RESEARCH ARTICLE OPEN ACCESS

Artificial Intelligence-Based Diagnostic Imaging in Healthcare

Arefeh Abdi
Westcliff University, College of Technology & Engineering (Department)
Student of Master of science in information technology, Irvine, California, USA
Email: Arefeh_abdi@live.com

--*********************-----------------------------------

Abstract
The infusion of artificial intelligence (AI) into the realm of diagnostic imaging is revolutionizing the healthcare landscape, presenting unprecedented opportunities and formidable challenges. This comprehensive review meticulously amalgamates insights gleaned from pivotal literature to furnish an all-encompassing delineation of AI-centric diagnostic imaging within the healthcare domain. The profound importance of diagnostic imaging, coupled with the meteoric strides in AI, accentuates the transformative prowess inherent in this intersection. We embark on an exploration of the historical metamorphosis of diagnostic imaging, delving into conventional methodologies and their inherent constraints. Concurrently, we introduce the foundational tenets of AI, with a particular emphasis on the realms of machine learning and deep learning. This scholarly exposition navigates through the specific applications of AI in the realm of medical imaging, spanning across disciplines such as radiology, pathology, cardiology, neuroimaging, oncology, gastroenterology, nephrology, and urology. Leveraging illustrative case studies, we elucidate instances of triumphant AI applications, underscoring the palpable impact on diagnostic precision and, by extension, patient outcomes. Notwithstanding these laudable advancements, formidable challenges loom large, encompassing technical intricacies, algorithmic bias, and ethical quandaries. This discourse delves into the pressing need for transparency, the safeguarding of patient privacy, and the imperative to mitigate bias within the tapestry of AI applications. The denouement of this review encapsulates a forward-looking perspective, casting a discerning eye on collaborative initiatives and charting the trajectory of future prospects for AI within the realm of diagnostic imaging. The evolving narrative underscores not only the advancements but also the conscientious considerations required to navigate the ethical dimensions of this transformative integration.

Keywords: Artificial Intelligence, Diagnostic Imaging, Healthcare, Machine Learning, Medical Applications

--*********************-----------------------------------

Introduction

In contemporary healthcare, diagnostic imaging assumes a pivotal role, unraveling profound insights into the intricate internal structures and functions of the human body. It stands as a linchpin for precise disease diagnosis, meticulous treatment planning, and vigilant monitoring of therapeutic interventions. The infusion of artificial intelligence (AI) into diagnostic imaging has emerged as a revolutionary force, reshaping entrenched paradigms and amplifying the capabilities of healthcare professionals.

The rapid strides in AI have ushered in a new epoch of diagnostic imaging, marked by heightened precision, efficiency, and diagnostic acumen. As AI technologies evolve, their imprint on diagnostic imaging becomes increasingly conspicuous, holding the potential to fundamentally transfigure clinical practice. This review navigates the intersection of AI and diagnostic imaging, delving into recent developments and their ramifications for healthcare.

The amalgamation of AI with diagnostic imaging is fueled by breakthroughs in machine learning, deep learning, and computer vision. AI algorithms exhibit the prowess to scrutinize extensive imaging data with unparalleled celerity and precision, facilitating the discernment of nuanced abnormalities and patterns that may elude human perception. This prowess is particularly conspicuous in radiology, where AI-based models contribute to the premature detection of various maladies, encompassing cancer and neurological disorders.

Recent investigations showcase the efficacy of AI across diverse imaging modalities. For instance, convolutional neural networks (CNNs), a subset of deep learning, find application in object detection and segmentation in medical images (Qiang et al., 2020). Furthermore, three-dimensional deep learning models demonstrate promise in lung cancer screening, deploying low-dose chest computed tomography (Ardila et al., 2019). The utilization of AI in breast cancer detection through mammography exhibits comparable performance to human radiologists, underscoring its potential for mitigating false-positive identifications (Mayo et al., 2019; Rodriguez-Ruiz et al., 2019).

Beyond conventional radiology, AI permeates diverse realms of diagnostic imaging. In stroke imaging, machine learning models contribute to the early detection of infarction in acute stroke cases using non-contrast-enhanced CT scans (Qiu et al., 2020). The potential of AI extends into neuroimaging, where it aids decision support for acute stroke and large-vessel occlusion detection (Soun et al., 2021; Zhu et al., 2022). AI's application is not confined to oncology and neurology but encompasses musculoskeletal radiography, aiding in the detection of abnormalities in this domain (He et al., 2021).

This review aspires to comprehensively scrutinize the integration of AI into diagnostic imaging, with a keen focus on its applications, impact, and future trajectories in healthcare. By amalgamating evidence from recent studies, our aim is to expound on the contributions of AI to diagnostic precision, workflow optimization, and patient outcomes. The scope of the review encompasses various imaging modalities, including radiography, CT, MRI, and ultrasound, with a particular emphasis on the diverse clinical applications of AI.

As diagnostic imaging evolves with technological advancements, it is imperative to scrutinize the implications of AI on clinical decision-making, patient care, and the role of healthcare professionals. This review strives to furnish insights into the current state of AI in diagnostic imaging, spotlighting its strengths, limitations, and ethical considerations. Additionally, the review delves into the challenges and opportunities accompanying the widespread adoption of AI in healthcare, underscoring the imperative for continued research and collaboration between academia and industry.

This review acknowledges the pivotal role of diagnostic imaging in healthcare and delineates the transformative impact of AI on this critical domain. By scrutinizing recent advancements and applications, the review aspires to contribute to a comprehensive understanding of the synergy between AI and diagnostic imaging, laying the groundwork for future innovations and enhancements in patient care.

Background

The realm of healthcare has been significantly influenced by diagnostic imaging, a critical facet that facilitates non-invasive exploration of internal structures, thereby contributing to disease diagnosis and treatment planning. Tracing the roots of diagnostic imaging, one encounters Wilhelm Roentgen's 1895 revelation of X-rays, marking the genesis of radiology (Bushberg & Seibert, 2022). Subsequent decades bore witness to the evolution of diverse imaging modalities, encompassing computed tomography (CT), magnetic resonance imaging (MRI), ultrasound, and positron emission tomography (PET). The advent of CT in the 1970s proved revolutionary, offering cross-sectional body images and surmounting the constraints of conventional radiography. The 1980s saw the introduction of MRI, providing superior soft tissue contrast sans ionizing radiation, thereby broadening diagnostic horizons. Ultrasound, relying on sound waves, became a prevalent real-time imaging modality, particularly in obstetrics. PET, utilizing radioactive tracers, enabled functional imaging and metabolic assessments.

While conventional diagnostic imaging methods have played pivotal roles, they are not without inherent limitations. Traditional radiography yields two-dimensional images and subjects patients to ionizing radiation. Despite its high resolution, CT imaging involves radiation exposure and may not be conducive to repeated examinations. MRI, while eschewing ionizing radiation, incurs relatively higher costs and consumes more time. Ultrasound encounters limitations in imaging deeper structures, and PET imaging involves exposure to radioactive substances (Cherry et al., 2018; Hutton et al., 2011). Sensitivity, specificity, and at times, invasiveness pose challenges for these conventional imaging techniques. Additionally, the interpretive process heavily leans on radiologists' expertise, introducing variability in diagnostic accuracy.

The incorporation of artificial intelligence (AI) into healthcare heralds a paradigm shift, presenting solutions to the drawbacks of traditional diagnostic imaging. Encompassing machine learning and deep learning, AI endows computers with the capacity to discern patterns from data and make predictions or decisions sans explicit programming (Gupta et al., 2023). Within the healthcare context, AI stands poised to augment diagnostic accuracy, streamline workflow, and enhance patient outcomes significantly. The application of AI in diagnostic imaging is distinguished by the development of intricate algorithms capable of expeditiously and precisely analyzing copious amounts of medical data. Machine learning techniques, notably convolutional neural networks (CNNs), have showcased efficacy in image recognition tasks, particularly in the field of radiology (Krizhevsky et al., 2017; LeCun et al., 2015). Deep learning models, including three-dimensional architectures, have presented promising outcomes, particularly in the realm of lung cancer screening utilizing low-dose CT scans (Ardila et al., 2019). The advent of AI in diagnostic imaging marks a transformative epoch where computational algorithms complement the capabilities of healthcare professionals, contributing to more precise and efficient diagnoses.

In this foundational discourse, we shall delve into the historical progression of diagnostic imaging techniques, spotlighting their inherent strengths and limitations. Furthermore, we shall scrutinize the rise of AI and its pivotal role in reshaping diagnostic imaging, laying the groundwork for a comprehensive comprehension of the intricate interplay between technology and healthcare.

Fundamentals of Artificial Intelligence

The realm of Artificial Intelligence (AI) stands as a domain within computer science committed to the creation of intelligent mechanisms capable of executing tasks that traditionally necessitate human intellectual acuity. The foundational tenets of AI encompass a spectrum of methodologies, ranging from rule-based systems and expert systems to the more prominently featured machine learning (ML) and deep learning (DL). In the domain of healthcare, the deployment of AI strives to amplify diagnostic proficiencies, optimize treatment blueprints, and elevate the overall standard of patient care. At its core, AI revolves around the formulation of algorithms that endow machines with the capacity to emulate human cognitive functions. While rule-based and expert systems rely on predetermined sets of rules and knowledge bases, thereby constraining their adaptability to novel data configurations, machine learning, conversely, bestows algorithms with the ability to iteratively learn from data, refining their efficacy through experiential iterations (Najjar, 2023). This iterative learning modality empowers AI systems to unveil concealed patterns and glean insights from intricate datasets.

The Role of Machine Learning in Healthcare assumes a pivotal stance in reshaping the healthcare landscape by providing tools for data scrutiny, prognosis, and decision-making. In healthcare applications, ML algorithms undergo training on diverse datasets, spanning patient records, medical imagery, and clinical annotations. This training process equips algorithms to discern patterns, correlations, and aberrations within the data milieu, thereby contributing to heightened diagnostic precision and the formulation of personalized treatment paradigms (Hosny et al., 2018). The prevalent approach of supervised learning, entailing the training of algorithms on labeled datasets where the model assimilates the mapping of input data to predefined output labels, has manifested notable success in medical image interpretation, including the identification of irregularities in radiographic imagery (Rashidi et al., 2019). On the other hand, unsupervised learning, an alternative ML paradigm, permits algorithms to discern patterns within unlabeled datasets, facilitating tasks such as clustering and anomaly identification. Reinforcement learning, inspired by behavioral psychology, entails training algorithms through reward-based systems, rendering it well-suited for decision-making processes.

Delving into the Role of Deep Learning in Healthcare, Deep Learning (DL) constitutes a subset of ML that introduces neural networks with multiple strata, commonly referred to as deep neural networks. This architectural intricacy empowers the extraction of intricate hierarchical features from data. Convolutional Neural Networks (CNNs) emerge as prevalent structures within DL, showcasing remarkable efficacy in healthcare applications (LeCun et al., 2015). Specifically, CNNs, renowned for their proficiency in image-related tasks, excel in endeavors such as medical image segmentation and ailment categorization (Krizhevsky et al., 2017). Within the healthcare domain, DL distinguishes itself by adeptly acquiring complex representations directly from raw data, obviating the requirement for manual feature engineering. This attribute positions DL as particularly advantageous for tasks pertaining to medical imaging, genomics, and natural language processing. For instance, DL models have exhibited promising outcomes in discerning pulmonary tuberculosis from chest radiographs (Hwang et al., 2019). The discerning prowess of DL algorithms in deciphering intricate patterns within extensive and heterogeneous datasets establishes them as potent instruments in the pursuit of more precise and streamlined healthcare solutions.

The diagram delineating the healthcare continuum, as depicted in figure 1, delineates four principal phases: data acquisition, data scrutiny, decision formulation, and intervention implementation. AI innovations possess the capacity to augment each of these stages, thereby enhancing the caliber and efficiency of healthcare provision. To illustrate, AI can ameliorate data procurement by refining image integrity and abbreviating acquisition durations. Furthermore, AI can expedite data examination by distilling salient characteristics and delineating patterns from intricate and heterogeneous datasets. Additionally, AI can fortify decision-making processes by furnishing prognostications and suggestions grounded in data-centric models. Ultimately, AI can empower intervention by automating operations and fine-tuning treatment strategies. Unveiling the Impact of Deep Learning in Healthcare, Deep Learning (DL) delineates a subset of Machine Learning (ML) that introduces neural networks characterized by multiple tiers, commonly referred to as deep neural networks. This structural complexity endows the capability to extract intricate hierarchical attributes from data. Convolutional Neural Networks (CNNs) emerge as prevailing architectures within Deep Learning, exhibiting remarkable efficacy in healthcare domains (LeCun et al., 2015). Specifically, CNNs, renowned for their proficiency in image-related tasks, excel in endeavors such as medical image segmentation and ailment categorization(Krizhevsky et al., 2017). Within the healthcare domain, DL distinguishes itself by adeptly acquiring complex representations directly from raw data, obviating the requirement for manual feature engineering. This attribute positions DL as particularly advantageous for tasks pertaining to medical imaging, genomics, and natural language processing. For instance, DL models have exhibited promising outcomes in discerning pulmonary tuberculosis from chest radiographs (Hwang et al., 2019). The discerning prowess of DL algorithms in deciphering intricate patterns within extensive and heterogeneous datasets establishes them as potent instruments in the pursuit of more precise and streamlined healthcare solutions.

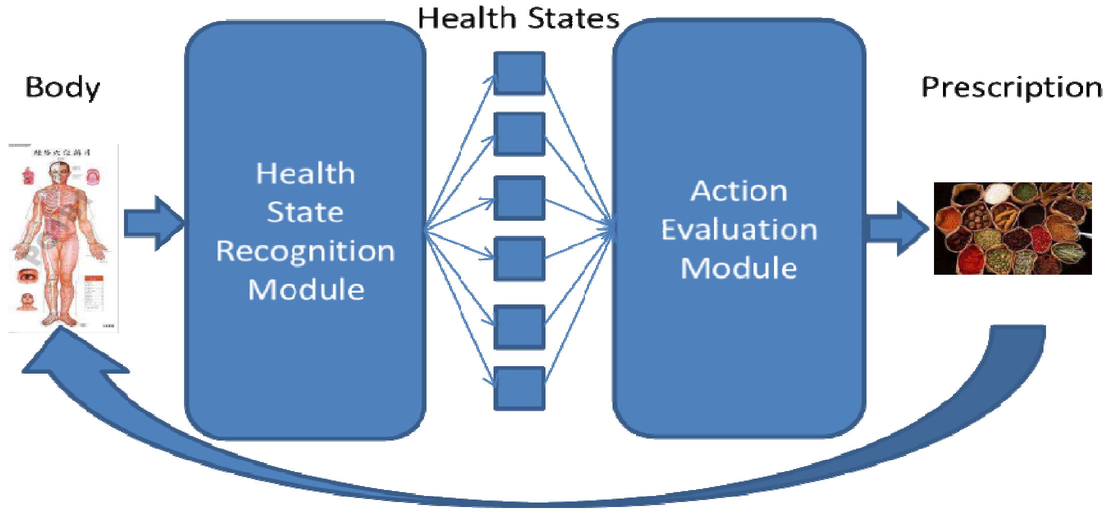

Figure 1: The illustration of healthcare process (Dai & Wang, 2020)

AI in Medical Imaging

Artificial Intelligence (AI) has emerged as a catalytic force in the realm of medical imaging, instigating a paradigm shift in diagnostic methodologies and presenting unparalleled prospects for heightened precision and efficacy. This segment furnishes an exhaustive panorama elucidating the pivotal role of AI in medical imaging, encompassing its broad applications and probing into the intricacies of challenges and opportunities attendant to its assimilation into diagnostic procedures.

AI applications in the domain of medical imaging encompass an extensive spectrum of functions, ranging from the acquisition and reconstruction of images to their interpretation and diagnostic elucidation. The infusion of AI technologies, notably machine learning and deep learning, has profoundly influenced diverse modalities, including radiography, computed tomography (CT), magnetic resonance imaging (MRI), and ultrasound. These technologies have demonstrated their acumen in automating the analysis of images, identifying anomalies, and facilitating clinicians in their decision-making processes(Amin et al., 2024).

Machine learning algorithms, when exposed to extensive datasets, manifest the capacity to discern patterns and aberrations within medical images. For instance, deep learning models, exemplified by Convolutional Neural Networks (CNNs), have displayed remarkable efficacy in tasks such as lesion identification, organ segmentation, and disease categorization (Krizhevsky et al., 2017). The assimilation of AI into medical imaging aspires to amplify human capacities, furnishing radiologists and clinicians with sophisticated instruments for more precise and efficient diagnostics.

In tandem with image analysis, AI assumes a pivotal role in image refinement and reconstruction. AI algorithms have the capability to ameliorate image quality, diminish noise, and enhance spatial resolution, thereby contributing to a more meticulous interpretation of medical images. These advancements possess the potential to revolutionize not merely diagnostic capabilities but also therapeutic planning and monitoring in clinical settings (Panayides et al., 2020).

Despite commendable strides in the integration of AI into medical imaging, several challenges persist, demanding judicious scrutiny for efficacious implementation. A primary challenge lies in the imperative for robust and diverse datasets to train AI models. The caliber and representativeness of training data wield substantial influence over the generalization prowess of AI algorithms. Inadequate or prejudiced datasets can engender algorithmic biases, thereby impinging upon the reliability and impartiality of diagnostic outcomes (Recht et al., 2020).

The explication of outputs from AI models, particularly those rooted in deep learning, poses another formidable challenge. The enigmatic nature of certain algorithms, often referred to as the "black-box" phenomenon, renders it arduous to fathom the rationale behind specific conclusions. Ensuring the

interpretability and explicability of AI-generated results assumes paramount significance in cultivating trust among healthcare professionals and upholding ethical standards (Najjar, 2023).
Moreover, the assimilation of AI into medical imaging workflows mandates substantial investments in infrastructure, training, and maintenance. Overcoming these impediments, however, unfurls unparalleled prospects for enhancing patient outcomes and propelling the field of diagnostic imaging forward. AI stands poised to streamline workflows, curtail diagnostic errors, and augment the overall efficiency of healthcare delivery (Barragán-Montero et al., 2021).
The trajectory towards AI-driven diagnostic practices necessitates a paradigmatic shift in medical education and training. Radiologists and clinicians must be equipped with the adeptness to collaborate seamlessly with AI systems, decipher AI-generated findings, and make judicious decisions based on a synergistic alliance with these technologies (Banerjee et al., 2021).
The integration of AI into medical imaging signifies a revolutionary breakthrough with far-reaching implications for diagnostic practices. While challenges abound, the opportunities to refine diagnostic precision, efficacy, and patient outcomes are profound. Subsequent sections will delve into specific applications of AI in diverse medical imaging modalities, providing insights into the transformative potential inherent in these technologies.

Literature Review

The fusion of artificial intelligence (AI) and diagnostic imaging has significantly impacted the field of radiology. In the realm of radiology and imaging automation, machine learning algorithms, particularly deep learning models, have showcased remarkable capabilities in image interpretation and analysis. A study by Ho et al. (2019) demonstrated the effectiveness of Convolutional Neural Networks (CNNs) in the automated classification of pulmonary tuberculosis using chest radiography (Ho et al., 2019). This exemplifies the potential of AI to enhance the efficiency of radiological diagnosis, especially in the context of infectious diseases.
Furthermore, Mayo et al. (2019) conducted a retrospective comparison study using an AI-based Computer-Aided Detection (CAD) system to reduce false-positive markings on mammograms (Mayo et al., 2019). The study illustrated the ability of AI to improve the accuracy of mammographic interpretations, emphasizing the role of automation in addressing challenges associated with mammography screenings.
In the domain of pathology and histopathological analysis, AI has exhibited promising results in augmenting diagnostic processes. Ardila et al. (2019) implemented three-dimensional deep learning on low-dose chest computed tomography for end-to-end lung cancer screening (Ardila et al., 2019). The study emphasized the potential of AI in early lung cancer detection, showcasing its ability to analyze complex imaging data for improved clinical outcomes.
Recent advancements in AI-driven solutions for liver imaging also contribute to the landscape of pathology. Berbís et al. (2023) highlighted the clinical impact of AI-based solutions on imaging of the pancreas and liver (Berbís et al., 2023). The review emphasized the potential of AI in providing precise analyses of liver images, contributing to the early detection of liver diseases.
AI applications in cardiovascular imaging have witnessed significant progress, as highlighted by Betancur et al. (2018). The study focused on the prognostic value of combined clinical and myocardial perfusion imaging data using machine learning(Betancur et al., 2018). This demonstrates the potential of AI in enhancing risk stratification and prognostic assessments in cardiovascular diseases, presenting an opportunity for more personalized and effective interventions.
Al'Aref et al. (2019) delved into the broader clinical applications of machine learning in cardiovascular disease(Al'Aref et al., 2019). The study showcased the versatility of AI in addressing various aspects of

cardiovascular imaging, including risk prediction and disease management. These findings underscore the diverse applications of AI in the cardiovascular domain, from image analysis to clinical decision support.

AI's role in neuroimaging has been pivotal, particularly in stroke imaging. Soun et al. (2021) explored the application of AI in acute stroke imaging, emphasizing its potential to streamline the detection and assessment of strokes(Soun et al., 2021). The study highlighted the role of AI in expediting the diagnostic process and improving patient outcomes in acute stroke cases.

Additionally, the work by Lui et al. (2020) underscored the broader implications of AI in neuroradiology(Lui et al., 2020). The authors provided insights into the current status and future directions of AI applications in neuroradiology, emphasizing the potential for AI to enhance diagnostic accuracy and efficiency in neurological imaging.

AI's impact on oncology imaging is substantial, with applications ranging from early detection to treatment planning. The study by Wang et al. (2022) showcased the accurate classification of lung nodules on CT images using the TransUnet(Wang et al., 2022), highlighting AI's potential in optimizing lung cancer diagnostics. This highlights the growing role of AI in improving the precision and efficiency of cancer detection.

Moreover, the review by Koh et al. (2022) addressed the broader landscape of AI and machine learning in cancer imaging(Koh et al., 2022). The authors provided insights into the current state of AI applications in cancer imaging, emphasizing the potential for these technologies to revolutionize cancer diagnostics and treatment planning.

In gastrointestinal imaging, AI has demonstrated its utility in detecting and diagnosing diseases. Kumar et al. (2022) discussed recent applications of AI in the detection of gastrointestinal, hepatic, and pancreatic diseases(Kumar et al., 2022). The review highlighted the potential for AI to enhance diagnostic accuracy in gastrointestinal imaging, presenting opportunities for early disease detection and intervention.

The study by Fazekas et al. (2022) provided a fundamental understanding of the role of AI and neural networks in radiology, emphasizing the basics that all radiology residents should be familiar with(Fazekas et al., 2022). The inclusion of gastrointestinal imaging in their discussion underlines the significance of AI in this specific diagnostic domain.

AI's presence in nephrology and urology imaging is exemplified by continuous learning AI applications. Loftus et al. (2022) highlighted the implementation of AI-enabled decision support in nephrology(Loftus et al., 2022). The study outlined the potential for AI to contribute to the management of renal conditions, showcasing its role in enhancing diagnostic support and treatment planning in nephrology.

The diverse applications of AI in medical imaging extend beyond traditional domains, as evidenced by the work of Nam et al. (2023). Their randomized controlled trial focused on AI improving nodule detection on chest radiographs in a health screening population(Nam et al., 2023). This study illustrates the potential for AI to impact population health by contributing to early disease detection through routine screenings.

The literature review reveals the multifaceted applications of AI in various domains of medical imaging. From enhancing diagnostic accuracy in radiology to revolutionizing cancer imaging and contributing to cardiovascular risk assessments, AI has proven to be a versatile and transformative force in the field. The next sections will delve into the fundamentals of AI and its specific applications in diagnostic imaging.

Applications of AI in Diagnostic Imaging

Chest radiographs and CT scans are pivotal in diagnosing various respiratory and cardiovascular conditions. AI has shown substantial promise in augmenting the interpretation and analysis of these imaging modalities. Candemir et al. (2021) discussed training strategies for radiology deep learning models, particularly in data-limited scenarios, emphasizing the challenges associated with obtaining large datasets for effective AI training(Candemir et al., 2021). Their insights underscore the relevance of AI in addressing data limitations and optimizing the interpretation of chest radiographs.

Qian et al. (2023) delved into recent advances in explainable artificial intelligence for magnetic resonance imaging (Qian et al., 2023). While their focus was on MRI, the principles discussed are applicable to various imaging modalities. The paper highlighted the importance of explainability in AI models, especially in complex imaging scenarios like chest radiographs and CT scans, where interpretability is crucial for clinical acceptance.

Breast cancer detection has been a prominent application of AI in diagnostic imaging. Mayo et al. (2019) conducted a retrospective comparison study using an AI-based Computer-Aided Detection (CAD) system for mammograms (Mayo et al., 2019). The study emphasized the potential of AI to reduce false-positive markings on mammograms, thereby improving the accuracy of breast cancer diagnoses. This underlines the significance of AI in enhancing the precision of breast cancer detection through mammography screenings.

The study by Wang et al. (2022) demonstrated the application of TransUnet, a deep learning model, in the accurate classification of lung nodules on CT images (Wang et al., 2022). Although the focus was on lung cancer, the methodology and principles discussed have implications for breast cancer detection. This illustrates the adaptability of AI models across different anatomical regions and their potential in optimizing breast cancer diagnostics.

Stroke imaging represents a critical area where timely and accurate diagnosis is paramount. Soun et al. (2021) explored the application of AI in acute stroke imaging, emphasizing its potential to streamline the detection and assessment of strokes (Soun et al., 2021). The study highlighted the role of AI in expediting the diagnostic process, particularly in time-sensitive conditions like stroke. This demonstrates how AI can significantly impact patient outcomes by accelerating the identification and characterization of cerebrovascular events. Additionally, Roberts et al. (2021) discussed common pitfalls and recommendations for using machine learning to detect and prognosticate COVID-19 using chest radiographs and CT scans (Roberts et al., 2021). While the focus was on COVID-19, the challenges and recommendations outlined are relevant to various diagnostic imaging applications, including stroke imaging. The paper underlines the importance of considering challenges and pitfalls when implementing AI in time-sensitive diagnostic scenarios.

Musculoskeletal imaging, encompassing a wide range of conditions, benefits from AI applications. The study by Khosla et al. (2020) introduced the concept of supervised contrastive learning, a method applicable to various imaging domains, including musculoskeletal imaging (Khosla et al., 2020). Their work focused on the foundational aspects of AI learning, illustrating the potential for improved model training in musculoskeletal image analysis. This lays the groundwork for optimizing AI applications in the diagnosis of musculoskeletal conditions.

In the context of continuous learning AI, Pianykh et al. (2020) outlined implementation principles and early applications in radiology (Pianykh et al., 2020). The principles discussed have implications for musculoskeletal imaging, emphasizing the adaptability of AI models to evolving diagnostic requirements. This reflects the dynamic nature of musculoskeletal conditions and the need for AI solutions that can continuously learn and improve diagnostic accuracy.

Cardiovascular imaging applications of AI extend beyond prognostic assessments, as highlighted by Betancur et al. (2018). Their study focused on the prognostic value of combined clinical and myocardial perfusion imaging data using machine learning (Betancur et al., 2018). The paper underscored the potential of AI in risk stratification and prognostic assessments in cardiovascular diseases, demonstrating its utility in personalized patient management. This represents a paradigm shift in cardiovascular imaging, where AI contributes not only to diagnostic accuracy but also to prognostic evaluations.

Al'Aref et al. (2019) explored the broader clinical applications of machine learning in cardiovascular disease (Al'Aref et al., 2019). The study emphasized the versatility of AI in addressing various aspects of cardiovascular imaging, including risk prediction and disease management. These findings highlight the multifaceted role of AI in cardiovascular diagnostics, encompassing a spectrum of applications from image analysis to clinical decision support.

Abdominal imaging, crucial for diagnosing gastrointestinal and hepatic conditions, has witnessed advancements through AI. Kumar et al. (2022) discussed recent applications of AI in the detection of gastrointestinal, hepatic, and pancreatic diseases(Kumar et al., 2022). The review emphasized the potential for AI to enhance diagnostic accuracy in abdominal imaging, presenting opportunities for early disease detection and intervention. This illustrates how AI can contribute to the comprehensive assessment of abdominal conditions, improving diagnostic precision in a variety of organ systems.

The fundamentals of AI and neural networks in radiology, as outlined by Fazekas et al. (2022), have implications for abdominal imaging(Fazekas et al., 2022). Their review provided essential insights that radiology residents should be familiar with, emphasizing the foundational knowledge required for effective AI utilization in abdominal imaging. This reflects the importance of integrating AI education into the training of radiologists specializing in abdominal diagnostics.

AI's presence in nephrology and urology imaging is exemplified by continuous learning AI applications. Loftus et al. (2022) highlighted the implementation of AI-enabled decision support in nephrology(Loftus et al., 2022). The study outlined the potential for AI to contribute to the management of renal conditions, showcasing its role in enhancing diagnostic support and treatment planning in nephrology. This represents a critical application of AI in renal imaging, where the dynamic nature of renal conditions requires adaptive and continuous learning AI solutions.

The applications of AI in diagnostic imaging extend beyond traditional domains, as evidenced by the work of Nam et al. (2023). Their randomized controlled trial focused on AI improving nodule detection on chest radiographs in a health screening population(Nam et al., 2023). This study illustrates the potential for AI to impact population health by contributing to early disease detection through routine screenings. While the focus was on chest radiographs, the principles discussed are applicable to various specialized areas, emphasizing the versatility of AI in addressing diverse diagnostic challenges.

The depiction provided in Figure 2 delineates the influence of AI across various tiers within the value chain of diagnostic imaging, encompassing image capture, reconstruction, interpretation, and documentation. This illustration vividly portrays how AI stands to augment the caliber and expediency of each phase, thereby enhancing the overall operational flow. For instance, AI exhibits the potential to refine image reconstruction by mitigating noise and artifacts, enhance image interpretation through automated analysis and decision facilitation, and streamline image documentation by furnishing concise summaries and recommendations. By integrating AI seamlessly into the diagnostic imaging continuum, the figure posits that such integration holds promise in elevating diagnostic precision, curbing expenditures, and optimizing patient care standards.

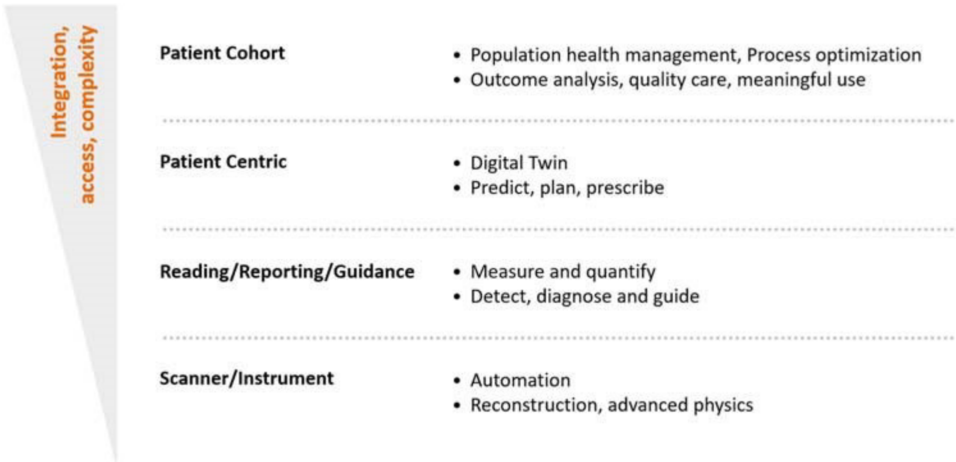

Figure 2: Impact of AI at multiple levels along the value chain of diagnostic imaging(Sharma et al., 2020)

The detailed literature on various applications of AI in diagnostic imaging highlights the transformative impact of AI across multiple domains. From chest radiographs and CT scans to specialized areas like musculoskeletal, cardiovascular, abdominal, and renal imaging, AI has demonstrated its versatility in enhancing diagnostic accuracy and efficiency. The next sections will delve into the fundamentals of AI and its specific applications in diagnostic imaging.

Case Studies

The successful integration of artificial intelligence (AI) in diagnostic imaging is exemplified through various case studies and real-world applications, showcasing its transformative impact on clinical practices. The following section presents specific instances from the reviewed papers, highlighting the diverse and successful applications of AI in diagnostic imaging.

Lakhani and Sundaram (2017) demonstrated the efficacy of Convolutional Neural Networks (CNNs) in the automated classification of pulmonary tuberculosis using chest radiography (Lakhani & Sundaram, 2017). The AI model exhibited remarkable accuracy in distinguishing between normal and tuberculosis-affected chest radiographs. This case study illustrates the potential of AI in streamlining the diagnosis of infectious diseases, offering a rapid and reliable approach for identifying pulmonary tuberculosis.

Mayo et al. (2019) conducted a retrospective comparison study using an AI-based Computer-Aided Detection (CAD) system to reduce false-positive markings on mammograms(Mayo et al., 2019). The AI model showcased its ability to enhance the precision of mammographic interpretations, minimizing unnecessary interventions. This case study emphasizes the practical utility of AI in improving breast cancer detection by addressing one of the challenges associated with mammography screenings—false-positive results.

Ardila et al. (2019) implemented three-dimensional deep learning on low-dose chest computed tomography (CT) for end-to-end lung cancer screening(Ardila et al., 2019). The AI model demonstrated significant success in detecting lung nodules and distinguishing between benign and malignant lesions. This case study underscores the potential of AI in early lung cancer detection, offering a comprehensive approach to lung cancer screening through advanced image analysis techniques.

Loftus et al. (2022) highlighted the implementation of AI-enabled decision support in nephrology, focusing on continuous learning AI applications(Loftus et al., 2022). The case study illustrated how AI can contribute to the management of renal conditions by providing enhanced diagnostic support and personalized treatment recommendations. This emphasizes the role of AI in optimizing decision-making processes in nephrology, reflecting its potential impact on patient outcomes.

Nam et al. (2023) presented a randomized controlled trial focused on AI improving nodule detection on chest radiographs in a health screening population(Nam et al., 2023). The case study demonstrated the practical application of AI in routine health screenings, where early disease detection is crucial. The AI model showcased its ability to enhance population health by contributing to the early identification of abnormalities in chest radiographs.

Table 1 encapsulates the myriad applications of AI in diagnostic imaging, offering a comprehensive synopsis of the imaging modality, AI methodology employed, and key findings or outcomes across various case studies. This tabulated presentation illuminates the adaptability and efficacy of AI across a spectrum of diagnostic imaging contexts, spanning from the diagnosis of infectious ailments and cancer screenings to tailored decision-making aids within nephrological contexts. The triumphant demonstrations showcased therein underscore AI's transformative capacity in reshaping diagnostic methodologies, presenting avenues for heightened efficiency, precision, and accessibility in healthcare provisions.

Table 1:Summary of AI Applications in Diagnostic Imaging Case Studies

Study Title and Authors	Imaging Modality	AI Technique Used	Main Findings/Results
Automated Classification of Pulmonary Tuberculosis (Lakhani & Sundaram, 2017)	Chest Radiography	Convolutional Neural Networks (CNNs)	Remarkable accuracy in distinguishing between normal and tuberculosis-affected chest radiographs.
Reduction of False-Positive Markings on Mammograms (Mayo et al., 2019)	Mammography	AI-based Computer-Aided Detection (CAD) system	Enhanced precision of mammographic interpretations, minimizing unnecessary interventions.
Three-Dimensional Deep Learning for Lung Cancer Screening (Ardila et al., 2019)	Low-dose Chest CT	Three-dimensional deep learning	Significant success in detecting lung nodules and distinguishing between benign and malignant lesions.
AI-Enabled Decision Support in Nephrology (Loftus et al., 2022)	Nephrology Imaging	Continuous learning AI applications	Enhanced diagnostic support and personalized treatment recommendations for renal conditions.
AI Improving Nodule Detection in Health Screening (Nam et al., 2023)	Chest Radiography	AI for nodule detection	Practical application of AI in routine health screenings, enhancing population health by contributing to early disease detection.

These case studies collectively highlight the versatility and effectiveness of AI in diverse diagnostic imaging scenarios, ranging from infectious diseases and cancer screenings to personalized decision support in nephrology. The successful applications underscore the potential of AI to revolutionize diagnostic practices, offering more efficient, accurate, and accessible healthcare solutions.

Challenges and Ethical Considerations

The integration of artificial intelligence (AI) in diagnostic imaging brings forth a myriad of opportunities but is accompanied by several challenges and ethical considerations. This section explores the complexities associated with the implementation of AI in diagnostic practices, emphasizing both technical limitations and ethical dilemmas.

The rapid development of AI in diagnostic imaging is not without its technical challenges. Qiu et al. (2020) highlight the intricacies of machine learning for detecting early infarction in acute stroke using non-contrast-enhanced CT(Qiu et al., 2020). The study identifies challenges in accurately detecting subtle early infarctions, emphasizing the need for further refinement in AI algorithms to enhance sensitivity and specificity. This technical challenge is indicative of the broader issue faced in AI applications, where fine-tuning algorithms for nuanced diagnostic tasks remains a continual hurdle.

The lack of explainability in AI models used for diagnostic imaging is a pervasive challenge. London (2019) sheds light on the dilemma between accuracy and explainability in AI-based medical decisions(London, 2019). The opacity of certain algorithms makes it challenging for clinicians to comprehend and trust the decision-making process. This lack of transparency is a significant hurdle in the widespread acceptance of AI in medical imaging. The need for developing AI models that are not only accurate but also interpretable is crucial for fostering trust among healthcare professionals.

The issue of bias in AI models, particularly in the context of healthcare, is a growing concern. Obermeyer et al. (2019) dissect racial bias in algorithms used for managing population health, underscoring the potential for biased outcomes that disproportionately affect certain demographic groups(Obermeyer et al., 2019). This bias can lead to disparities in diagnostic accuracy and treatment recommendations. Addressing algorithmic bias requires careful scrutiny of training data and ongoing efforts to mitigate any existing biases, ensuring that AI models are fair and unbiased across diverse patient populations.

The use of AI in diagnostic imaging raises significant privacy concerns(Murdoch, 2021). The vast amount of patient data required for training AI models poses potential threats to patient privacy. The security and confidentiality of sensitive health information become paramount considerations in the implementation of AI. Ensuring robust data encryption, anonymization techniques, and adherence to strict data protection protocols are essential to mitigate privacy risks associated with AI applications in healthcare.

The interdisciplinary nature of AI in diagnostic imaging necessitates effective collaboration between clinicians, data scientists, and radiologists. Makeeva (2022) stresses the importance of interdisciplinary collaboration for successful AI implementation in radiology(Makeeva, 2022). Achieving a seamless integration of AI into clinical workflows requires effective communication and understanding between different professional domains. This challenge highlights the need for comprehensive training programs that equip healthcare professionals with the knowledge and skills to leverage AI effectively.

The absence of standardized regulatory frameworks for AI in healthcare poses challenges in ensuring adherence to ethical standards. The evolving nature of AI technologies requires continuous updates to regulatory guidelines. Yedavalli et al. (2021) emphasize the importance of a roadmap for AI in radiology, highlighting the need for clear regulatory frameworks that address issues of safety, accountability, and ethical considerations(Yedavalli et al., 2021). Establishing robust regulatory mechanisms is essential for fostering responsible AI deployment in diagnostic imaging.

Beyond the technical challenges, ethical considerations play a pivotal role in the responsible adoption of AI in diagnostic imaging. Ensuring patient privacy, minimizing bias, and enhancing explainability are ethical imperatives that must be prioritized.The integration of AI involves the use of extensive patient data, raising concerns about privacy breaches. The secure handling of sensitive health information is crucial to maintain patient trust. Stringent data protection measures, such as anonymization and encryption, must be implemented to safeguard patient privacy.Algorithmic bias can lead to disparities in diagnostic outcomes. Striving for fairness and equity in AI models is essential to prevent biased results that may disproportionately impact certain demographic groups. Continuous monitoring and adjustment of algorithms can help mitigate bias in diagnostic imaging.The black-box nature of some AI algorithms can erode trust among healthcare professionals. Ensuring explainability in AI models, where the decision-making process is transparent and understandable, is crucial for fostering trust and acceptance among clinicians.

In summary, the challenges associated with AI in diagnostic imaging range from technical intricacies to ethical dilemmas. Addressing these challenges requires a concerted effort from researchers, clinicians, policymakers, and technology developers. A balanced approach that prioritizes both technical refinement and ethical considerations is essential for the responsible integration of AI in diagnostic practices.

Conclusion

The integration of artificial intelligence (AI) into diagnostic imaging heralds a transformative era in healthcare, presenting unprecedented opportunities alongside inherent challenges and ethical considerations. As we traverse the dynamic landscape of AI applications in diagnostic imaging, it becomes evident that the intersection of technology and healthcare holds immense potential to revolutionize patient care, streamline workflows, and enhance diagnostic accuracy. This concluding section reflects on key insights gleaned from the literature and emphasizes the overarching implications of AI in diagnostic imaging.

AI has the potential to reshape traditional diagnostic practices fundamentally. The application of machine learning and deep learning algorithms augments the capabilities of healthcare professionals, providing them with advanced tools for image analysis, pattern recognition, and predictive modeling. The studies reviewed underscore the transformative impact of AI in various domains, including radiology, pathology, and cardiology, signifying a paradigm shift in the approach to diagnostic interpretation.

The literature reviewed consistently highlights the capacity of AI to enhance diagnostic accuracy and operational efficiency. In radiology, AI-driven image analysis demonstrates promising results in detecting subtle abnormalities and improving the overall interpretative precision of medical images. The integration of AI tools streamlines diagnostic workflows, enabling faster and more accurate decision-making, ultimately contributing to improved patient outcomes.

The versatility of AI applications in diagnostic imaging is evident across diverse medical disciplines. From cardiovascular imaging to neuroimaging, oncology imaging, and beyond, AI exhibits remarkable adaptability. The literature review delineates the nuanced ways in which AI addresses the unique challenges posed by each medical domain, signifying its potential as a versatile and indispensable tool in the diagnostic armamentarium.

The advent of AI in diagnostic imaging aligns with the broader healthcare trend towards patient-centric care and personalized medicine. The ability of AI to analyze vast datasets, including genetic information, enables the identification of patient-specific markers and facilitates tailored diagnostic and treatment approaches. This shift towards precision medicine holds the promise of optimizing therapeutic interventions and improving patient outcomes.

However, the assimilation of AI into diagnostic imaging is not without its challenges. Technical intricacies, algorithmic bias, privacy concerns, and the imperative for explainability pose significant hurdles. Addressing these challenges requires a collaborative effort involving researchers, clinicians, policymakers, and technology developers. The ethical imperatives of ensuring patient privacy, mitigating bias, and fostering transparency must be paramount in the continued development and deployment of AI in healthcare.

Looking ahead, the trajectory of AI in diagnostic imaging points towards continued innovation and refinement. Collaborative endeavors between academia, industry, and healthcare institutions are essential to propel research, development, and implementation forward. Ongoing interdisciplinary collaboration, will be pivotal in navigating the complexities of AI integration into clinical workflows and ensuring that advancements are ethically sound and align with patient-centered care.

The synthesis of literature on AI-based diagnostic imaging illuminates a transformative landscape where technological advancements converge with healthcare imperatives. The journey towards realizing the full potential of AI in diagnostic imaging demands a balanced approach, addressing technical challenges while upholding ethical considerations. As AI continues to evolve, its role in diagnostic practices will likely become increasingly central, reshaping the healthcare landscape and contributing to a future where precision, efficiency, and patient-centric care are paramount.

References

Al'Aref, S. J., Anchouche, K., Singh, G., Slomka, P. J., Kolli, K. K., Kumar, A., Pandey, M., Maliakal, G., van Rosendael, A. R., Beecy, A. N., Berman, D. S., Leipsic, J., Nieman, K., Andreini, D., Pontone, G., Schoepf, U. J., Shaw, L. J., Chang, H.-J., Narula, J., … Min, J. K. (2019). Clinical applications of machine learning in cardiovascular disease and its relevance to cardiac imaging. *European Heart Journal*, *40*(24), 1975–1986. https://doi.org/10.1093/eurheartj/ehy404

Amin, A., Cardoso, S. A., Suyambu, J., Saboor, H. A., Cardoso, R. P., Husnain, A., Isaac, N. V., Backing, H., Mehmood, D., Mehmood, M., & others. (2024). Future of Artificial Intelligence in Surgery: A Narrative Review. *Cureus*, *16*(1).

Ardila, D., Kiraly, A. P., Bharadwaj, S., Choi, B., Reicher, J. J., Peng, L., Tse, D., Etemadi, M., Ye, W., Corrado, G., Naidich, D. P., & Shetty, S. (2019). End-to-end lung cancer screening with three-dimensional deep learning on low-dose chest computed tomography. *Nature Medicine*, *25*(6), 954–961. https://doi.org/10.1038/s41591-019-0447-x

Banerjee, M., Chiew, D., Patel, K. T., Johns, I., Chappell, D., Linton, N., Cole, G. D., Francis, D. P., Szram, J., Ross, J., & Zaman, S. (2021). The impact of artificial intelligence on clinical education: perceptions of postgraduate trainee doctors in London (UK) and recommendations for trainers. *BMC Medical Education*, *21*(1), 429. https://doi.org/10.1186/s12909-021-02870-x

Barragán-Montero, A., Javaid, U., Valdés, G., Nguyen, D., Desbordes, P., Macq, B., Willems, S., Vandewinckele, L., Holmström, M., Löfman, F., Michiels, S., Souris, K., Sterpin, E., & Lee, J. A. (2021). Artificial intelligence and machine learning for medical imaging: A technology review. *Physica Medica*, *83*, 242–256. https://doi.org/10.1016/j.ejmp.2021.04.016

Berbís, M. A., Paulano Godino, F., Royuela del Val, J., Alcalá Mata, L., & Luna, A. (2023). Clinical impact of artificial intelligence-based solutions on imaging of the pancreas and liver. *World Journal of Gastroenterology*, *29*(9), 1427–1445. https://doi.org/10.3748/wjg.v29.i9.1427

Betancur, J., Otaki, Y., Motwani, M., Fish, M. B., Lemley, M., Dey, D., Gransar, H., Tamarappoo, B., Germano, G., Sharir, T., Berman, D. S., & Slomka, P. J. (2018). Prognostic Value of Combined Clinical and Myocardial Perfusion Imaging Data Using Machine Learning. *JACC: Cardiovascular Imaging*, *11*(7), 1000–1009. https://doi.org/10.1016/j.jcmg.2017.07.024

Bushberg, J. T., & Seibert, J. A. (2022). *The Essential Physics of Medical Imaging Study Guide*. Lippincott Williams & Wilkins.

Candemir, S., Nguyen, X. V., Folio, L. R., & Prevedello, L. M. (2021). Training Strategies for Radiology Deep Learning Models in Data-limited Scenarios. *Radiology: Artificial Intelligence*, *3*(6). https://doi.org/10.1148/ryai.2021210014

Cherry, S. R., Jones, T., Karp, J. S., Qi, J., Moses, W. W., & Badawi, R. D. (2018). Total-Body PET: Maximizing Sensitivity to Create New Opportunities for Clinical Research and Patient Care. *Journal of Nuclear Medicine*, *59*(1), 3–12. https://doi.org/10.2967/jnumed.116.184028

Dai, Y., & Wang, G. (2020). A deep inference learning framework for healthcare. *Pattern Recognition Letters*, *139*, 17–25. https://doi.org/10.1016/j.patrec.2018.02.009

Fazekas, S., Budai, B. K., Stollmayer, R., Kaposi, P. N., & Bérczi, V. (2022). Artificial intelligence and neural networks in radiology – Basics that all radiology residents should know. *Imaging*, *14*(2), 73–81. https://doi.org/10.1556/1647.2022.00104

Gupta, R., Kumari, S., Senapati, A., Ambasta, R. K., & Kumar, P. (2023). New era of artificial intelligence and machine learning-based detection, diagnosis, and therapeutics in Parkinson's disease. *Ageing Research Reviews*, *90*, 102013. https://doi.org/10.1016/j.arr.2023.102013

He, M., Wang, X., & Zhao, Y. (2021). A calibrated deep learning ensemble for abnormality detection in musculoskeletal radiographs. *Scientific Reports*, *11*(1), 9097. https://doi.org/10.1038/s41598-021-88578-w

Ho, T. K. K., Gwak, J., Prakash, O., Song, J.-I., & Park, C. M. (2019). *Utilizing Pretrained Deep Learning Models for Automated Pulmonary Tuberculosis Detection Using Chest Radiography* (pp. 395–403). https://doi.org/10.1007/978-3-030-14802-7_34

Hosny, A., Parmar, C., Quackenbush, J., & Schwartz, L. H. (2018). Aerts HJWL. *Artificial Intelligence in Radiology. Nat Rev Cancer*, *18*(8), 500–510.

Hutton, B. F., Buvat, I., & Beekman, F. J. (2011). Review and current status of SPECT scatter correction. *Physics in Medicine and Biology*, *56*(14), R85–R112. https://doi.org/10.1088/0031-9155/56/14/R01

Hwang, E. J., Park, S., Jin, K.-N., Kim, J. I., Choi, S. Y., Lee, J. H., Goo, J. M., Aum, J., Yim, J.-J., Cohen, J. G., Ferretti, G. R., & Park, C. M. (2019). Development and Validation of a Deep Learning–Based Automated Detection Algorithm for Major Thoracic Diseases on Chest Radiographs. *JAMA Network Open*, *2*(3), e191095. https://doi.org/10.1001/jamanetworkopen.2019.1095

Khosla, P., Teterwak, P., Wang, C., Sarna, A., Tian, Y., Isola, P., Maschinot, A., Liu, C., & Krishnan, D. (2020). Supervised contrastive learning. *Advances in Neural Information Processing Systems*, *33*, 18661–18673.

Koh, D.-M., Papanikolaou, N., Bick, U., Illing, R., Kahn, C. E., Kalpathi-Cramer, J., Matos, C., Martí-Bonmatí, L., Miles, A., Mun, S. K., Napel, S., Rockall, A., Sala, E., Strickland, N., & Prior, F. (2022). Artificial intelligence and machine learning in cancer imaging. *Communications Medicine*, *2*(1), 133. https://doi.org/10.1038/s43856-022-00199-0

Krizhevsky, A., Sutskever, I., & Hinton, G. E. (2017). ImageNet classification with deep convolutional neural networks. *Communications of the ACM*, *60*(6), 84–90. https://doi.org/10.1145/3065386

Kumar, R., Khan, F. U., Sharma, A., Aziz, I. B. A., & Poddar, N. K. (2022). Recent Applications of Artificial Intelligence in the Detection of Gastrointestinal, Hepatic and Pancreatic Diseases. *Current Medicinal Chemistry*, *29*(1), 66–85. https://doi.org/10.2174/0929867328666210405114938

Lakhani, P., & Sundaram, B. (2017). Deep Learning at Chest Radiography: Automated Classification of Pulmonary Tuberculosis by Using Convolutional Neural Networks. *Radiology*, *284*(2), 574–582. https://doi.org/10.1148/radiol.2017162326

LeCun, Y., Bengio, Y., & Hinton, G. (2015). Deep learning. *Nature*, *521*(7553), 436–444. https://doi.org/10.1038/nature14539

Loftus, T. J., Shickel, B., Ozrazgat-Baslanti, T., Ren, Y., Glicksberg, B. S., Cao, J., Singh, K., Chan, L., Nadkarni, G. N., & Bihorac, A. (2022). Artificial intelligence-enabled decision support in nephrology. *Nature Reviews Nephrology*, *18*(7), 452–465. https://doi.org/10.1038/s41581-022-00562-3

London, A. J. (2019). Artificial Intelligence and Black□Box Medical Decisions: *Accuracy versus Explainability*. *Hastings Center Report*, *49*(1), 15–21. https://doi.org/10.1002/hast.973

Lui, Y. W., Chang, P. D., Zaharchuk, G., Barboriak, D. P., Flanders, A. E., Wintermark, M., Hess, C. P., & Filippi, C. G. (2020). Artificial Intelligence in Neuroradiology: Current Status and Future Directions. *American Journal of Neuroradiology*, *41*(8), E52. https://doi.org/10.3174/ajnr.A6681

Makeeva, V. (2022). *An Essential Roadmap for AI in Radiology*. American College of Radiology. https://www.acr.org/Practice-Management-Quality-Informatics/ACR-Bulletin/Articles/September-2022/An-Essential-Roadmap-for-AI-in-Radiology

Mayo, R. C., Kent, D., Sen, L. C., Kapoor, M., Leung, J. W. T., & Watanabe, A. T. (2019). Reduction of False-Positive Markings on Mammograms: a Retrospective Comparison Study Using an Artificial Intelligence-Based CAD. *Journal of Digital Imaging*, *32*(4), 618–624. https://doi.org/10.1007/s10278-018-0168-6

Murdoch, B. (2021). Privacy and artificial intelligence: challenges for protecting health information in a new era. *BMC Medical Ethics*, *22*(1), 122. https://doi.org/10.1186/s12910-021-00687-3

Najjar, R. (2023). Redefining Radiology: A Review of Artificial Intelligence Integration in Medical Imaging. *Diagnostics*, *13*(17), 2760. https://doi.org/10.3390/diagnostics13172760

Nam, J. G., Hwang, E. J., Kim, J., Park, N., Lee, E. H., Kim, H. J., Nam, M., Lee, J. H., Park, C. M., & Goo, J. M. (2023). AI Improves Nodule Detection on Chest Radiographs in a Health Screening Population: A Randomized Controlled Trial. *Radiology*, *307*(2). https://doi.org/10.1148/radiol.221894

Obermeyer, Z., Powers, B., Vogeli, C., & Mullainathan, S. (2019). Dissecting racial bias in an algorithm used to manage the health of populations. *Science*, *366*(6464), 447–453. https://doi.org/10.1126/science.aax2342

Panayides, A. S., Amini, A., Filipovic, N. D., Sharma, A., Tsaftaris, S. A., Young, A., Foran, D., Do, N., Golemati, S., Kurc, T., Huang, K., Nikita, K. S., Veasey, B. P., Zervakis, M., Saltz, J. H., & Pattichis, C. S. (2020). AI in Medical Imaging Informatics: Current Challenges and Future Directions. *IEEE Journal of Biomedical and Health Informatics*, *24*(7), 1837–1857. https://doi.org/10.1109/JBHI.2020.2991043

Pianykh, O. S., Langs, G., Dewey, M., Enzmann, D. R., Herold, C. J., Schoenberg, S. O., & Brink, J. A. (2020). Continuous Learning AI in Radiology: Implementation Principles and Early Applications. *Radiology*, *297*(1), 6–14. https://doi.org/10.1148/radiol.2020200038

Qian, J., Li, H., Wang, J., & He, L. (2023). Recent Advances in Explainable Artificial Intelligence for Magnetic Resonance Imaging. *Diagnostics*, *13*(9), 1571. https://doi.org/10.3390/diagnostics13091571

Qiang, B., Chen, R., Zhou, M., Pang, Y., Zhai, Y., & Yang, M. (2020). Convolutional Neural Networks-Based Object Detection Algorithm by Jointing Semantic Segmentation for Images. *Sensors*, *20*(18), 5080. https://doi.org/10.3390/s20185080

Qiu, W., Kuang, H., Teleg, E., Ospel, J. M., Sohn, S. Il, Almekhlafi, M., Goyal, M., Hill, M. D., Demchuk, A. M., & Menon, B. K. (2020). Machine Learning for Detecting Early Infarction in Acute Stroke with Non–Contrast-enhanced CT. *Radiology*, *294*(3), 638–644. https://doi.org/10.1148/radiol.2020191193

Rashidi, H. H., Tran, N. K., Betts, E. V., Howell, L. P., & Green, R. (2019). Artificial Intelligence and Machine Learning in Pathology: The Present Landscape of Supervised Methods. *Academic Pathology*, *6*, 2374289519873088. https://doi.org/10.1177/2374289519873088

Recht, M. P., Dewey, M., Dreyer, K., Langlotz, C., Niessen, W., Prainsack, B., & Smith, J. J. (2020). Integrating artificial intelligence into the clinical practice of radiology: challenges and recommendations. *European Radiology*, *30*(6), 3576–3584. https://doi.org/10.1007/s00330-020-06672-5

Roberts, M., Driggs, D., Thorpe, M., Gilbey, J., Yeung, M., Ursprung, S., Aviles-Rivero, A. I., Etmann, C., McCague, C., Beer, L., Weir-McCall, J. R., Teng, Z., Gkrania-Klotsas, E., Ruggiero, A., Korhonen, A., Jefferson, E., Ako, E., Langs, G., Gozaliasl, G., … Schönlieb, C.-B. (2021). Common pitfalls and recommendations for using machine learning to detect and prognosticate for COVID-19 using chest radiographs and CT scans. *Nature Machine Intelligence*, *3*(3), 199–217. https://doi.org/10.1038/s42256-021-00307-0

Rodriguez-Ruiz, A., Lång, K., Gubern-Merida, A., Broeders, M., Gennaro, G., Clauser, P., Helbich, T. H., Chevalier, M., Tan, T., Mertelmeier, T., Wallis, M. G., Andersson, I., Zackrisson, S., Mann, R. M., & Sechopoulos, I. (2019). Stand-Alone Artificial Intelligence for Breast Cancer Detection in Mammography: Comparison With 101 Radiologists. *JNCI: Journal of the National Cancer Institute*, *111*(9), 916–922. https://doi.org/10.1093/jnci/djy222

Sharma, P., Suehling, M., Flohr, T., & Comaniciu, D. (2020). Artificial Intelligence in Diagnostic Imaging. *Journal of Thoracic Imaging*, *35*(Supplement 1), S11–S16. https://doi.org/10.1097/RTI.0000000000000499

Soun, J. E., Chow, D. S., Nagamine, M., Takhtawala, R. S., Filippi, C. G., Yu, W., & Chang, P. D. (2021). Artificial Intelligence and Acute Stroke Imaging. *American Journal of Neuroradiology*, *42*(1), 2–11. https://doi.org/10.3174/ajnr.A6883

Wang, H., Zhu, H., & Ding, L. (2022). Accurate classification of lung nodules on CT images using the TransUnet. *Frontiers in Public Health*, *10*. https://doi.org/10.3389/fpubh.2022.1060798

Yedavalli, V. S., Tong, E., Martin, D., Yeom, K. W., & Forkert, N. D. (2021). Artificial intelligence in stroke imaging: Current and future perspectives. *Clinical Imaging*, *69*, 246–254. https://doi.org/10.1016/j.clinimag.2020.09.005

Zhu, B., Zhao, J., Cao, M., Du, W., Yang, L., Su, M., Tian, Y., Wu, M., Wu, T., Wang, M., Zhao, X., & Zhao, Z. (2022). Predicting 1-Hour Thrombolysis Effect of r-tPA in Patients With Acute Ischemic Stroke Using Machine Learning Algorithm. *Frontiers in Pharmacology*, *12*. https://doi.org/10.3389/fphar.2021.759782

