AI-Personalized Medicine Therapy

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Edited by

Joohee Pradhan and Ajay Kumar Shukla

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CHAPTER ONE

AI-DRIVEN ADVANCES IN MEDICAL TREATMENT AND DELIVERY

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Abstract

The integration of computational intelligence into healthcare has revolutionized patient care, process efficiency, and cost reduction. This chapter discusses how machine learning, natural language processing, and robotics have transformed medical practices using artificial intelligence (AI). AI systems can find outlines and make precise forecasts in large datasets. This allows for patient-specific treatment programs. Healthcare workers can diagnose diseases early, forecast outcomes, and adapt treatment plans using AI-driven insights, improving patient outcomes. AI automates and supports healthcare decisions, improving efficiency. AI-powered robotic surgery saves recovery time and complications due to its precision and minimally invasiveness. AI systems also automate scheduling, billing, and patient administration, saving healthcare providers time and enhancing administrative efficiency. AI-enabled telemedicine uses wearable gadgets and mobile health apps to provide distant consultations and chronic disease monitoring.

This chapter also deliberates ethical questions associated to AI in healthcare, such as data privacy, algorithmic prejudice, and the necessity for tough regulations. As these technologies improve, engineers, physicians, and politicians must collaborate to safely and effectively integrate AI into healthcare practice. AI-driven medical care and delivery improvements will make healthcare more personalized, efficient, and cost-effective. These

innovations can elevate healthcare, boosting patient outcomes and system efficiency.

Keywords: Artificial Intelligence, Natural language processing, Drug discovery, Challenges

1.1 Introduction

Advanced artificial intelligence (AI) is swiftly revolutionising the trajectory of healthcare (Topol, 2019; Lele, 2019). Artificial intelligence (AI) encompasses the creation and advancement of computer systems that can carry out activities that usually necessitate human intelligence. These activities encompass several cognitive processes such as experiential learning, pattern recognition, problem-solving, decision-making, language comprehension, and human interaction (Shiwlani et al., 2024; Jiang et al., 2017; Esteva et al., 2017). Artificial Intelligence enables robots to imitate cognitive processes and adapt their actions according to the facts they analyze, without necessitating focused programming for each objective. Artificial intelligence (AI) is an intricate and diverse discipline that consists of numerous elements that collaborate to develop intelligent systems (Udegbe et al., 2024; Parikh et al., 2019). Artificial intelligence has demonstrated considerable promise in several healthcare domains, such as medical imaging, diagnostics, pharmaceutical research, virtual health aides, and remote patient monitoring as shown in Figure 1.1. Biomedical imaging algorithms driven by artificial intelligence have transformed diagnosis by assisting in the timely identification of illnesses and facilitating treatment planning (Ramlakhan et al., 2022; Yu et al., 2018). AI-driven prediction models in the pharmaceutical sector have expedited the process of identifying potential medication candidates and have contributed to the advancement of personalised therapies. Telehealth assistants, chatbots, and remote patient monitoring have upgraded patient outcomes and decreased hospitalizations by facilitating ongoing health monitoring and proactive disease control (Hinton et al., 2012).

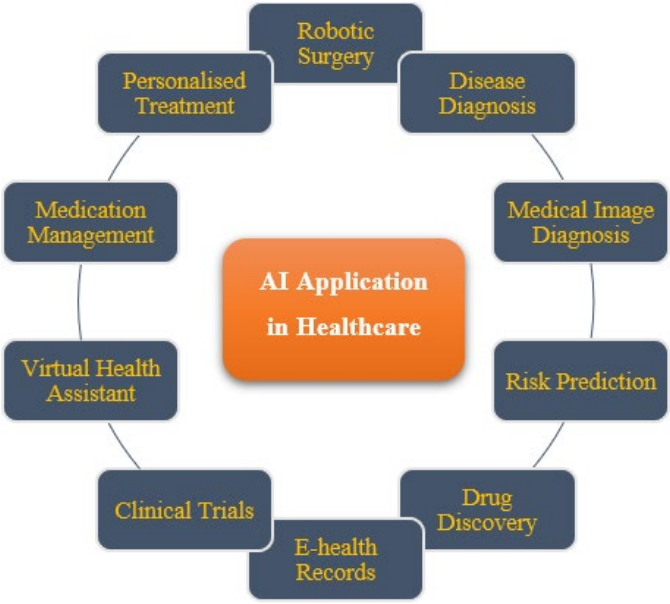

Figure 1.1: AI application in healthcare

- The evolution of AI in healthcare
  The advancement of artificial intelligence (AI) in the healthcare sector has been extraordinary, progressing from rudimentary data analysis tools to complex systems that are vital to contemporary medical practice (Holmes et al., 2015; Esteva et al., 2019; Obermeyer & Emanuel, 2016). Formerly, artificial intelligence (AI) was predominantly employed for the purpose of automating administrative duties. However, it has broadened its scope to include sophisticated applications such as predictive analytics, diagnostic imaging, and personalized medicine. Currently, artificial intelligence (AI) is propelling advancements in the early identification of diseases, scheduling of treatments, and monitoring of patients, thus improving the precision and effectiveness of healthcare provision (Davenport & Kalakota, 2019; Maddox et al., 2019). The ongoing development of AI technology (as shown in Figure 1.2) can substantially transform patient care by facilitating more accurate, individualized, and pre-emptive healthcare solutions (Topol, 2012).

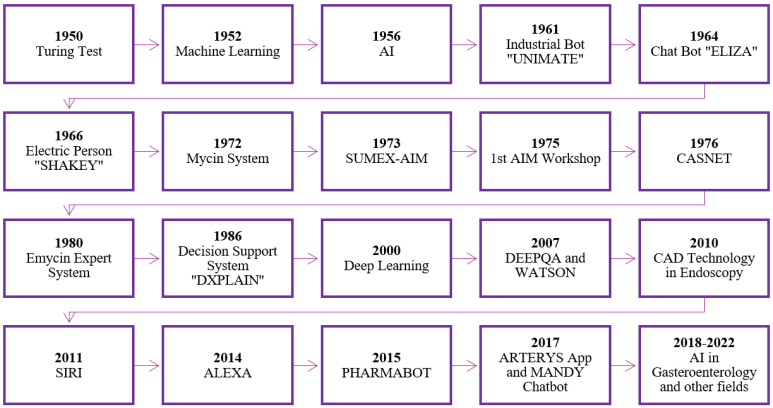

Figure 1.2: Evolution of AI

1.2 AI Technologies in Healthcare

1.2.1 AI-powered administrative automation

AI can automate appointment scheduling and event insurance claim processing. AI can lessen the workload of healthcare practitioners and enhance healthcare systems by taking on these duties. New administrative automation uses NLP to improve patient-provider communication. AI-driven administrative assistants do repetitive tasks like organizing appointments and filing insurance claims, optimizing healthcare administrative operations (Agarwal, 2024).

1.2.2 Virtual Certified Nursing Assistants

AI-powered virtual assistants are crucial for patient health management. Virtual assistants can answer questions, remind patients, and track symptoms, improving patient involvement and relieving healthcare personnel of administrative tasks. Natural language processing helps patients and virtual nursing aids communicate. Patients can also use AI-powered chatbots to schedule appointments and refill prescriptions. These artificial intelligence innovations allow patients to take control of their healthcare and optimize treatments, making patient care more well-organized and effective (Chavali et al., 2024).

1.2.3 Patient remote monitoring

Remote Patient Monitoring (RPM) is a cutting-edge AI healthcare tool that is changing patient health management. Wearable devices allow patients to monitor their vital signs and health data at home. Smartwatches and fitness trackers record heart rate, blood pressure, glucose levels, and other biochemical markers. Healthcare providers receive the data safely and can remotely analyze it. Real-time monitoring improves patient outcomes and empowers patients to manage their treatment (Shaik et al., 2023).

1.2.4 Robotic surgery

Machine learning algorithms improve surgical planning, and artificially intelligent surgical robots can perform complex measures more indeed and efficiently. Robotic-assisted surgery can reduce patient mortality by allowing physicians to remotely control procedures, making them more accessible. Artificial intelligence has advanced in robot-assisted surgery. Machine learning algorithms have better-quality for surgical planning, allowing surgeons to make better decisions before surgeries. Artificial intelligence algorithms can help surgeons create the most operative surgical procedures for each patient by analyzing medical imaging scans, genetic data, and past surgical results. Surgery with AI goes beyond particular procedures. Artificial intelligence systems can identify patterns and trends that improve surgical operations and post-operative care by continuously analyzing surgical results and patient data. This iterative learning process improves and maximizes surgical operations over time, benefiting future patients and advancing medicine (Hassan et al., 2023).

1.2.5 Telemedicine

Telemedicine is a major AI healthcare innovation that is changing medical care. Telemedicine allows patients and doctors to consult remotely using advanced communication technologies. Video conferencing, internet platforms, and other digital technologies allow patients to engage with healthcare providers from home, eliminating the need for in-person appointments. Machine learning algorithms can analyse patient data, medical records, and symptoms to help doctors diagnose and treat patients. AI can improve medical image interpretation, speeding up and improving results (Haleem et al., 2021).

1.2.6 Medical Imaging AI

X-rays, CT (Computed tomography) images, and MRIs (Magnetic Resonance Imaging) can be investigated using machine learning algorithms to find anomalies and improve diagnosis. This may speed up and improve diagnosis, improving patient outcomes. Cloud computing and deep learning are used in AI medical imaging to analyze data and help doctors screen, evaluate, and diagnose patients. Recent pragmatic studies have shown that AI detection in medical imaging detects diseases better than humans. If widely implemented, this could save millions of lives. Integrating artificial intelligence (AI) for medical image processing could have the greatest impact on world healthcare (Khalifa & Albadawy, 2024).

1.2.7 AI Drug Discovery

The capability of artificial intelligence to analyze large volumes of data has tremendously impacted pharmaceutical discovery. Deep learning practices allow artificial intelligence (AI) to scan huge datasets to identify and predict drug efficacy. These innovations can accelerate drug discovery, enabling the development of new and more effective treatments. Drug discovery using AI has great potential. Traditional drug development methods need iterative experimentation and are resource-intensive. However, artificial intelligence-driven algorithms can examine molecular edifices, genetic data, and clinical data to find forms and correlations that could help identify pharmaceutical candidates. This data-driven approach helps researchers prioritise compounds with the most potential and reduce experimental testing (Vora et al., 2023).

1.2.8 Individualised treatments

AI helps to analyze patient data and allows for personalized conduct plans that account for genetics, lifestyle, and medical history. This customized treatment technique can improve results and prevent side effects. AI can assess genetic, biomarker, lifestyle, and therapy data using machine learning techniques. This research lets artificial intelligence find patterns and relationships that conventional methods miss. Through these crucial observations, artificial intelligence (AI) can help healthcare providers create personalized conduct plans that meet each patient's unique needs (Johnson et al., 2021).

1.2.9 Predictive analytics

AI can analyze patient data and utilize predictive analytics to anticipate hospital readmissions and prescription mistakes. Machine learning algorithms allow artificial intelligence (AI) to examine large datasets, identify trends, and provide significant insights that improve patient conclusions. AI's ability to analyze patient information and predict negative outcomes revolutionizes healthcare. Healthcare practitioners can avert unfavorable events by identifying high-risk individuals or situations. Artificial intelligence algorithms can predict hospital readmissions based on medical history, vital signs, and other data. This helps healthcare personnel allocate resources more efficiently, prioritize preventive actions, and improve post-discharge care plans to reduce readmission (Alowais et al., 2023).

1.2.10 AI General Disease Diagnosis

AI's ability to analyze patient data has revolutionized illness detection, especially for complex diseases like cancer and Alzheimer's. Artificial intelligence can analyse medical records, radiological scans, genetic profiles, and other patient data using machine learning. This study helps identify patterns, anomalies, and potential biomarkers for accurate and timely disease diagnosis. Like AI in medical imaging, AI sickness diagnosis analyzes more data and computes patient disease and outcomes to improve results. Artificial intelligence improves disease diagnostic speed and accuracy. AI analysis speeds up diagnosis, detecting new diseases and disorders (Kutbi, 2024).

This promptness is crucial in critical cases where early action can improve patient outcomes. AI technology accelerates diagnosis and permits healthcare providers to quickly apply appropriate treatment techniques, potentially improving patient survival and prognosis.

1.3 Machine Learning in Diagnosis and Treatment

Machine learning (ML) is essential in healthcare as it utilizes artificial intelligence to boost patient care and optimise clinical data management. It operates as follows:

- Collection and Management of Data:
  Machine learning is dependent on patient data, which is gathered and structured using specific technologies and methodologies. These algorithms use detailed analysis of extensive datasets to detect patterns that medical practitioners can use to identify novel diseases and forecast treatment results (Bacciu et al., 2015).

- Forecasting the response to treatment:
  Machine learning algorithms can estimate an individual's probability of responding positively to particular therapies. Through the investigation of patient data, these computational models detect patterns that predict the results of treatment (J M & P, 2024).

- Evaluating Treatment Plans:
  Consider a scenario when a physician prescribes a particular medicine to a patient. Machine learning technology can verify the effectiveness of this treatment plan by identifying a patient with a comparable medical background who received positive outcomes from the same therapy (Rajpurkar et al., 2022).

- IoMT (Internet of Medical Things):
  The Internet of Medical Things (IoMT) is the interconnected system of medical devices and applications that establish communication among themselves over Internet networks. Through the synchronization of medical devices to a central network, healthcare personnel can integrate substantial amounts of patient data, so enabling enhanced understanding and decision-making (Razdan & Sharma, 2022).

1.4 Natural Language Processing in Medicine

- Healthcare NLP applications
  NLP in healthcare improves medical care and patient experience. NLP affects patients' healthcare from finding to recovery. Healthcare NLP application cases show how machine learning (ML) models improve efficiency. These insights increase patient experience (PX) in hospitals and clinics, government agencies, healthcare professionals, and decision-makers who use them to improve regional medical care (Locke et al., 2021). Natural Language Processing (NLP) organizes unstructured data and searches for semantic relations and contextual information to aid the Machine Learning (ML) engine in understanding complex human language. It helps the engine understand lexicons,

grammatical structures, and word-phrase connections for future use. NLP helps medical professionals manage patient and VoC data (Malgaroli et al., 2023).

Natural Language Processing (NLP) helps healthcare practitioners and Health Ministries improve their healthcare delivery models by collecting relevant information from patient feedback and experiences. Neuro-linguistic programming helps analyze biomedical data and knowledge from EHRs. This includes drug dosages, patient age, lifestyle, and illness, and treatment plans. NLP is also utilised in healthcare to analyze employee satisfaction by analyzing voice of the employee (VoE) data to improve the employee experience (Siddiqui, 2023).

Natural Language Processing (NLP) simplifies data gathering and interpretation, whether from medical records or patient questionnaires. Increases operating efficiency. NLP also helps extract important information from open-ended patient and employee questionnaires without comparison lists. NLP in healthcare helps staff understand rest intervals, clinical hours, duty schedules, and leisure amenities. This improves employee happiness by revealing workers' opinions on workplace culture (Iroju & Olaleke, 2015). NLP also helps hospitals create better organizational and career roadmaps that foster purpose, accomplishment, and pleasure.

- Practice using text language processing tools
  AARP (American Retirement Association)

  ARP's nutrition program is an example of NLP in healthcare. The initiative improved geriatric healthcare for people over 50. This study examined people's opinions of Noom, Weight Watchers, and MyFitnessPal. They used Twitter and polls for their investigation. They realized they needed an automated method to utilize NLP in healthcare to accurately manage and understand data, especially survey results.

  Repustate helped AARP manage data complexity and scale by designing a bespoke aspect-based sentiment analysis model for survey replies and Twitter data. The system employed semantic techniques to identify correlations between health, money, convenience, recipes, outcomes, and motivation and examined Twitter's most popular words and phrases. This engine used NLP in healthcare to find several unique findings that helped AARP create the best geriatric nutrition program for seniors (NLP, 2021).

Nahdi Medical

Based in Saudi Nahdi Medical manages 145 cities and villages across Saudi Arabia. Besides pharmacies, it provides radiography, oncology, cardiology, and pediatrics services. Nahdi provides video consultations to persons who cannot attend medical visits. To consistently use staff and patient comments, a machine learning model that natively analyzed Arabic data was needed.

A precise system that can analyze all Arabic patient voice data and survey comments was developed using Natural Language Processing (NLP) in healthcare. Repustate's machine model read and analyzed data in its original form, maintaining the Arabic text's intricacies. The automated Arabic sentiment analysis model easily understood Arabic and its dialects and successfully detected and categorized valuable feedback using a specialized Arabic part-of-speech tagger, lemmatizer, and sentiment models. Arabic natural language processing (NLP) model automatic subject and theme recognition enabled more detailed sentiment analysis, giving Nahdi valuable commercial insights (Nahdi Care).

HealthLinks

HealthLinks is a notable NLP healthcare success story. HealthLinks, a Jeddah-based healthcare consultancy, collaborates with the Ministry of Health, Saudi Arabia, healthcare executives, and stakeholders to improve Gulf healthcare quality. Identifying hidden care service dysfunctions and patient data-supported knowledge development is the strategic goal. Healthlinks used Healthcare Natural Language Processing (NLP) tools to examine its 12 million annual surveys for this purpose.

Repustate's NLP technology helped HealthLinks manage this massive data set. AI-driven automation detected trends in historical data and almost eliminated human errors. Sentiment analysis helped the software evaluate the polarity of healthcare performance. The organization used this indicator to assess performance across the Gulf area, including rural communities, to help policymakers improve patient-centered care (NLP, 2021).

EHR, medical records

The customer is a major US hospital that needed NLP to use doctor notes in EHRs. Physicians hoped this would help them understand, compare, and analyze medications, dosage combinations, pharmaceutical efficacy, primary care physicians, laboratory data, medical imaging, and other topics. The CTO stated, "There is a vast amount of data nestled within these records, and I wish I could extract it." What happens when a medicine is given at different doses? There is just one, but I have many.

Repustate's NLP model hierarchically categorized, organized, and searched all progress notes across their system, highlighting NLP's importance in healthcare. The engine classified structured data in health records and created reports to track drug and dose efficacy. The technology allowed them to permute and combine their data to find relevant information. Everything without disrupting the process or activity (Yang et al., 2022).

1.5 Robotics and AI in Surgery

Healthcare robots are replacing human work, improving capabilities, and supporting healthcare practitioners. These include robots used in laparoscopic surgeries, robotic helpers for rehabilitation and patient care, robots in implants and prostheses, and robots that help doctors and other healthcare workers. These gadgets are being developed by several firms to increase patient contact and healthcare machine-human interaction. Most developing robots use AI to improve categorization, language recognition, and image processing (Deo & Anjankar, 2023).

AI advances may help digital surgical procedures, particularly master-slave manipulators in robot-assisted surgery (RAS). With 1.25 million da Vinci surgeries conducted worldwide in 2020, RAS use has constantly increased. A robot must be trained to do surgery autonomously through explicit programming, observation of surgeons, or video demonstrations. The Smart Tissue Autonomous Robot (STAR) beat human surgeons in a porcine model during an experimental anastomotic suturing research, although this study has boundaries and has not been reproduced (Moglia et al., 2021).

Implicit learning, or imitation learning, lets robots learn new tasks by watching and copying surgery. Breaking surgical tasks into subtasks, recognizing, and modeling them for execution. The da Vinci surgical system was taught to put a stitch on an inanimate model after watching a JIGSAWS

dataset video. AI and computer vision improve suturing and knot-tying skills in surgery. Johns Hopkins University's Smart Tissue Autonomous Robot (STAR) can conduct animal intestinal anastomosis better than human surgeons. Although a completely autonomous robotic surgeon is still far off, researchers are interested in applying AI to improve surgery. The Institute of Information Technology at Alpen-Adria Universität Klagenfurt is training algorithms to recognize surgeon interventions using surgical footage. These algorithms, based on many movies, may help unskilled surgeons perform complex procedures or emergencies. Surgeons must actively create these tools to assure clinical relevance, quality, and a smooth transition from lab to clinic (Knudsen et al., 2024).

1.6 AI in Healthcare Delivery Systems

Artificial Intelligence (AI) is rapidly transforming healthcare delivery systems by enhancing the precision, productivity, and personalization of medical services. AI has made major advances in diagnostics. AI methods, especially those that use machine learning and deep learning, may examine complicated medical data like imaging, pathology, and genetics to find patterns that physicians may overlook. Radiology, cancer, and cardiology require early and correct diagnosis for optimal treatment. AI can detect tiny irregularities in medical imaging, offer diagnosis, and prioritize urgent cases, improving patient outcomes (Bajwa et al., 2021).

AI is essential for diagnoses and individualized therapy planning. AI systems can personalize treatment programs to a patient's medical history, genetic profile, and lifestyle using the latest clinical recommendations and research. This tailored strategy reduces trial-and-error and improves care quality by providing the most effective medicines. Patient care and coordination are also being transformed by AI. AI technologies can monitor patient data in actual time, allowing healthcare providers to address issues rapidly. Chronic disease management benefits from continual monitoring to avoid complications. AI integrates data from EHRs, wearable devices, and patient self-reports to improve care coordination. This integration gives healthcare providers a complete picture of a patient's health, boosting decision-making and communication (Ghanem et al., 2024).

AI automates billing, coding, and scheduling, improving administrative workflow. Clinical note transcription and recapitulation using natural language processing (NLP) techniques can reduce healthcare providers' documentation load and improve medical record accuracy. AI-driven

workflow optimization solutions can also detect operational inefficiencies to assist healthcare businesses allocate resources and cut expenses. AI can also control population health and predict. AI can discover population patterns and risk factors by analyzing massive databases, enabling targeted treatments and prevention. AI-powered predictive analytics can predict healthcare trends, resource demands, and outbreaks, helping clinicians and public health officials prepare and respond. AI's promise in healthcare delivery systems is hampered by many obstacles. Avoiding biases that could lead to unequal treatment outcomes requires high-quality and diverse data for AI model training. Controlling ethics and regulations like openness, accountability, and patient consent is crucial. AI adoption also involves major infrastructure, training, and change management investments (Johnson et al., 2021).

1.7 Telemedicine and AI

Telemedicine has changed healthcare by delivering remote medical services, especially in underdeveloped areas. Telemedicine is now more efficient, accurate, and tailored thanks to AI. AI is used in remote healthcare delivery including telehealth and patient monitoring (Vudathaneni et al., 2024).

1.7.1 AI's role in remote healthcare delivery

AI improves remote healthcare delivery efficiency and effectiveness. This is done through accurate diagnosis, individualized treatment programs, and predictive analytics. AI's essential functions in remote healthcare delivery:

- Improved Diagnostics: AI systems, especially machine learning, and deep learning, evaluate medical data, such as imaging and clinical records, to aid in diagnosis. Telemedicine platforms can include AI-powered diagnostic tools to give clinicians fast, accurate interpretations, especially in remote areas without specialists (Qurban & Cassidy, 2024).

- AI technologies can examine patient data to create individualized treatment regimens. These systems offer the best treatments based on patient history, genetics, and lifestyle. This tailored strategy improves patient outcomes and is effective for remote chronic disease management (Udegbe et al., 2024).

- AI-based predictive analytics can identify health hazards by studying patient data trends. AI can monitor patient data for deterioration and notify doctors before it worsens. Preventing hospitalizations and remotely controlling diabetes, heart disease, and respiratory ailments requires this predictive skill (Shukla, 2023).

- AI-driven virtual assistants and chatbots are increasingly employed in telemedicine for patient triage, basic medical advice, and appointment scheduling. These systems can handle basic questions, freeing up healthcare providers to handle more difficult cases, and enhancing efficiency (Sun & Zhou, 2023).

1.7.2 Telehealth and patient monitoring applications

AI can be used in telehealth to monitor patients continuously, which is essential for chronic disease and post-operative treatment. Here are some AI applications in telehealth and patient monitoring:

- AI-powered wearable gadgets and sensors enable remote patient monitoring of vital indicators like heart rate, blood pressure, and glucose levels. These gadgets give real-time data to doctors, enabling prompt treatment of disorders. Chronic illnesses like diabetes, hypertension, and heart disease benefit from constant monitoring (Hilty et al., 2021).

- AI-Driven Analytics: AI can evaluate large amounts of data from remote monitoring devices to uncover outlines and trends that humans may miss. AI can detect early complications in surgery and chronic illness patients, enabling preventive care (Božić, 2023).

- The use of AI in telehealth platforms is growing, leading to more complete care. For instance, AI can support to analysis of a patient's symptoms, offer follow-up measures, remind patients to take their meds, and warn them of potential drug interactions (Kuziemsky et al., 2019).

- AI in Mental Health Telemedicine: AI is refining mental health care through telemedicine. Speech patterns, facial expressions, and other behavioral markers can help AI algorithms diagnose sadness, anxiety, and other mental health concerns. This device provides early intervention and continuous patient monitoring outside of the clinic (Sharma et al., 2023).

- AI-driven telemedicine systems can optimize resource allocation and eliminate in-person visits, improving accessibility and lowering healthcare costs. Patients in remote or underserved locations can receive timely care without travel or significant wait periods due to this increased efficiency (Nwankwo et al., 2024).

1.8 Ethical and Security Challenges

1.8.1 Privacy concerns surrounding data

Sensitive Patient Data: Effective AI-driven healthcare solutions require vast quantities of sensitive patient data. This data often includes delicate medical, genetic, and personal information. Data collection, storage, and utilization present serious privacy problems. Unauthorized access or breaches can expose personal health information (PHI), which could be misused or stolen (Mennella et al., 2024).

Data security: AI systems require massive volumes of data, making security difficult. Hacking and data breaches threaten patient privacy. To safeguard patient data, healthcare practitioners must use encryption, secure data storage, and rigorous access controls.

Informed Consent and Data Usage: Confirming patients are well-informed about how AI-driven systems will use their data is another ethical issue. Patients may not grasp AI technology and data utilization, making informed permission essential. To ensure patients understand and consent to data use, clear communication and transparency are key.

1.8.2 Minimizing AI biases

Bias in Training Data: AI systems learn from their training data. With biased data, the AI system will likely produce biased results. This can lead to unfair treatment or misdiagnosis in healthcare, especially for minority groups underrepresented in training data. AI model development must use broad and representative datasets to address this issue.

Algorithmic Fairness: Fairness in AI systems across patient demographics is a major ethical issue. Both training data and algorithms can cause biases. AI systems must be monitored and tested to discover and rectify biases to ensure equal care for all patients.

Impact on Vulnerable Populations: If poorly developed and executed, AI-driven systems may worsen healthcare inequities for vulnerable populations. Biased AI systems may disproportionately affect low-income and minority communities. These biases can be mitigated by including varied stakeholder input and continuous AI performance evaluation across demographic groupings (Chen et al., 2021).

1.8.3 Ethical and regulatory considerations

Regulatory Oversight: AI in healthcare has advanced faster than regulations, leaving no comprehensive guidelines. Governments and regulators must now create AI healthcare frameworks that are safe and ethical. This encompasses data privacy, algorithmic transparency, and accountability criteria (Schmidt et al., 2024).

Ethics in AI: AI-driven treatment decisions create difficult ethical problems, especially in life-and-death situations. Ethics like autonomy, beneficence, and justice must be measured when determining how much AI should be involved in healthcare decisions. Clear guidelines on when and how AI can be used in decision-making must be maintained to ensure human oversight (Pouzar, 2024).

Transparency and Accountability: Ethical issues in AI-driven healthcare include AI decision-making transparency. AI should explain its conclusions and suggestions to patients and healthcare providers. Additional accountability systems are needed to handle AI-driven therapeutic errors or bad outcomes. Define accountability for AI judgments that hurt.

Cross-Border and International Considerations: As AI in healthcare grows, cross-border data transfers and international regulatory alignment become more difficult. Data privacy and AI governance regulations differ by country, making cross-border AI implementation difficult. International collaboration and regulation harmonization are needed to employ AI ethically and securely in global healthcare.

1.9 Future Innovations and Trends

AI promises to alter diagnostics, therapy, and operational efficiency in healthcare. Here we discuss these advances and their prospects.

- AI-enhanced healthcare diagnostics
  AI is revolutionizing healthcare diagnostics. AI streamlines workflows and improves diagnosis accuracy and efficiency. The following instances, statistics, and expert opinions demonstrate this change (Maleki Varnosfaderani & Forouzanfar, 2024).

- Enhancing CT Imaging Precision
  Radiology, particularly CT, is using AI to handle patient mispositioning, which can increase radiation exposure or image noise. AI-enabled camera technology detects anatomical landmarks for proper patient positioning, and image reconstruction reduces radiation dose and enhances image quality, enhancing diagnostic confidence (Najjar, 2023).

- MR Image Acquisition Acceleration
  AI-based image reconstruction speeds up MR imaging exams, increasing department efficiency and lowering exam costs. This technique shortens tests and assures accurate scans, making MR more accessible to stressed or painful patients (Wang et al., 2024).

- Simplifying Ultrasound Measurements
  Ultrasound has become essential in cardiac diagnosis. AI-based ultrasound measurements enable quick, reproducible echo quantification. The patient and staff experience are improved, and diagnostic decision-making is more accurate due to less manual variability (Gilbert et al., 2020)

- Improving Radiological Interpretation
  AI aids radiologists with image segmentation and quantification. It assists radiologists by identifying interesting or incidental results. AI systems have cut reading times and increased diagnostic accuracy in multiple sclerosis patients by 44%. Searching 26% faster, AI-based lung nodule detection found previously missed lesions (Khalifa & Albadawy, 2024).

- Encouraging Multidisciplinary Cancer Care Collaboration
  AI is integrating patient data from imaging, pathology, EHRs, and genomes. This holistic view helps cancer patients make timely and educated treatment decisions, improving outcomes (Frazer et al., 2022).

- Assisting with minimally invasive surgeries
  AI-based workflow automation and clinical decision assistance let interventional physicians conduct minimally invasive procedures more accurately and efficiently. Cloud-based AI detects big vascular blockage in CT images, a key stroke cause (Shuaib, 2024).

- Early Detection of Patient Decline
  AI-enabled techniques in acute and post-acute settings detect respiratory failure and cardiac arrest early. One hospital reduced general ward major adverse events by 35% and cardiac arrests by 86% using these technologies (Kwon et al., 2018).

- Medical Equipment Predictive Maintenance
  AI also forecasts medical equipment maintenance. This predictive strategy has reduced service cases and clinical practice disruptions, improving care continuity (Boretti, 2024).

- Streamlining Hospital Operations
  AI optimises medical equipment, beds, and staff. It predicts patient flow, bed allocation, and patient transfer, facilitating effective care delivery (Maleki Varnosfaderani & Forouzanfar, 2024).

- Remote monitoring of cardiac patients
  AI is spreading beyond hospitals, especially in cardiac care. Atrial fibrillation and heart rhythm irregularities are sensed early from remote electrocardiogram (ECG) records using cloud-based AI. Proactive cardiac treatment improves outcomes. AI-enhanced healthcare diagnostics improve accuracy, efficiency, and patient-centricity. AI in diagnostic modalities improves patient outcomes and healthcare institution efficiency (Lüscher et al., 2024).

1.10 Conclusion

AI is rapidly changing healthcare by integrating into medical imaging, diagnostics, drug discovery, virtual health supporters, and remote patient monitoring. AI-powered medical imaging algorithms have transformed disease identification and therapy planning. AI-driven predictive models have sped medication discovery and enabled individualized treatments. Remote patient monitoring and continuous health tracking have reduced hospitalizations and improved results. Virtual health assistants and chatbots have enhanced patient involvement and access to care.

AI's predictive analytics and risk stratification have enabled individualized preventive methods and population health management, improving health outcomes and disease prevention. To deploy AI ethically, data confidentiality, algorithmic bias, and regulatory compliance must be addressed. Overcoming these hurdles and achieving AI's potential requires collaboration and continual examination. AI can help improve healthcare accessibility, address social determinants of health, and promote international healthcare research and innovation, promoting global healthcare equity. AI transforms healthcare, making it more precise, efficient, and patient-centered. Healthcare systems may improve patient outcomes and equity by ethically and cooperatively using AI, revolutionizing diagnosis, treatment, and care delivery worldwide. As technology advances, AI in healthcare can improve patient care and medical logistics.

List of abbreviations

AI	Artificial Intelligence
NLP	Natural Language Processing
RPM	Remote Patient Monitoring
CT	Computed Tomography
MRIs	Magnetic Resonance Imaging
IoMT	Internet Of Medical Things
ML	Machine Learning
PX	Patient Experience
VoE	Voice of the Employee
STAR	Smart Tissue Autonomous Robot

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