2, 6].

5. RESULTS

The analysis of the selected research articles highlights the rapidly expanding role of artificial intelligence (AI) radiomics and radio genomics in transforming modern medical imaging and advancing precision healthcare. The reviewed studies consistently demonstrate that the integration of AI with imaging data significantly enhances disease detection characterization and prediction thereby supporting more effective and strategic treatment planning [1-6].

Several studies report that radiomics enables the extraction of a large volume of high-dimensional quantitative features from medical images. These features provide detailed insights into tissue architecture tumor heterogeneity and underlying pathological characteristics that are often not visible through conventional qualitative analysis. Radiomic features have been successfully utilized to develop robust predictive models for disease classification, diagnosis, and prognosis assessment [1, 3-5]. In oncology radiomics has shown particularly promising outcomes. Research findings indicate that features derived from CT and MRI imaging can effectively differentiate between benign and malignant tumors assess tumor aggressiveness and predict patient survival rates. Furthermore radiomics has been applied to evaluate treatment response in patients undergoing chemotherapy radiotherapy and targeted therapies enabling clinicians to monitor therapeutic effectiveness and adjust treatment strategies accordingly [1, 3, 4].

Radio genomics studies further reveal a strong correlation between imaging features and genetic as well as molecular alterations. This integrative approach is especially valuable in cancer research where genetic variations play a critical role in tumor growth metastasis and treatment response. By linking imaging phenotypes with genomic data radio genomics provides a non-invasive method to understand tumor biology in greater depth [2, 5, 6].

Additionally AI-based algorithms including machine learning and deep learning models have demonstrated high accuracy in identifying disease patterns and generating predictive models. In many cases these AI-driven approaches outperform traditional imaging interpretation methods offering improved diagnostic precision and reproducibility [2-4].

Overall the findings from the reviewed literature indicate that AI-based radiomics and radio genomics have substantial potential to enhance medical imaging by providing deeper insights into disease mechanisms improving diagnostic accuracy and enabling more personalized and effective treatment planning. These technologies are therefore emerging as powerful tools in the advancement of precision medicine [2, 6].

6. CONCLUSION

Artificial intelligence based Radiomics and radio genomics are rapidly changing the role of medical imaging in modern healthcare. These technologies allow medical images to be analyzed in a more detailed and quantitative way by extracting useful data from imaging features and combining them with genetic and molecular information. As a result they help in understanding disease characteristics, more clearly and support better early decision making. The use of artificial intelligence algorithms in Radiomics and Radio genomics allows the creation of predictive models which assist clinician in detecting diseases predicting treatment response and planning appropriate therapy. These technologies have shown significant potential in oncology where accurate tumor characterization is important for selecting effective treatment methods and improving patient outcomes. However several challenges still exist before these technologies can fully be operated. In the future continuous advancements in artificial intelligence medical imaging technologies and biomedical data analysis are expected to strengthen the role of AI based Radiomics and Radio genomics in precision medicine. These developments will help healthcare professionals provide more personalized and effective treatments based on the individual characteristics of each patient. Overall AI driven Radiomics and Radio genomics have the potential to significantly improve medical imaging by enhancing diagnostic accuracy supporting personalized treatment on time and ultimately improving the patient care.

REFERENCES

1. Artificial intelligence-based MRI radiomics and radio genomics in glioma Fan *et al*. https://pmc.ncbi.nlm.nih.gov/articles/PMC10938723/
2. Saxena S, Jena B, Gupta N, Das S, Sarmah D, Bhattacharya P, *et al*. Role of Artificial Intelligence in Radio genomics for Cancers in the Era of Precision Medicine. Cancers. 2022;14(12):2860–N.PAG. https://doi.org/10.3390/cancers14122860SpringerLink article
3. Zeng S, Wang X, Yang H. Radiomics and radiogenomics: extracting more information from medical images for the diagnosis and prognostic prediction of ovarian cancer. Military Medical Research. 2024;11(1):77. https://doi.org/10.1186/s40779-024-00580-1
4. Advancements in Radiomics-Based AI for Pancreatic ductal adenocarcinoma. (2025). Georgios Lekkas ORCID, Eleni Vrochidou ORCID and Georgea. Papakostas *ORCID. 2025;12(8):10.3390/bioengineering12080849. https://www.mdpi.com/2306-5354/12/8/849
5. Europe PMC. (n.d.). Europe PMC. https://europepmc.org/article/pmc/pmc9406706
6. Europe PMC. (n.d.-b). Europe PMC. https://europepmc.org/article/MED/35740526

About the Corresponding Author
Nishi Thakur is serving as an Assistant Professor (Radiology) in the Department of Allied and Health Sciences at Doon Institute of Medical Sciences, Uttarakhand, India. Her academic and professional interests focus on radiological sciences, medical imaging, healthcare education, and allied health research.