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# Artificial Intelligence Transformation in the Health Care Industry and Its Applications

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**A B S T R A C T**

Artificial intelligence (AI) is the programing of computer systems to analyze, problem-solve, and make decisions just as a human would. AI was first introduced in the 1950s with many limitations finally which would developed compared. Advancements in AI programs have been happening since it was first introduced in the 1950s. The use of them has had a positive impact on the quality of medicine improving accuracy, consistency, and efficiency in all aspects. The most widely known and accepted evidence-based medicine used today are flowcharts and database research. A physician will take the patient's history, current symptoms, and lab results to determine the proper diagnosis and give the appropriate treatment plan. An AI system will do this same process, in a fraction amount of time and have greater accuracy because it can tap into multiple databases at once.

**Keywords**: Artificial intelligence, Physician, Medicine, Treatment plan, Personalized diagnostic, Preventative care.

**A R T I C L E I N F O**

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## 1. Introduction

The application of technology and artificial intelligence (AI) in healthcare has the potential to address some of these supply-and-demand challenges. The increasing availability of multi-modal data (genomics, economic, demographic, clinical and phenotypic) coupled with technology innovations in mobile, internet of things (IoT), computing power and data security herald a moment of convergence between healthcare and technology to fundamentally transform models of healthcare delivery through AI-augmented healthcare systems. In particular, cloud computing is enabling the transition of effective and safe AI systems into mainstream healthcare delivery. Cloud computing is providing the computing capacity for the analysis of considerably large amounts of data, at higher speeds and lower costs compared with historic 'on premises' infrastructure of healthcare organisations[1-3].

**Artificial intelligence**

AI refers to the science and engineering of making intelligent machines, through algorithms or a set of rules, which the machine follows to mimic human cognitive functions, such as learning and problem solving.[9] AI systems have the potential to anticipate problems or deal with issues as they come up and, as such, operate in an intentional, intelligent and adaptive manner. AI's strength is in its ability to learn and recognise patterns and relationships from large multidimensional and multimodal datasets; for example, AI systems could translate a patient's entire medical record into a single number that represents a

likely diagnosis. Moreover, AI systems are dynamic and autonomous, learning and adapting as more data become available. Machine learning (ML) refers to the study of algorithms that allow computer programs to automatically improve through experience. ML itself may be categorised as 'supervised', 'unsupervised' and 'reinforcement learning' (RL), and there is ongoing research in various sub-fields including 'semi-supervised', 'self-supervised' and 'multi-instance' ML.

**Stakeholder engagement and co-creation**

Build a multidisciplinary team including computer and social scientists, operational and research. A multi-stakeholder team brings the technical, strategic, operational expertise to define problems, goals, success metrics and intermediate milestones.

## 2. Human-centred AI

A human-centred AI approach combines an ethnographic understanding of health systems, with AI. Through user-designed research, first understand the key problems (we suggest using a qualitative study design to understand 'what is the problem', 'why is it a problem', 'to whom does it matter', 'why has it not been addressed before' and 'why is it not getting attention') including the needs, constraints and workflows in healthcare organisations, and the facilitators and barriers to the integration of AI within the clinical context. After defining key problems, the next step is to identify which problems are appropriate for AI to solve, whether there is availability of applicable datasets to build and later evaluate AI. By contextualising algorithms in an existing workflow, AI systems would operate within existing norms and practices to ensure adoption, providing appropriate solutions to existing problems for the end[4].

**AI today**

AI systems today are beginning to be adopted by healthcare organisations to automate time consuming, high volume repetitive tasks. Moreover, there is considerable progress in demonstrating the use of AI in precision diagnostics[5-9].

**AI in the medium term**

In the medium term, we propose that there will be significant progress in the development of powerful algorithms that are efficient (eg require less data to train), able to use unlabelled data, and can combine disparate structured and unstructured data including imaging, electronic health data, multi-omic, behavioural and pharmacological data[10-13].

**Augmented care**

AI could significantly reduce inefficiency in healthcare, improve patient flow and experience, and enhance caregiver experience and patient safety through the care pathway. AI could be applied to the remote monitoring of patients (eg intelligent telehealth through wearables/sensors) to identify and provide timely care of patients at risk of deterioration.

**Virtual assistants and AI chatbots**

AI chatbots (such as those used in Babylon and Ada are being used by patients to identify symptoms and recommend further actions in community and primary care settings. AI chatbots can be integrated with wearable devices such as smartwatches to provide insights to both patients and caregivers in improving their behaviour, sleep and general wellness.

**Precision diagnostics**

**Diagnostic imaging**

The automated classification of medical images is the leading AI application today. A recent review of AI/ML-based medical devices approved in the USA and Europe from 2015–2020 found that more than half (129 (58%) devices in the USA and 126 (53%) devices in Europe) were approved or CE marked for radiological use.[34] Studies have demonstrated AI's ability to meet or exceed the performance of human experts in image-based diagnoses from several medical specialties including pneumonia in radiology (a convolutional neural network trained with labelled frontal chest X-ray images outperformed radiologists in detecting pneumonia), dermatology (a convolutional neural network was trained with clinical images and was found to classify skin lesions accurately), pathology (one study trained AI algorithms with whole-slide pathology images to detect lymph node metastases of breast cancer and compared the results with those of pathologists) and cardiology (a deep learning algorithm diagnosed heart attack with a performance comparable with that of cardiologists).

**Diabetic retinopathy screening**

Key to reducing preventable, diabetes-related vision loss worldwide is screening individuals for detection and the prompt treatment of diabetic retinopathy. However, screening is costly given the substantial number of diabetes patients and limited manpower for eye care worldwide.

**Improving the precision and reducing waiting timings for radiotherapy planning**

An important AI application is to assist clinicians for image preparation and planning tasks for radiotherapy cancer treatment. Currently, segmentation of the images is time consuming and laborious task, performed manually by an oncologist using specially designed software to draw contours around the regions of interest[14-19].

**Precision therapeutics**

To make progress towards precision therapeutics, we need to considerably improve our understanding of disease. Researchers globally are exploring the cellular and molecular basis of disease, collecting a range of multimodal datasets that can lead to digital and biological biomarkers for diagnosis, severity and progression. Two important future AI applications include immunomics / synthetic biology and drug discovery.

**Immunomics and synthetic biology**

Through the application of AI tools on multimodal datasets in the future, we may be able to better understand the cellular basis of disease and the clustering of diseases and patient populations to provide more targeted preventive strategies, for example, using immunomics to diagnose and better predict care and treatment options. This will be revolutionary for multiple standards of care, with particular impact in the cancer, neurological and rare disease space, personalising the experience of care for the individual.

**AI-driven drug discovery**

AI will drive significant improvement in clinical trial design and optimisation of drug manufacturing processes, and, in general, any combinatorial optimisation process in healthcare could be replaced by AI.

**Precision medicine**

Over the past decade, synthetic biology has produced developments like CRISPR gene editing and some personalised cancer therapies. However, the life cycle for developing such advanced therapies is still extremely inefficient and expensive. In future, with better access to data (genomic, proteomic, glycomic, metabolomic and bioinformatic), AI will allow us to handle far more systematic complexity and, in turn, help us transform the way we understand, discover and affect biology. This will improve the efficiency of the drug discovery process by helping better predict early which agents are more likely to be effective and also better anticipate adverse drug effects, which have often thwarted the further development of otherwise effective drugs at a costly late stage in the development process. This, in turn will democratise access to novel advanced therapies at a lower cost.

## 3. Challenges

We recognize that there are significant challenges related to the wider adoption and deployment of AI into healthcare systems. These challenges include, but are not limited to, data quality and access, technical infrastructure, organizational capacity, and ethical and responsible practices in addition to aspects related to safety and regulation. Some of these issues have been covered, but others go beyond the scope of this current article.

## Conclusion and key recommendations

Advances in AI have the potential to transform many aspects of healthcare, enabling a future that is more personalized, precise, predictive and portable. As much as the last 10 years have been about the roll out of digitisation of health records for the purposes of efficiency (and in some healthcare systems, billing/reimbursement), the next 10 years will be about the insight and value society can gain from these digital assets, and how these can be translated into driving better clinical outcomes with the assistance of AI, and the subsequent creation of novel data assets and tools. It is clear that we are at an turning point as it relates to the convergence of the practice of medicine and the application of technology, and although there are multiple opportunities, there are formidable challenges that need to be overcome as it relates to the real world and the scale of implementation of such innovation. A key to delivering this vision will be an expansion of translational research in the field of healthcare applications of artificial intelligence. Alongside this, we need investment into the upskilling of a healthcare workforce and future leaders that are digitally enabled, and to understand and embrace, rather than being intimidated by, the potential of an AI-augmented healthcare system.

The delivery, administration, and patient experience of healthcare are all being completely transformed by the advancement of AI-driven technology and further its integration into existing systems. In diagnostics, AI-powered diagnostic tools have shown remarkable accuracy in diagnosing diseases including cancer, heart issues, and neurological disorders, particularly in the area of medical imaging. These technologies frequently outperform human clinicians in this regard. Their speed and precision have frequently surpassed that of human professionals. ML algorithms scan vast amounts of data from imaging studies, genomes, and medical records to identify patterns and predict patient outcomes, enabling earlier and more accurate diagnosis. By analyzing patient data to suggest tailored medication, AI improves treatment success and minimizes side effects. These technologies can reduce hospital admissions and readmissions by remotely monitoring patients and alerting medical professionals to issues before they get worse[20-24]. Healthcare facilities operate more effectively, and resources are directed where they are most needed because to AI's capacity to manage massive information and optimize workflows. Additionally, for the healthcare industry to adopt AI, a cultural shift must occur. By automating processes like scheduling, billing, and patient triage and allocating resources optimally to cut down on wait times and enhance workflow overall, AI also increases operational competence.

## Applications of Al in Healthcare

AI has revolutionized the way medical professionals approach diagnosis, treatment planning, and operating procedures. has many different and extensive uses in healthcare. AI is influencing how healthcare is delivered in the future, from improving administrative procedures and guaranteeing ethical concerns to revolutionizing diagnostics and treatment customization[25-29].

## Diagnostics and Disease Identification

The integration of AI into diagnostic and disease identification has revolutionized healthcare, particularly in medical imaging, where AI algorithms exhibit unparalleled proficiency. Pathology and AI's examination of microscopic details help pathologists quickly and precisely identify problems. The cooperative concept of AI algorithms and radiologists in radiology improves patient care, solves staffing shortages, and speeds up and improves diagnosis. Beyond productivity improvements, AI has a significant impact on patient outcomes in diagnostics. Quick and precise diagnoses allow for prompt interventions, which are essential when prognosis is greatly impacted by early diagnosis.

## Treatment Personalization

With a major contribution to medication discovery and development as well as the treatment landscape, AI's disruptive impact in healthcare is especially noticeable in therapy personalization.

## Drug Discovery and Development

The application of AI to medication research and discovery marks a significant advancement for the pharmaceutical sector. AI has become a vital collaborator in the field of drug research, helping to identify possible therapeutic candidates. Large datasets are painstakingly analyzed by ML algorithms, which also forecast the effectiveness of different substances and expedite the preliminary phases of drug screening. Furthermore, by enabling more effective clinical trials, anticipating possible adverse effects, and identifying patient groups who would react best to particular treatments, AI helps to optimize drug development. As AI algorithms continue to evolve and learn from diverse datasets, the potential for discovering novel therapies, improving treatment efficacy, and tailoring interventions to individual patient profiles has become

gradually promising, steering in a new era of innovation in the pharmaceutical landscape[30].

**Revolutionizing Personalized Healthcare**

One of the most transformative applications of AI in healthcare lies in treatment planning, and personalization can be performed a step further by leveraging AI to tailor interventions based on individual patient profiles. AI algorithms assist medical providers in creating treatment plans that are both more successful and less likely to have negative side effects by evaluating patient-specific data. A paradigm change away from broad treatment techniques and toward more focused and patient-centered healthcare strategies are represented by this degree of customization. AI serves as an advanced guide for treatment planning, considering the specifics of a patient's genetic composition, medical history, and other pertinent variables..

**Predictive Analytics and Preventive Medicine**

To improve patient outcomes and lessen the strain on healthcare systems, proactive healthcare where interventions are started before diseases worsen, is encouraged by the combination of AI and preventive medicine.

**Predicting Disease Outbreaks**

The AI uses its analytical skills to examine large information and spot trends and abnormalities that could be signs of an outbreak. AI helps healthcare organizations to proactively execute timely interventions, strategically manage resources, and lessen the effect of emerging health hazards.

**Identifying High-Risk Patients**

By identifying patients who are at higher risk for illnesses through the analysis of individual patient data, AI supports preventative medicine. AI has the potential to transform predictive analytics and preventive medicine as it develops further in these fields, making it a valuable instrument for improving both individual and public health[31-33].

**Optimizing Clinical Processes**

Mobile apps use NLP and ML algorithms to generate tailored maps of patients' illnesses, prompt people to experience symptoms, and deliver clearly understandable health information. Early intervention is made possible by this proactive strategy, which also improves the general patient experience. healthcare outcomes by guaranteeing prompt responses to unforeseen changes in a patient's condition.

**Administrative and Operational Efficiency**

In the healthcare industry, integrating big data, analytics, AI, and ML improves operational effectiveness and lowers expenses. Both supervised and unsupervised ML techniques are essential for comprehending parameters, connecting them to illnesses, and forecasting results. It supports anomaly detection, tailored therapy, and diagnostics. In contrast to proactive healthcare, which emphasizes prevention over reaction, reactive ML deals with urgent medical requirements and responses to symptoms.

**Revenue Cycle Management**

Healthcare firms are handling billing, claims, and general financial workflows differently because of AI's ability to streamline complex financial operations. By automating processes like billing and coding, AI algorithms lower errors, speed up the processing of claims, and eventually maximize revenue streams.

**Supply Chain Optimization**

Supply chain optimization is another domain where AI brings transformative change. It is crucial to the healthcare industry to make sure that medical resources are acquired, distributed, and managed in a timely and effective manner. AI helps with demand forecasting, inventory management, and logistics optimization using predictive analytics and ML. Costs are decreased, waste is decreased, and the supply chain becomes more robust and responsive as a result.

**Patient Engagement and Remote Monitoring**

The synergy between AI, wearable devices, and telemedicine not only enhances remote monitoring but also empowers individuals to take a more active role in their health. As technology continues to advance, the integration of AI in patient engagement and remote monitoring stands as a testament to the potential for more personalized, efficient, and accessible healthcare delivery.

**Transforming Patient Engagement and Preventive Healthcare by Wearable Devices**

AI-enabled wearable technology has become a potent instrument for measuring patient involvement. These gadgets gather health data in real time and range from fitness trackers to advanced wearable health monitoring systems. Healthcare professionals can remotely monitor patients thanks to AI algorithms that evaluate this data and produce meaningful findings. Vital signs and health parameters are continuously monitored to enable early abnormality detection and fast intervention by patients and healthcare providers[34-48].

**Revolutionizing Virtual Care and Remote Consultations Through Telemedicine**

AI in telemedicine improves the effectiveness of remote consultations, increases access to healthcare for a variety of populations, and guarantees continuity of care, particularly in circumstances when in-person visits may be difficult.

**Ethical Considerations in AI Applications**

A thorough analysis of ethical issues is required when integrating AI in healthcare. The primary issue is data privacy since AI depends on large datasets that contain sensitive data, necessitating strong safeguards to protect personal information. It takes constant work to detect and lessen biases to ensure justice and inclusivity. To ensure responsibility and foster confidence between patients and healthcare providers, ethical considerations like interpretability and openness in AI decision-making processes are essential. AI in healthcare adheres to ethical standards, puts patient welfare first, and strikes a careful balance between technological innovation and moral ideals requires ongoing oversight and regulatory frameworks[39-40].

**Improved Diagnostic Accuracy and Enhanced Treatment Planning**

AI enhances diagnostic accuracy by meticulously analyzing vast datasets, enabling early detection of diseases. In medical imaging and pathology, AI algorithms contribute to more precise and timely diagnoses, reduce errors and improve patient outcomes by tailoring treatment plans based on individual patient profiles, ushering in a personalized medicine era. ML algorithms analyze patient-

specific data, optimizing treatment efficacy while minimizing potential adverse effects.

**Cost Reduction and Efficiency**

AI-driven automation streamlines administrative tasks, from billing to claims processing, reducing errors and optimizing revenue cycle management. Operational workflows benefit from AI's predictive analytics, enhancing supply chain management and minimizing inefficiencies, ultimately reducing costs.

**Patient-Centered Care**

AI facilitates patient-centric care by providing personalized treatment options, improving engagement, and fostering a collaborative approach between healthcare providers and patients. Enhanced communication and individualized interventions contribute to a more satisfactory patient experience.

**Access to Healthcare in Underserved Areas**

AI-powered telemedicine and remote monitoring address geographical barriers, expanding access to healthcare services in underserved areas. Remote consultations facilitated by AI bridge the gap between patients and healthcare providers, overcoming distance-related challenges.

**Future Potential and Innovation**

The incorporation of AI sets the stage for future innovations in healthcare. Predictive analytics, genomics, and continuous technological advancements hold the promise of novel solutions, transforming healthcare delivery and improving overall patient outcomes[41-44].

**Challenges and Concerns**

The widespread adoption of AI in healthcare is accompanied by a set of challenges and concerns that necessitate careful consideration to ensure responsible and ethical implementation. While AI holds transformative potential, its deployment demands substantial resources, such as high computational power, large datasets, and specialized data science expertise. Addressing these challenges and concerns requires collaborative effort from stakeholders, including policymakers, healthcare professionals, technologists, and ethicists.

**Current Regulations**

Ambiguities in legal frameworks, especially regarding liability and accountability for AI-driven decisions, require clarification to establish a robust regulatory environment. The regulatory landscape for AI in healthcare is evolving, and navigating compliance with existing regulations poses challenges.

**Bias and Fairness of AI Algorithms**

Ethical issues surrounding AI are profound, especially when it comes to biases in AI systems. AI algorithms may inadvertently perpetuate biases present in the data on which they are trained. One of the prime concerns is the risk of data misuse by AI developers or healthcare providers who may mistakenly expose patient data.

**Current Applications of AI in Healthcare**

These case studies demonstrate the potential applications of AI in healthcare, but they also highlight the importance of resolving concerns like data security, legal compliance, and the need for smooth integration with existing procedures. The evolution of these instances provides valuable insights into the ongoing application of AI technologies to transform healthcare.

**IBM Watson Health**

One well-known example of the use of AI in healthcare is IBM Watson Health. Watson Health analyzes enormous volumes of medical data, including as research articles, clinical notes, and patient records, by utilizing AI and cognitive computing. It helps medical practitioners identify and treat complicated medical disorders[45-48].

**Google Health**

Google Health is another major player in the healthcare AI landscape. Google has invested in AI technologies for medical imaging analysis, drug discovery, and patient care. DeepMind, a subsidiary of Google's parent company Alphabet, has made progress in using AI for tasks such as predicting patient deterioration and analyzing medical images. Google Health has showcased the potential of AI to revolutionize various aspects of healthcare, but it has also encountered challenges related to data privacy concerns and the need for transparent and ethical AI practices.

**Startups in the Healthcare AI Space**

Numerous startups have emerged that focus on diverse applications of AI in healthcare. For instance, PathAI utilizes ML for pathological interpretation, Aidoc specializes in AI-powered radiology solutions, and Tempus focuses on using AI to personalize cancer care. These startups showcase agility and innovation in the healthcare AI space, often bringing niche solutions to specific healthcare challenges.

**Healthcare Institutions Implementing AI**

The Cleveland Clinic has implemented AI-driven chatbots to enhance patient engagement and communication. These cases demonstrate that AI is not limited to technology companies but is integrated into the strategies of healthcare providers seeking to improve efficiency, patient outcomes, and overall healthcare delivery.

**Emerging AI Technologies**

Emerging AI technologies, such as federated learning, explainable AI, and reinforcement learning, hold promise for addressing current limitations and expanding the scope of AI applications in healthcare. Federated learning allows AI models to be trained across decentralized datasets without compromising data privacy.

**Artificial Intelligence in Healthcare Services**

AI is used daily in many areas of modern healthcare, from the online scheduling service for appointments to drug interaction warnings when physicians prescribe multiple medications to research development. A physician will take the patient's history, current symptoms, and lab results to determine the proper diagnosis and give the appropriate treatment plan. Deep learning (DL) can be used to detect lesions, compose reports, and create differential diagnoses. AI can be applied to colonoscopies to help in the identification and verification of benign versus malignant colon polyps. The AI CAD system has been deemed beneficial for the differentiation between adenomas and polyps, the improvement of imaging, and the development of prediction models for patient prognoses and treatment. The practice of AI within the PCP office to care for patients is rapidly turning into online consultations,

advice visits, medication refills, orders of test kits, and much more[49].

**Artificial Intelligence in Drug Design and Development**

Recent studies have also found AI to be useful in reducing time and costs in pharmaceutical technology and drug delivery design. More specifically, machine learning (ML: for forecasting drug absorption, distribution, metabolism, and excretion) and deep learning (DL: for predicting various pharmacokinetic parameters, such as drug absorption, bioavailability, clearance, volume of distribution, and half-life) algorithms can predict the pharmacokinetics and toxicity of potential drug candidates.

**Artificial Intelligence-Pillar of Healthcare**

Multiple issues have arisen in AI making it difficult to form as a fundamental pillar in the healthcare environment. Difficulties such as relevant data accessibility, concern for clinical implementation, and ethical dilemmas will have to be faced in the future. Keeping accountability of AI systems in practice through enforcing strict regulations, performing regular auditing, and validation are suggested to ensure better human-centered AI systems[50]. It is imperative that patients are fully aware when AI is processing their information, and that they fully consent to the use of their information for ML. AI education should be developed in a way that can be easy for healthcare workers to understand, and leave room for personal decisions at the discretion of health experts[51-52].

## 4. Conclusion

AI in healthcare has produced revolutionary results in a number of sectors. The ways in which AI has improved patient centered care, reduced costs, improved treatment planning, and boosted accessibility highlight how revolutionary this technology has the potential to be in the healthcare industry. AI has been used in several fields, such as patient engagement and diagnostics, and it has demonstrated encouraging results in enhancing the skills of medical personnel and enhancing patient outcomes. AI in healthcare is dynamic and promising, and a collective commitment to responsible implementation will be pivotal in harnessing its full potential for the benefit of patients, healthcare professionals, and society at large. AI has some impact on healthcare settings and that can assists physicians in accurate, quick diagnosis and developing effective treatment plans, expediting patient waiting time, reducing redundant paperwork for nurses, and ensuring the regulatory requirements can be examples of the use of AI in healthcare. Besides the benefits of AI in the medical sector, the negative consequences need to be judged well for use in the workforce[53-54]. Resolving data accessibility, maintaining data privacy, ensuring the authenticity of ChatGPT, maintaining accountability, and proper training of the health associates are the parameters to overcome the negative aspects of AI.

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