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THE ROLE OF ARTIFICIAL INTELLIGENCE IN EARLY DISEASE DIAGNOSIS AND TREATMENT

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Abstract

Artificial intelligence (AI) is increasingly being integrated into healthcare and has the potential to improve the early detection, diagnosis, treatment planning, and monitoring of diseases. This study reviewed the role of AI, particularly machine learning (ML) and deep learning (DL), in early disease diagnosis and treatment by synthesizing evidence from peer-reviewed scientific literature and reports from recognized health and regulatory organizations. Relevant literature was identified through searches of PubMed, Scopus, Web of Science, and Google Scholar using keywords related to AI, machine learning, deep learning, early disease diagnosis, medical imaging, clinical decision support, personalized medicine, treatment prediction, and healthcare. The findings were synthesized thematically according to four major areas: early disease detection and diagnosis; disease prediction and clinical decision support; treatment planning, personalization, and monitoring; and challenges, ethical considerations, and future directions. Medical imaging emerged as one of the most prominent applications of AI, particularly for image-based disease screening and diagnosis. Diabetic retinopathy provided an important quantitative example, with published meta-analyses reporting high diagnostic performance, including sensitivity and specificity values generally approaching or exceeding 90% under defined study conditions. AI was also found to support disease-risk prediction, clinical decision-making, treatment selection, personalized medicine, drug discovery, dose optimization, and continuous monitoring of treatment response and disease progression. However, the reviewed evidence demonstrated that AI performance is strongly influenced by data quality, patient population, imaging characteristics, clinical setting, algorithmic design, and validation

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procedures. Ethical and practical concerns, including data privacy, algorithmic bias, explainability, cybersecurity, accountability, regulatory requirements, and workflow integration, remain important barriers to widespread implementation. Overall, AI represents an important decision-support technology with considerable potential to complement clinical expertise and facilitate earlier diagnosis, individualized treatment, and continuous patient monitoring. However, robust external and prospective regulatory oversight, human supervision, and continuous post-deployment evaluation are essential for safe, reliable, and equitable clinical implementation.

INTRODUCTION

Artificial intelligence (AI) has emerged as a key technology in modern healthcare, with the potential to transform how clinicians detect, diagnose, monitor, and treat diseases (Fahim et al., 2025). AI refers to computer-based systems that analyze complex information and generate predictions, recommendations, or decisions based on defined objectives. Machine learning (ML), a major branch of AI, enables algorithms to learn patterns from large datasets and improve their performance on specific tasks. In healthcare, these technologies can analyze clinical records, medical images, laboratory results, physiological signals, genetic information, and other patient data to support clinical decision-making (Alowais et al., 2023). Early and accurate diagnosis is a fundamental component of effective healthcare because the identification of disease at an early stage can facilitate timely intervention and potentially improve clinical outcomes (Sharma et al., 2025). Integration of AI in healthcare systems—A discussion of the challenges and opportunities of integrating AI in healthcare systems for disease detection and diagnosis. *AI in Disease detection: advancements and applications*, 239-263.. Conventional diagnosis often depends on physicians' experience, laboratory investigations, imaging techniques, and interpretation of multiple clinical parameters. Although these approaches remain essential, increasing patient numbers and the enormous volume and complexity of medical information create challenges for healthcare systems (Broder et al., 2011). AI-based approaches can assist clinicians by rapidly processing large datasets, identifying subtle patterns, and highlighting abnormalities that may require further clinical investigation. The U.S. Food and Drug Administration (FDA), for example, identifies applications of AI/ML in areas such as medical imaging and cardiovascular risk assessment, demonstrating the growing integration of these technologies into clinical practice.

Medical imaging is one of the most developed applications of AI in early disease diagnosis. Deep-learning and other machine-learning algorithms can be trained to recognize patterns in radiographs, computed tomography (CT), magnetic resonance imaging (MRI), ultrasound, mammography, and other imaging modalities (Rana et al., 2023). Such systems may support the detection and characterization of abnormalities associated with cancer, cardiovascular disorders, neurological diseases, and other conditions. An analysis of FDA-authorized AI/ML-enabled medical devices reported that radiology represented the largest group of applications, with diagnostic assistance being a major intended use. The FDA continues to maintain and update a list of AI-enabled medical devices authorized for marketing in the United States, reflecting the expanding clinical use of these technologies. Beyond image analysis, AI can contribute to disease prediction and risk assessment by integrating information from electronic health

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records, laboratory investigations, vital signs, wearable devices, and other sources (Sahiner et al., 2019). Predictive models can identify combinations of risk factors associated with disease development and may help healthcare professionals prioritize patients who require additional testing or closer monitoring. AI can also facilitate continuous health monitoring through digital and sensor-based technologies, potentially allowing abnormal physiological changes to be identified before they become clinically severe (Wang et al., 2023).

AI also has an expanding role in treatment planning and personalized medicine. By integrating clinical characteristics, diagnostic information, treatment histories, and, where available, molecular or genomic information, AI systems can assist in identifying treatment options and predicting potential responses to therapy (Khan et al., 2024). In drug development, AI can support target identification, molecular screening, drug discovery, and prediction of drug–target interactions. The World Health Organization (WHO) recognizes that AI has potential applications not only in diagnosis and treatment but also in health research, drug development, disease surveillance, and public-health activities (World Health Organization, 2024). Another important application is the use of AI to improve treatment monitoring. Algorithms can analyze patient responses over time and potentially identify treatment failure, adverse events, or changes in disease status (Olawade et al., 2023). In this context, AI is increasingly viewed as a clinical decision-support technology rather than simply an automated replacement for healthcare professionals. Appropriate integration of AI can provide clinicians with additional evidence while allowing medical decisions to remain connected to patient history, clinical examination, professional judgment, and patient preferences.

Despite its potential, the use of AI in healthcare also presents important challenges. AI systems depend heavily on the quality, representativeness, and completeness of the data used for their development. Biased or incomplete datasets may result in biased predictions and unequal performance among different patient populations. Other concerns include patient privacy, cybersecurity, transparency of algorithms, explainability, accountability, regulatory oversight, and the possibility of incorrect predictions. The WHO emphasizes that AI technologies used in healthcare should be developed and deployed with attention to ethics, human rights, equity, accountability, and appropriate governance. Therefore, the role of AI in early disease diagnosis and treatment should be understood as a rapidly developing component of modern healthcare rather than a replacement for conventional medical practice. Evidence from the growing number of AI-enabled medical devices and clinical applications demonstrates increasing adoption, while regulatory and ethical frameworks remain important for ensuring safety and effectiveness. The integration of AI with clinical expertise, high-quality patient data, advanced diagnostic technologies, and appropriate regulatory safeguards could contribute to earlier detection of disease, more individualized treatment strategies, improved monitoring, and more efficient healthcare delivery. Consequently, examining the applications, benefits, limitations, and prospects of AI is essential for understanding its contribution to early disease diagnosis and modern therapeutic practice.

2. Methodology

2.1 Research Design

A systematic literature-based research approach was adopted to examine the role of artificial intelligence (AI) in early disease diagnosis and treatment following previous standard methodology (Balgude et al., 2024). The methodology focused on identifying, reviewing, and synthesizing published scientific evidence concerning AI-based diagnostic systems, disease prediction, clinical decision support, personalized

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treatment, medical imaging, and treatment monitoring. A literature-based approach was selected because the study aimed to provide a broad assessment of existing applications, benefits, limitations, and prospects of AI in healthcare rather than evaluate a single AI system experimentally.

2.2 Literature Search Strategy

Relevant scientific literature was identified through searches of major electronic databases, including PubMed, Scopus, Web of Science, and Google Scholar. Searches were conducted using combinations of keywords such as *artificial intelligence*, *machine learning*, *deep learning*, *early disease diagnosis*, *disease detection*, *medical imaging*, *clinical decision support*, *AI-assisted diagnosis*, *personalized medicine*, *treatment prediction*, and *AI in healthcare*. Boolean operators such as AND and OR were used to combine search terms and improve the retrieval of relevant publications.

Particular attention was given to peer-reviewed research articles, systematic reviews, clinical studies, and authoritative reports published by organizations such as the World Health Organization (WHO) and the U.S. Food and Drug Administration (FDA). The WHO has highlighted the potential applications of AI in diagnosis, treatment, health research, drug development, and public health while emphasizing the importance of ethical and responsible implementation.

2.3 Inclusion and Exclusion Criteria

Studies were included if they addressed the application of artificial intelligence (AI), machine learning, or deep learning in healthcare, particularly in the areas of early disease detection, diagnosis, disease prediction, treatment, or treatment monitoring (Ahmed et al., 2020). Eligible studies were required to report clinical, diagnostic, technological, or other healthcare-related outcomes and to be published in peer-reviewed journals or produced by recognized health or regulatory organizations. Studies were also required to provide sufficient methodological or application-related information to allow meaningful interpretation of their findings. Studies were excluded if they were unrelated to medical diagnosis or treatment, represented duplicate publications, lacked sufficient methodological or application-related information, or focused exclusively on non-healthcare applications of AI.

2.4 Data Extraction and Analysis

Information from the selected publications was organized according to several major categories: AI technology used, medical application, disease or clinical condition, data source, diagnostic or therapeutic function, reported benefits, limitations, and clinical relevance (Raposo et al., 2024). Particular emphasis was placed on applications involving medical imaging, electronic health records, laboratory data, genomic information, physiological measurements, and wearable-device data. The extracted information was synthesized narratively to identify common patterns and developments in AI-assisted healthcare. Diagnostic applications were examined in terms of their ability to detect abnormalities, classify disease, predict disease risk, and support clinicians in making diagnostic decisions. Treatment-related applications were evaluated according to their contribution to treatment selection, personalized medicine, drug discovery, response prediction, and treatment monitoring.

2.5 Assessment of AI Applications in Early Diagnosis

AI applications for early diagnosis were evaluated across major clinical areas, including cancer, cardiovascular diseases, neurological disorders, infectious diseases, and other chronic conditions. Medical imaging was given particular attention because AI-enabled medical devices have become increasingly prominent in radiology and image-based diagnosis. Previous analysis of FDA-authorized AI/ML-enabled medical devices found

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that radiology constituted a major application area.

The assessment considered the ability of AI systems to recognize disease-associated patterns, process large volumes of clinical information, identify abnormalities, and provide risk predictions. Where reported in the reviewed literature, diagnostic performance indicators such as accuracy, sensitivity, specificity, precision, area under the receiver operating characteristic curve (AUC), and predictive values were considered.

2.6 Assessment of AI in Treatment

The methodology also examined the application of AI in treatment planning and personalized healthcare. Studies involving AI-assisted treatment selection, prediction of therapeutic response, drug discovery, clinical decision support, and monitoring of treatment outcomes were reviewed. The analysis considered how AI can integrate clinical, laboratory, imaging, and molecular information to support individualized treatment strategies. Particular attention was given to whether AI was used as a decision-support tool for healthcare professionals rather than as an autonomous replacement for clinical judgment. This distinction is important because current guidance emphasizes human oversight, safety, transparency, accountability, and appropriate governance in healthcare AI.

2.7 Evaluation of Challenges and Ethical Considerations

The reviewed literature was additionally analyzed for challenges associated with the implementation of AI in healthcare. These included data quality, algorithmic bias, patient privacy, cybersecurity, explainability, transparency, generalizability, regulatory requirements, and clinical validation. Ethical considerations were assessed using internationally recognized guidance, particularly WHO recommendations concerning human autonomy, safety, transparency, accountability, inclusiveness, equity, and sustainable AI implementation in healthcare.

2.8 Data Synthesis

Finally, the findings were synthesized into four major themes: AI for early disease detection and diagnosis, focusing on the use of AI technologies to identify diseases at earlier stages and improve diagnostic accuracy; AI for disease prediction and clinical decision support, highlighting the role of AI in predicting disease risks, progression, and supporting clinical decision-making; AI for treatment planning, personalization, and monitoring, examining how AI can assist in developing individualized treatment strategies, optimizing therapeutic decisions, and monitoring patient responses; and challenges, ethical considerations, and future directions, addressing issues related to data quality, privacy, bias, interpretability, regulatory requirements, and clinical implementation. This thematic synthesis was used to describe the potential contribution of AI to earlier diagnosis and improved treatment while also identifying the limitations and challenges that need to be addressed before its widespread implementation in clinical practice.

3. Results

3.1 Overall Role of Artificial Intelligence in Disease Diagnosis and Treatment

The literature synthesis demonstrated that artificial intelligence (AI), particularly machine learning (ML) and deep learning (DL), is increasingly being applied throughout the healthcare pathway, including disease screening, early diagnosis, risk prediction, clinical decision support, treatment planning, personalized medicine, and treatment monitoring. Current regulatory evidence also demonstrates increasing clinical implementation: the U.S. Food and Drug Administration (FDA) maintains a continuously updated list of AI-enabled medical devices authorized for marketing in the United States. The list includes applications in radiology, cardiology, neurology, gastroenterology, pathology, ophthalmology-related technologies, and other clinical areas. The strongest evidence identified in this review concerned image-based

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diagnosis and screening. AI systems can process large numbers of medical images and identify disease-associated patterns, thereby supporting clinicians in detecting abnormalities at an early stage. Evidence was particularly substantial for diabetic retinopathy (DR), breast cancer screening, and radiological applications (Table 1).

Table 1. Major applications of artificial intelligence in early disease diagnosis and treatment

Healthcare application	AI technology commonly used	Major data source	Potential clinical role
Medical imaging	Deep learning/CNNs	X-ray, CT, MRI, ultrasound	Detection and classification of abnormalities
Diabetic retinopathy screening	Deep learning	Fundus photographs/OCT	Early detection and referral
Breast cancer screening	Deep learning	Mammograms	Detection of suspicious lesions
Cardiovascular disease	ML/DL	ECG, imaging, clinical records	Risk prediction and diagnosis
Neurological diseases	ML/DL	MRI, CT, EEG, clinical data	Detection and classification
Infectious diseases	ML	Laboratory and clinical data	Risk prediction and clinical decision support
Cancer diagnosis	ML/DL	Histopathology, imaging, genomic data	Detection, classification and prognosis
Treatment planning	ML/DL	Clinical, molecular and imaging data	Treatment selection and personalization

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Drug discovery	ML/DL	Molecular and genomic datasets	Target and compound identification
Treatment monitoring	ML/ML-based prediction	EHR, wearable and laboratory data	Monitoring disease progression and response

3.2 Diagnostic Performance of AI in Diabetic Retinopathy

Diabetic retinopathy provided one of the clearest quantitative examples of AI-assisted early disease diagnosis. A systematic review and meta-analysis of 21 prospective studies reported pooled AI sensitivity of 88.0%, specificity of 91.2%, and an area under the curve (AUC) of approximately 0.980. The pooled diagnostic odds ratio was approximately 206.8, although performance varied according to disease category, patient population, geographical region, image characteristics, and algorithm type. Another systematic review focusing on real-world applications included 34 studies and reported an overall pooled accuracy of 81%, sensitivity of 94%, specificity of 89%, and a diagnostic odds ratio of 128. The authors concluded that AI-based screening demonstrated acceptable diagnostic performance when applied to real-world fundus images. All these results are presented in Table 2 and Figure 1.

Table 2. Reported diagnostic performance of AI for diabetic retinopathy

Evidence source	Number of studies	Sensitivity	Specificity	Other performance measure
Prospective-study meta-analysis	21	88.0%	91.2%	AUC ≈ 0.980
Real-world fundus-image meta-analysis	34	94%	89%	Accuracy = 81%; DOR = 128
Prospective real-world RDR analysis, patient level	10 datasets; N=45,785	95.33%	92.01%	DOR not reported in summary
Prospective real-world RDR analysis, eye level	7 datasets; N=15,390 eyes	91.24%	93.90%	—

RDR = referable diabetic retinopathy; DOR = diagnostic odds ratio; AUC = area under the curve. Values are reported estimates from the cited meta-analyses and should not be interpreted as performance of one universal AI system.

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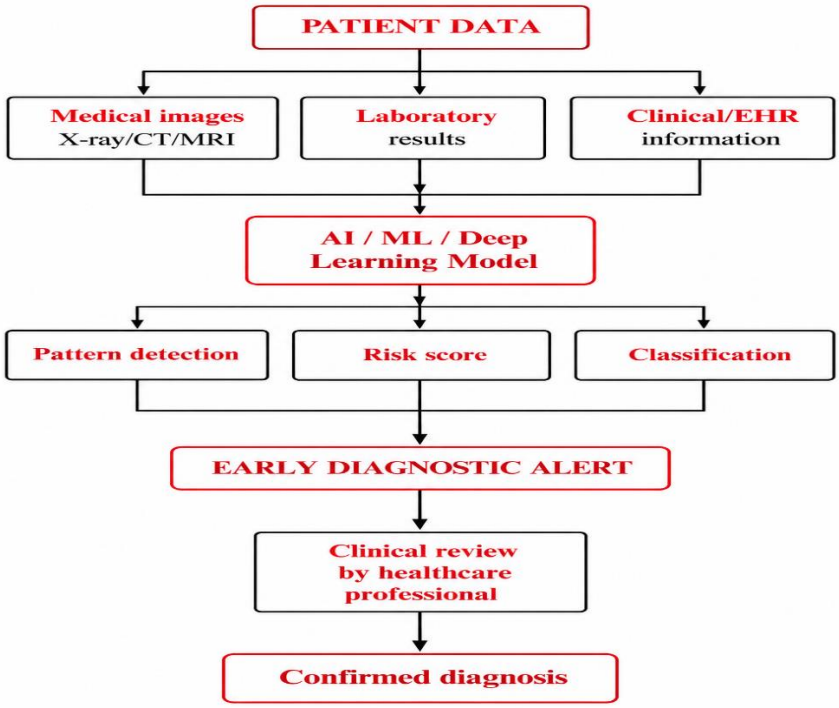


Figure 1. Conceptual representation of AI-assisted early disease diagnosis

3.3 AI in Medical Imaging

Medical imaging emerged as one of the most important areas of clinical AI implementation. The FDA's current AI-enabled medical-device list contains numerous authorized devices associated with radiology, including systems for CT, MRI, ultrasound, mammography, lung imaging, cardiovascular imaging, and other applications. AI-based image analysis can perform tasks such as segmentation, classification, lesion detection, image reconstruction, quantitative assessment, and prioritization of potentially urgent examinations. These functions may help clinicians manage large imaging workloads and identify abnormalities that require further assessment. Breast cancer screening provides another important example. McKinney et al. evaluated an AI system using large datasets from the United Kingdom and United States and demonstrated the potential of AI to improve mammographic cancer detection and prediction. The study emphasized the potential of AI to support early breast cancer screening, although subsequent clinical implementation requires appropriate validation and integration into screening workflows.

3.4 AI in Disease Prediction and Risk Assessment

The results further demonstrated that AI is not restricted to diagnosing established disease. Machine-learning models can integrate multiple variables to estimate disease risk before definitive clinical manifestations become apparent. Such models may use demographic information, laboratory parameters, vital signs, electronic health records, imaging findings, and physiological signals. This predictive capability is particularly relevant to chronic and progressive diseases in which early intervention may influence subsequent outcomes. AI-supported risk assessment may also enable healthcare

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systems to identify patients requiring additional diagnostic investigations or more frequent monitoring.

3.5 AI in Treatment Planning and Personalized Medicine

The literature indicated an expanding application of AI beyond diagnosis toward treatment planning. AI can combine multiple forms of patient information to assist in predicting therapeutic response and identifying treatment strategies appropriate to individual clinical characteristics. AI has also become increasingly relevant to drug discovery. Machine-learning approaches can analyze molecular structures, biological pathways, genomic information, and drug–target interactions to prioritize candidate compounds and potential therapeutic targets (Figure 3). WHO identifies drug development and health research among the areas in which AI may contribute to healthcare innovation.

Table 3. Role of AI across the treatment pathway

Treatment stage	Application of AI	Expected contribution	
Treatment selection	Patient-specific prediction models	Support individualized treatment decisions	
Drug discovery	Molecular ML/DL models	Identification and prioritization of candidate compounds	
Dose optimization	Predictive algorithms	Support individualized dosing	
Prognosis	Risk prediction models	Estimation of disease progression	
Treatment monitoring	Longitudinal data analysis	Identification of response or deterioration	
Adverse-event monitoring	Pattern recognition	Early identification of potential complications	
Follow-up	Remote/wearable data analysis	Continuous monitoring of patient status	

3.6 AI-Based Treatment Monitoring

Another important finding was the potential use of AI for continuous treatment monitoring. Data from electronic health records, laboratory tests, imaging, wearable devices, and remote-monitoring technologies can be analyzed longitudinally to identify changes in patient status. This approach may help identify treatment response, disease progression, or potential complications earlier than intermittent clinical

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assessment alone. However, the clinical value of continuous AI monitoring depends on the quality of data, appropriate thresholds, integration into clinical workflows, and human interpretation.

3.7 Challenges Associated with AI Implementation

Although the diagnostic performance reported in several studies was high, the literature also demonstrated substantial variation between studies. Differences in patient populations, disease prevalence, image quality, diagnostic thresholds, clinical settings, algorithms, and reference standards can influence reported performance (Figure 4). For example, a 2026 meta-analysis found that AI performance for diabetic retinopathy differed according to the clinical pathway and disease category, emphasizing that performance should be interpreted within the context in which the system is deployed.

Table 4. Major challenges and their implications

Challenge	Potential effect
Limited or biased training data	Reduced generalizability
Differences among patient populations	Unequal diagnostic performance
Poor-quality images/data	Increased false-positive or false-negative results
Algorithmic bias	Potential inequities between patient groups
Lack of explainability	Reduced clinician confidence
Data privacy concerns	Risk to patient confidentiality
Cybersecurity	Potential unauthorized access or manipulation
Insufficient external validation	Uncertain real-world performance
Regulatory requirements	Need for evidence of safety and effectiveness
Workflow integration	Potential disruption or alert fatigue

WHO emphasizes that AI in healthcare should place ethics and human rights at the center of development and deployment and highlights the importance of accountability, transparency, equity, and human oversight.

4. Discussion

4.1 AI as a Tool for Earlier Disease Detection

The findings of this review demonstrate that artificial intelligence (AI), particularly machine learning (ML) and deep learning (DL), has progressed from experimental research toward increasingly practical applications in clinical

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healthcare. The strongest quantitative evidence identified in this review was associated with image-based diagnosis and screening, particularly diabetic retinopathy (DR). A meta-analysis of 21 prospective studies reported pooled sensitivity and specificity of 88.0% and 91.2%, respectively, with an area under the curve (AUC) of approximately 0.98, although diagnostic performance varied according to disease category, patient source, geographical region, image quality, and algorithm characteristics (Wang et al., 2023). Similarly, a real-world meta-analysis of 34 studies reported pooled sensitivity of 94%, specificity of 89%, and overall accuracy of 81% for AI-based DR screening using real-world fundus images (Joseph et al., 2024). More recent evidence comparing AI-assisted and manual DR screening has also reported broadly comparable diagnostic performance, while highlighting differences according to whether images were obtained from dilated or undilated eyes (Tahir et al., 2025).

These findings indicate that AI can provide substantial diagnostic capacity under appropriate conditions, particularly where large numbers of images or complex datasets must be processed. However, high sensitivity or specificity in a particular study should not be interpreted as evidence that AI universally outperforms healthcare professionals. Diagnostic performance depends on disease prevalence, patient characteristics, image quality, reference standards, clinical setting, algorithm design, and decision thresholds. Therefore, AI should be considered an additional diagnostic resource whose clinical value depends on appropriate validation and integration into healthcare workflows.

4.2 AI and Medical Imaging

Medical imaging represents one of the most mature areas of AI application because radiological and pathological images contain structured information that can be analyzed using computational methods. Deep-learning systems can support image classification, lesion detection, segmentation, image reconstruction, quantitative analysis, and prioritization of potentially urgent examinations (Rana & Bhushan, 2023; Najjar, 2023). These capabilities may assist healthcare professionals in managing increasing imaging volumes and identifying abnormalities that require further assessment. The growing number of AI-enabled medical devices authorized by the U.S. Food and Drug Administration (FDA) further demonstrates the translation of AI research into regulated healthcare technologies. The FDA's current database includes numerous authorized AI-enabled devices, with radiology representing a prominent application area. These devices have undergone applicable premarket evaluation according to their intended uses and technological characteristics (U.S. FDA, 2026). Thus, the regulatory landscape provides evidence that AI is increasingly being incorporated into practical medical technologies rather than remaining exclusively at the research stage.

Nevertheless, the evidence also indicates a gap between technical performance and real-world clinical utility. A systematic review of AI research in radiology found that most studies were retrospective and that external validation was relatively limited; among studies permitting direct comparison, performance generally decreased during external validation (Mongan et al., 2022). This finding emphasizes that performance obtained from carefully controlled datasets may not be maintained when algorithms are transferred to different institutions, equipment, patient populations, or clinical environments. AI-assisted imaging should therefore be implemented with appropriate clinical oversight rather than treated as an independent diagnostic authority.

4.3 AI and Personalized Treatment

The role of AI extends beyond disease detection toward treatment planning and personalized medicine. AI systems can integrate clinical characteristics, laboratory measurements, imaging findings, treatment histories, and molecular information to identify patterns associated with

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therapeutic response. This capability is particularly relevant to precision medicine because patients with the same diagnosis may differ substantially in disease biology, prognosis, and response to treatment. Recent literature indicates that deep-learning approaches are increasingly being investigated for drug-response prediction and personalized treatment, particularly in oncology (Hajim et al., 2024). AI may also support drug discovery by analyzing molecular structures, biological pathways, genomic information, and drug-target interactions to prioritize potential therapeutic compounds and targets. However, the ability of a model to predict treatment response does not by itself demonstrate that using the prediction will improve patient outcomes. Treatment-oriented AI therefore requires prospective clinical evaluation that assesses not only predictive accuracy but also patient safety, clinical usefulness, treatment outcomes, and cost-effectiveness.

4.4 AI and Clinical Decision-Making

The findings support the interpretation of AI primarily as a clinical decision-support technology rather than a replacement for healthcare professionals. AI can rapidly analyze large and complex datasets, whereas clinicians contribute clinical history, physical examination findings, contextual information, professional experience, patient preferences, and ethical considerations that may not be fully represented within an algorithm. This human-AI collaboration is particularly important when AI outputs are uncertain or conflict with clinical findings. Recent systematic evidence on predictive AI-based clinical decision-support systems indicates considerable heterogeneity in diagnostic performance and highlights a continuing gap between technical validation and real-world clinical implementation (2026). Consequently, successful implementation requires clear definition of the role of AI within the clinical workflow, appropriate training of users, mechanisms for reviewing algorithmic recommendations, and procedures for managing incorrect or uncertain outputs. WHO guidance similarly emphasizes human autonomy, safety, transparency, accountability, inclusiveness, and equity in the development and deployment of AI for health (World Health Organization, 2021). Therefore, AI should function as an analytical layer that supports clinical reasoning while retaining appropriate human responsibility for medical decisions.

4.5 Importance of Data Quality and Generalizability

One of the most important findings from the literature is that AI performance is strongly influenced by the quality, diversity, completeness, and representativeness of the data used for development and validation. Models trained on highly controlled datasets may perform differently when exposed to data generated under routine healthcare conditions. Differences in patient demographics, disease prevalence, imaging equipment, acquisition protocols, data quality, clinical workflows, and reference standards can all affect algorithmic performance. The evidence from DR screening illustrates this issue particularly well. Prospective and real-world meta-analyses have reported high diagnostic performance but also substantial variation according to patient source, geographical region, imaging modality, disease category, and image quality (Wang et al., 2023; Joseph et al., 2024). Similar concerns have been reported in radiology, where external validation can result in lower performance than that observed during initial development (Mongan et al., 2022).

Therefore, AI systems intended for clinical use should undergo a staged evaluation process involving internal validation, independent external validation, prospective clinical evaluation, testing across diverse patient populations, and continuous post-deployment monitoring. This is particularly important for low- and middle-income countries, where healthcare infrastructure, disease patterns,

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available equipment, and patient populations may differ from those represented in the datasets used to develop commercial or academic AI systems. WHO has specifically emphasized that systems developed predominantly using data from high-income settings may not perform equally well in other healthcare environments (World Health Organization, 2021).

4.6 Ethical, Legal, and Safety Considerations

The expansion of AI in healthcare creates important ethical, legal, and safety considerations. Healthcare AI systems often require large quantities of sensitive patient information, creating risks related to privacy, confidentiality, cybersecurity, and inappropriate data access. Strong data-protection procedures and appropriate governance are therefore necessary throughout data collection, model development, deployment, and monitoring. Algorithmic bias is another major concern. If training datasets inadequately represent certain populations, AI systems may perform differently across demographic, geographic, or socioeconomic groups. Such differences can contribute to unequal access to accurate diagnosis or treatment support. Explainability is also important because healthcare professionals may need to understand why an AI system generated a particular prediction, especially when the prediction influences a high-risk clinical decision. WHO recommends that AI for health protect human autonomy, promote safety and public benefit, ensure transparency and explainability, establish accountability, promote inclusiveness and equity, and support sustainable implementation (World Health Organization, 2021). More recent WHO guidance on large multimodal models further emphasizes the need for appropriate governance, evidence of benefit, and management of risks associated with rapidly developing AI technologies (World Health Organization, 2025). These principles are particularly relevant when AI systems are integrated into routine clinical practice.

The regulatory environment is also becoming increasingly important. The FDA maintains an updated list of AI-enabled medical devices authorized for marketing in the United States and indicates that listed devices have met applicable premarket requirements concerning safety and effectiveness for their intended use (U.S. FDA, 2026). Regulatory authorization, however, should not be interpreted as evidence that an AI system is universally effective across all clinical environments. Post-market surveillance and continued evaluation remain important as technologies encounter broader patient populations and changing clinical conditions.

4.7 AI for Continuous Treatment Monitoring

An additional area highlighted by the reviewed literature is the potential for AI to support continuous monitoring after diagnosis and treatment. Electronic health records, laboratory measurements, wearable sensors, physiological signals, and repeated imaging can generate longitudinal data that allow algorithms to identify changes in disease status over time. Such systems may assist in detecting treatment response, disease progression, deterioration, or potential adverse events. Continuous monitoring may be particularly valuable for chronic diseases in which patient status changes gradually and intermittent clinical assessments may not capture all relevant changes. However, implementation also introduces the possibility of excessive alerts, false-positive signals, and clinician alert fatigue. The usefulness of AI-based monitoring therefore depends not only on predictive performance but also on appropriate thresholds, workflow integration, data quality, and clear procedures for responding to alerts. AI-generated alerts should be interpreted in combination with clinical information rather than automatically triggering treatment changes.

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4.8 From Technical Accuracy to Clinical Effectiveness

An important implication of the reviewed evidence is that technical accuracy should not be considered equivalent to clinical effectiveness. Measures such as accuracy, sensitivity, specificity, AUC, and diagnostic odds ratios provide important information about model performance, but they do not necessarily demonstrate whether AI improves patient outcomes. A clinically useful system should ideally demonstrate that its implementation leads to earlier diagnosis, appropriate treatment decisions, reduced complications, improved patient outcomes, increased efficiency, or other measurable benefits. This distinction is particularly important because much of the AI literature remains focused on retrospective datasets and technical performance. Recent systematic evidence on predictive AI-based clinical decision-support systems found substantial heterogeneity and reported that only a minority of studies involved prospective deployment, demonstrating the continuing gap between algorithm development and routine clinical implementation. Future studies should therefore include prospective, multicenter, and pragmatic evaluations that examine both algorithmic performance and real-world clinical outcomes.

4.9 Implementation, Workflow Integration, and Future Directions

The successful adoption of AI requires more than the development of accurate algorithms. AI systems must be compatible with existing electronic health records, imaging platforms, laboratory systems, and clinical workflows. Interoperability, user training, infrastructure, computational resources, maintenance, and clear responsibility for AI-assisted decisions are important considerations. Poorly integrated systems may increase workload or generate unnecessary alerts rather than improving efficiency. Future research should therefore move toward clinically validated, interoperable, and context-specific AI systems. Multicenter datasets, external validation, prospective trials, standardized reporting, transparent performance assessment, and post-deployment surveillance should become important components of AI evaluation. Greater representation of populations from different geographical and socioeconomic settings is also necessary to reduce the risk of inequitable performance. The development of explainable and interpretable AI may further improve clinician confidence and facilitate appropriate oversight. In parallel, regulatory frameworks should continue to evolve to address continuously learning systems, software updates, cybersecurity, data governance, and post-market performance. AI education for healthcare professionals will also be important so that users understand both the capabilities and limitations of AI-based tools.

4.10 Integrated Interpretation of the Findings

Overall, the evidence indicates that AI has the potential to contribute across the entire clinical pathway, beginning with patient and population-level data collection and progressing through early detection, risk prediction, diagnosis, treatment support, and continuous monitoring (Figure 2). Medical imaging currently provides some of the strongest evidence for clinical application, while predictive analytics, personalized treatment, drug discovery, and wearable-based monitoring represent expanding areas of research. The findings support a model in which AI operates as a continuous decision-support layer rather than an isolated diagnostic tool. Patient data from imaging, electronic health records, laboratory investigations, genomic information, and wearable devices can be processed by ML and DL systems to generate information about disease risk, diagnosis, treatment options, and treatment response. These outputs can then be reviewed by healthcare professionals and incorporated into patient management. Subsequent monitoring generates

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new information that can inform updated clinical decisions, creating a feedback loop between data, AI analysis, clinical interpretation, treatment, and monitoring. Thus, the future contribution of AI to healthcare will depend not simply on developing more sophisticated algorithms but on establishing reliable connections between AI technology, high-quality clinical data, healthcare professionals, regulatory systems, and patient-centered care. Responsible implementation, rigorous validation, ethical governance, and continuous monitoring are essential to ensure that technological advances translate into safe and meaningful improvements in healthcare.

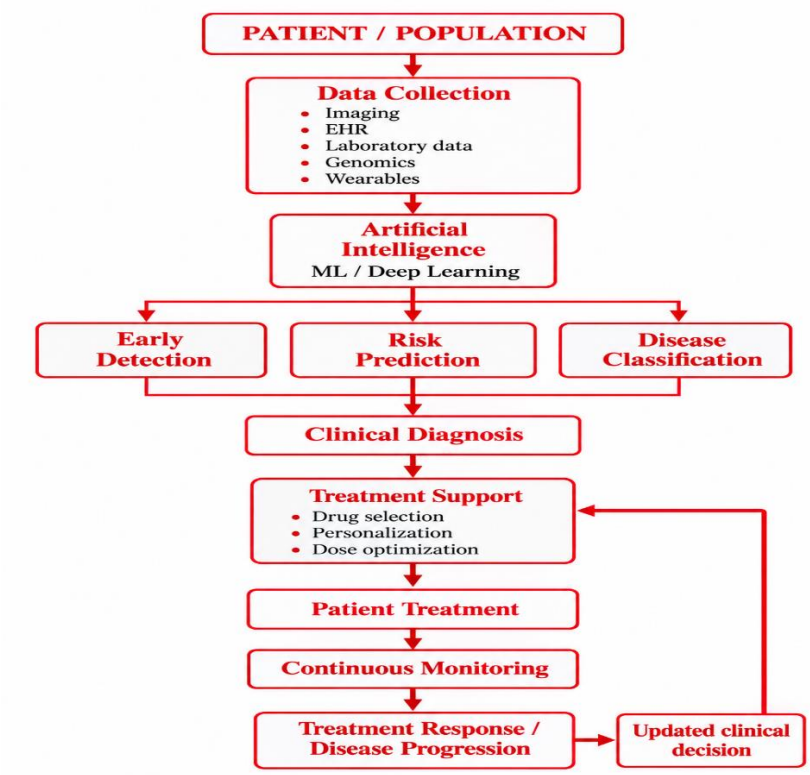


Figure 4. AI-Enabled Clinical Workflow from Data Collection to Continuous Patient Management

Conclusion

Artificial intelligence (AI) has emerged as an important technology in healthcare, with applications in early disease detection, diagnosis, risk prediction, treatment planning, personalized medicine, and continuous patient monitoring. The reviewed evidence indicates that medical imaging is one of the most developed areas of AI application, with strong diagnostic performance reported for conditions such as diabetic retinopathy and other diseases. AI can also integrate clinical, laboratory, imaging, and molecular data to support treatment selection, dose optimization, therapeutic-response prediction, and clinical decision-making. However, the effectiveness of AI depends strongly on data quality, population diversity, clinical setting, and appropriate validation. Challenges related to privacy, algorithmic bias, explainability, cybersecurity, regulatory requirements, and human oversight must also be addressed. Therefore, AI should primarily function as a clinical decision-support tool that complements healthcare professionals rather than replaces them. Future implementation should emphasize external and prospective validation, diverse

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datasets, continuous monitoring, ethical governance, and patient safety. Overall, responsible integration of AI with clinical expertise has considerable potential to support earlier diagnosis, more personalized treatment, and improved patient-centered healthcare.

Ethical statement

The collection of plant material must comply with relevant institutional, national, and international guidelines and legislation. Our study complies with relevant institutional, national, and international guidelines and legislation.

Consent for publication: All the authors agreed to publish the present work.

Data Availability Statement: Data are available from the corresponding author on reasonable request.

Competing Interest: The authors declare there is no conflict of interest.

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Author Contributions

Mubashir Naveed contributed to the conceptualization, literature review, data collection, and drafting of the manuscript. Muhammad Usman, Farwa Anam, and Mubashar Ijaz Shah contributed to the research methodology, data analysis, interpretation of results, and critical revision of the manuscript. Rabail Urooj contributed to data interpretation, manuscript review, editing, and overall supervision of the study. All authors reviewed and approved the final version of the manuscript.

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REFERENCES

Fahim, Y. A., Hasani, I. W., Kabba, S., & Ragab, W. M. (2025). Artificial intelligence in healthcare and medicine: clinical applications, therapeutic advances, and future perspectives. *European journal of medical research*, *30*(1), 848.

Alowais, S. A., Alghamdi, S. S., Alsuhebany, N., Alqahtani, T., Alshaya, A. I., Almohareb, S. N., ... & Albekairy, A. M. (2023). Revolutionizing healthcare: the role of artificial intelligence in clinical practice. *BMC medical education*, *23*(1), 689.

Sharma, N., & Kaushik, P. (2025). Integration of AI in healthcare systems—A discussion of the challenges and opportunities of integrating AI in healthcare systems for disease detection and diagnosis. *AI in Disease detection: advancements and applications*, 239-263.

Broder, J. S. (2011). *Diagnostic Imaging for the Emergency Physician E-Book: Diagnostic Imaging for the Emergency Physician E-Book*. Elsevier Health Sciences.

Rana, M., & Bhushan, M. (2023). Machine learning and deep learning approach for medical image analysis: diagnosis to detection. *Multimedia tools and applications*, *82*(17), 26731-26769.

Sahiner, B., Pezeshk, A., Hadjiiski, L. M., Wang, X., Drukker, K., Cha, K. H., ... & Giger, M. L. (2019). Deep learning in medical imaging and radiation therapy. *Medical physics*, *46*(1), e1-e36.

Wang, C., He, T., Zhou, H., Zhang, Z., & Lee, C. (2023). Artificial intelligence enhanced sensors-enabling technologies to next-generation healthcare and biomedical platform. *Bioelectronic Medicine*, *9*(1), 17.

ISSN (Online): 3006-2071 | ISSN (Print): 3006-2063
Volume 4 • Issue 5 • September 2026

Khan, A. O. R., Islam, S. M., Sarkar, A., Islam, T., Paul, R., & Bari, M. S. (2024). Real-time predictive health monitoring using AI-driven wearable sensors: Enhancing early detection and personalized interventions in chronic disease management. *International Journal for Multidisciplinary Research*, *6*(5), 1-21.

World Health Organization. (2024). *Ethics and governance of artificial intelligence for health: large multi-modal models. WHO guidance*. World Health Organization.

Olawade, D. B., Wada, O. J., David-Olawade, A. C., Kunonga, E., Abaire, O., & Ling, J. (2023). Using artificial intelligence to improve public health: a narrative review. *Frontiers in Public Health*, *11*, 1196397.

Balgude, S. D., Gite, S., Pradhan, B., & Lee, C. W. (2024). Artificial intelligence and machine learning approaches in cerebral palsy diagnosis, prognosis, and management: a comprehensive review. *PeerJ Computer Science*, *10*, e2505.

Ahmed, Z., Mohamed, K., Zeeshan, S., & Dong, X. (2020). Artificial intelligence with multi-functional machine learning platform development for better healthcare and precision medicine. *Database*, *2020*, baaa010.

Raposo, H. (2024). Intelligent imaging: A systematic review of artificial intelligence techniques in disease detection, segmentation, and classification. *Segmentation, and Classification (May 13, 2024)*.

Joseph, S., Selvaraj, J., Mani, I., Kumaragurupari, T., Shang, X., Mudgil, P., Ravilla, T., & He, M. (2024). Diagnostic accuracy of artificial intelligence-based automated diabetic retinopathy screening in real-world settings: A systematic review and meta-analysis. *American Journal of Ophthalmology*, *263*, 214–230.

Wang, H., et al. (2023). Performance of artificial intelligence in diabetic retinopathy screening: A systematic review and meta-analysis of prospective studies. *Frontiers in Endocrinology*. The meta-analysis included 21 prospective studies and reported pooled sensitivity of 88.0%, specificity of 91.2%, and AUC of approximately 0.98.

Mongan, J., et al. (2022). Radiology artificial intelligence: A systematic review and evaluation of methods (RAISE). *European Radiology, 32*, 4635–4646

Najjar, R. (2023). Redefining radiology: A review of artificial intelligence integration in medical imaging. *Diagnostics, 13*(17), 2760.

Hajim, W. I., et al. (2024). Optimized models and deep learning methods for drug response prediction in cancer treatments: A review. *PeerJ Computer Science*.

Tahir, et al. (2025). Artificial intelligence versus manual screening for the detection of diabetic retinopathy: A comparative systematic review and meta-analysis. *[Use the journal details from your database/reference manager before final submission].*

World Health Organization. (2021). *Ethics and governance of artificial intelligence for health: WHO guidance*. Geneva: World Health Organization.

World Health Organization. (2025). *Ethics and governance of artificial intelligence for health: Guidance on large multi-modal models*. Geneva: World Health Organization.

U.S. Food and Drug Administration. (2026). *Artificial Intelligence-Enabled Medical Devices*. U.S. Food and Drug Administration. The FDA states that its list identifies AI-enabled medical devices authorized for marketing in the United States and is periodically updated.