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Artificial Intelligence in Healthcare

Syed Gulfraz Naqvi[1], Taha Nasir[2], Hammad Azam[3], Laiba Zafar[4]

[1] School of Commerce and Accountancy, University of Management Technology Lahore, Pakistan.
Email: gulfraz.naqvi@umt.edu.pk
[2] School of Commerce and Accountancy, University of Management Technology Lahore, Pakistan.
[3] School of Commerce and Accountancy, University of Management Technology Lahore, Pakistan.
[4] School of Commerce and Accountancy, University of Management Technology Lahore, Pakistan.

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ABSTRACT

Technology's impact on today's world cannot be overstated. Human work is made easier to manage and more productive by technological advancements. Errors attributable to human error have been reduced because of technological advancements in the healthcare sector. Artificial intelligence (AI) has the potential to impact the medical and healthcare industries significantly. The "quadruple goals" of healthcare include better population health, better care for individual patients, better care for individual caregivers, and lower overall healthcare expenses. To achieve these objectives, healthcare systems across the world face significant challenges. In this paper, we examine the existing use of AI in healthcare, outline a process for creating reliable, safe, and efficient AI systems, and make some educated guesses about their future. It was determined that AI plays a crucial role in medical decision-making, especially predictive analytics when it comes to diagnosing and treating patients and managing health services in general. The current study's findings outline the implications for policymakers and regulatory authorities. In addition to that, the last section outlines the future research directions.

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Corresponding Author's Email: gulfraz.naqvi@umt.edu.pk

1. Introduction

The phrase "artificial intelligence" (AI) is often used to refer to computer-based approaches that mimic the functions of human intellectual abilities such as abstract thinking, machine learning, adaptability, emotional intelligence, and perceptual understanding (Doyle, Leavitt, & Rigg, 2020). Machines may be programmed to do jobs that previously required human judgment and interpretation. The multidisciplinary nature of these techniques makes them applicable in many settings. Artificial intelligence has been used in medicine since the 1950s when doctors first tried computer-assisted approaches to improve their diagnosis. Recent interest and success in using AI in medicine may be attributed to the exponential increase in the processing capacity of modern computers and the vast amounts of digital data available for collection and use (LeCun, Bengio, & Hinton, 2015). Artificial intelligence is having a profound impact on the medical industry. Clinical, diagnostic, rehabilitative, surgical, and prognostic care are all possible areas where AI might be useful in medicine. Other critical areas where AI is having an impact on medicine include clinical decision-making and sickness diagnosis. For disease diagnosis and clinical decision-making, artificial intelligence (AI) technology can take in, interpret, and report enormous amounts of data from several modalities (Lasko, Denny, & Levy, 2013). Artificial intelligence systems may analyze The mounds of data created in the medical profession, giving new insights. These techniques may discover new medicines for healthcare management and patient care treatments.

Artificial intelligence has the potential to improve healthcare delivery and cost greatly. The use of AI and robotics in healthcare is advancing quickly, especially in the context of early detection and diagnosis. Meanwhile, AI is becoming more beneficial as its development continues,

and routine jobs take humans in a fraction of the time it takes. Artificial intelligence (AI) quickly overtakes human doctors as the primary care provider (Kelly, Karthikesalingam, Suleyman, Corrado, & King, 2019). Health systems that used to depend on human intervention to manage patients and healthcare resources are now fully automated. The healthcare system needs novel ways of enhancing efficiency without adding to the budget deficit. Here is where we may use modern tools (LeCun et al., 2015). The healthcare industry may benefit from the rapid development of technology, especially in artificial intelligence and robots.

The "quadruple goals" of healthcare include better population health, better care for individual patients, better care for individual caregivers, and lower overall healthcare expenses. To achieve these objectives, healthcare systems across the world face significant challenges. Due to the world's ageing population, the increasing prevalence of chronic disease, and the ever-increasing healthcare expense, governments, payers, regulators, and providers are all under pressure to innovate and adapt healthcare delivery methods. The global pandemic has contributed to the challenges faced by healthcare systems throughout the world by increasing the demands for "executing" (providing high-quality, effective treatment) and "transforming" care at scale via the use of data-driven insights from around the world (Kelly et al., 2019). The increased number of people in need of medical attention. Quick and simple access to medical care. Some supply and demand problems may be resolved using technology and AI in healthcare. The increasing availability of multimodal data (genomics, economics, demographics, clinical, and phenotypic) and recent advancements in mobile devices, the Internet of Things (IoT), computing power, and data security point to the connection between healthcare and technology (LeCun et al., 2015). As time and space become increasingly merging, AI-enhanced healthcare systems are drastically disrupting the conventional manner of giving medical treatment.

2. Literature Review

The profession of early diagnosis is in desperate need of artificial intelligence. It may improve diagnostic tests' efficiency, precision, and dependability for diseases like cancer. Data from several patients, including visual data, are analyzed and used to make inferences about a select group of individuals. Correlations are discovered, and predictions are made via a self-learning system. One example is Google's DeepMind healthcare technology, which combines machine learning and neuroscience systems to simulate the human brain and aid doctors in diagnosis and decision-making. This innovative technology may help with healthcare management. There are many potential advantages to using AI in healthcare settings, but there will also be difficulties to overcome. Whether AI can enforce doctors' rights and responsibilities is a topic of worry, as are concerns about privacy and the preparedness of current laws to accommodate this new development. Artificial intelligence is already being recognized by rules, as seen by its adoption by many healthcare systems. It turns out that standards for developing healthcare IT products and services are feasible to design and execute.

Zupic and Ater suggest that bibliometric methods be used to assess many fields of study to increase objectivity and lessen researcher prejudice. Because of its usefulness in providing a quantitative measure of research impact, bibliometrics has become more mainstream. Bibliometrics has developed into a useful technique for predicting trends in academic output in recent years. This survey's research methodology is like those in Table 1.

Table 1 List of research using bibliometric analysis. *Source*: Authors' elaboration

References	Field
Huang et al. [1]	Rehabilitation medicine
Hao et al. [2]	Text mining in medical research
	Medical big data
Liao et al. [3]	Global evolution of research on AI in health and medicine
dos Santos et al. [4]	Data mining and machine learning techniques applied to public health problems
Connelly et al. [5]	Robotic surgery
Guo et al. [6]	AI-related research conducted in the field of health problems
Choudhury et al. [7]	Machine learning in geriatric clinical
Choudhury and Asan [8]	AI in patient safety outcomes

Source: (Secinaro et al., 2021)

The reported scientific publications did not match the keywords and subjects that had been previously researched. The research paper by Huang et al. Virtual reality (VR) is explored for its potential in medical rehabilitation. According to the authors, rehabilitation programs enhance patients' quality of life and functional independence with physical impairments or disabilities. The availability of state-of-the-art technology in recent years has facilitated research and therapy in many fields of medicine.

Hao and Xiao (2014) state that focusing on text mining for medical studies is important. Text mining, in which data is extracted automatically from several textual sources, is believed to provide new yet unknown information. You may think of text mining methods as a sort of data mining that is applied to written content. The use of text mining for the analysis of medical data is growing quickly. Similar arguments were made by (dos Santos, Steiner, Fenerich, & Lima, 2019). Data mining and machine learning can be used in the public health sector. Public health has several facets, including disease prevention, health promotion, and life extension. Data mining and machine learning techniques have enabled the uncovering of hitherto unseen information. Both articles touch on the secondary topic of big data's use in healthcare.

According to Liao et al. (2018), "big data" defines the huge amounts of digital data accumulated from several sources and is the most popular "buzzword" in the worlds of business and academic study. Because of the potential for collecting massive volumes of data in the medical field, this field has been dubbed "medical big data." Data mining and ML techniques may be used to organize and disseminate this information to doctors and patients. Chaudhry et al. (2013) presented a thorough evaluation of ML's use in geriatric care, establishing the suitability of study into its use in treating mental disorders and ocular diseases.

Tran et al. (2019) argue that improving artificial intelligence for healthcare must be a top research goal globally. His bibliometric study illuminates key issues in developing and using AI technology. The usage of surgical robots has increased substantially in recent years, as shown by research (Connolly, Seligman, Kastenmeier, Goldblatt, & Gould, 2014). They found that robotic surgery is increasingly being used in fields including urology, colorectal, cardiothoracic, orthopaedic, maxillofacial, and neurological surgery, among others, based on a review of the relevant literature.

This viewpoint is reinforced by the bibliometric analysis conducted by (Guo et al., 2019). Deep dive into the AI literature released in 2019 thus far. This research investigates the practical uses of AI in healthcare, providing insight into the potential of algorithms to benefit medical professionals. There is also cutting-edge research being conducted around AI. This is where the work of Choudhury and Asan (2020) comes in; they conducted a methodical search of the literature on AI to uncover possible threats to human health. Were 53 studies presented, including clinical warnings, clinical reporting, and other approaches to improving pharmaceutical safety?

2.1. The Application of Artificial Intelligence in Health Service

Technology's impact on today's world cannot be overstated. Human labour is simplified and increased in efficiency thanks to technological advancements. Errors attributable to human error have been reduced because of technological advancements in the healthcare sector (Neumann, Winkelhaus, Grosse, & Glock, 2021). For instance, a surgical procedure may be fraught with danger and failure if technology is not used. AI, or artificial intelligence, simulates intelligent human behaviour in computing systems. Clinical decision-making will become more challenging because of artificial intelligence's effect on patient diagnosis, prevention, and treatment (Sunarti et al., 2021).

Artificial intelligence (AI) in medicine might simplify or significantly alter patient treatment. Technology use in healthcare can potentially improve patient management options and results (Land, Boeras, Chen, Ramsay, & Peeling, 2019). It also has the potential to aid recruitment and retention initiatives in remote hospitals. While this may eventually lead to a more equitable global healthcare system, promoting the early acceptability and sustainable deployment of healthcare systems is challenging when the user perspective is poor, and technology is not being used properly. Public health applications of artificial intelligence. Research into the numerous dimensions of AI's use in government might be modelled after using such systems in public health.

2.2. The Problem with the Application of Artificial Intelligence in Health Service

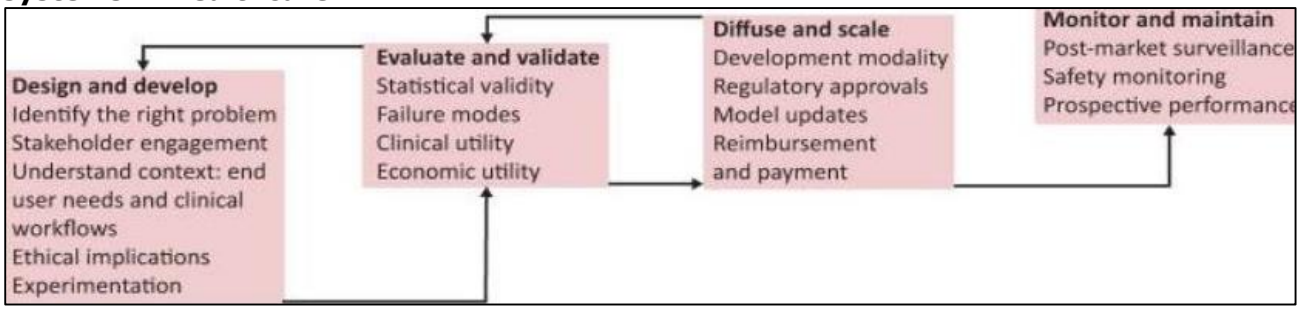
The use of AI has improved several facets of healthcare administration. Clinical use of AI is expected to become commonplace soon. However, AI's ethical and legal ramifications in healthcare have been questioned. Many people are worried about the potential for bias, the lack of clarity in certain AI algorithms, the security of data used to train AI models, and the burden of responsibility associated with using AI in healthcare settings (Murphy et al., 2021). Some ethical concerns have been raised about using AI in clinical settings. Those factors include safety, effectiveness, confidentiality, transparency, informed consent, freedom of choice, freedom to experiment, affordability, and availability (Klugman, Dunn, Schwartz, & Cohen, 2018).

2.3. How to Build an Effective and Trusted AI-Augmented Healthcare System?

Despite AI's popularity for over a decade, many healthcare AI solutions are still in the planning and prototyping stages. Although there are numerous approaches to creating AI systems for healthcare, it is not uncommon for people to try to force a solution that does not fit into the local context (such as clinical workflow, user needs, beliefs, safety, and ethical implications) into a problem that does (Davenport & Kalakota, 2019).

AI will work in tandem with human intelligence rather than trying to replace it. Accordingly, the key to creating effective AI systems in healthcare is not to do away with them but to improve essential aspects of human interaction in medical practice (Bohr & Memarzadeh, 2020). Further, a human-centred understanding of the complexities of patient journeys and treatment plans will pave the way for AI innovation in healthcare. Based on the work of (Wiens et al., 2019), we provide in Figure 1 a human-centred, problem-based approach for developing AI-enhanced healthcare systems that are both effective and trustworthy.

Figure 1: Multi-step, iterative approach to building effective and reliable AI-augmented systems in healthcare



2.4. What are the Current and Future Use Cases of AI in Healthcare?

Precision diagnosis, precision treatment, and, ultimately, precision medicine are the "quadruple goals" of healthcare, and they may be achieved with the assistance of AI by democratizing and standardizing a future of AI-augmented and connected care (Feeley, 2017). Drug development, virtual clinical practice, illness diagnosis, prognosis, medication management, health monitoring, and other possible uses of artificial intelligence in healthcare have all seen rapid advancements in the research of their prospective applications (Briganti & Le Moine, 2020). This encompasses both conventional and alternative forms of healthcare.

2.5. Today's AI (and What is Coming Soon)

For the time being, AI systems cannot reason, as human doctors can rely on "common sense" or "clinical intuition and experience" (Zhu et al., 2020). Instead, AI acts as a signal converter, transforming known data sets into ones that show unexpected relationships. Healthcare firms use current AI technology to automate high-volume, low-value procedures (Spring, Faulconbridge, & Sarwar, 2022). Improvements have also been made in using AI for planning radiation therapy and detecting diseases like diabetic retinopathy.

2.6. Artificial intelligence in the Mid-term (5-10 years from now)

In the not-too-distant future, we expect to see significant progress in the development of efficient and powerful algorithms (e.g., require fewer data to train), can use unlabeled data, and can combine different types of structured and unstructured data, such as Imaging, electronic health data, multi-omics, behavioural, and pharmacological data (Sendak et al., 2020). Additionally, healthcare organizations and medical practices will shift from being early consumers

of AI platforms to collaborating in creating new AI systems for precision medicine alongside technology partners (Pee, Pan, & Cui, 2019).

2.7. Artificial Intelligence with a Ten-Year Time Horizon

Over time, higher-performing AI systems will allow for AI-enhanced, internet-enabled healthcare that can accurately diagnose and treat patients. As healthcare shifts from the present, one-size-fits-all paradigm toward a data-driven, individualized, preventive approach to disease management, better patient outcomes (improved clinical and patient care experience) will be feasible through the most cost-effective delivery method.

3. Discussion

The healthcare industry, and the health services industry, can only go ahead by adopting AI. However, there will be fallout from AI usages, such as malfunctioning systems, ethical problems, and even new laws. Some potential subjects of discussion include health equity, peer-reviewed images, patient-reported language on medical conditions, diagnosis and treatment, and cost reimbursement codes. Using erroneous and unrepresentative training datasets for AI systems may lead to bias, wrong predictions, unwanted events, and widespread prejudice. Transparency Medical image analysis and clinical risk prediction are two areas where deep learning models have shown promising outcomes. The medical industry, which places a premium on transparency and the ability to justify clinical decisions, has difficulties because of this barrier. If we are going to put our faith in doctors when it comes to AI, we need them to consider where health problems come from and how they are being solved. Concerns about the autonomous capabilities of AI applications and the susceptibility to harmful effects from unintended or purposeful manipulation of these apps may be major barriers to the widespread use of AI in medical practice. Artificial intelligence has the potential to improve healthcare delivery and management. Health-related information and services may be disseminated more efficiently via digital channels when AI is used for telemedicine, which might significantly influence hospitals' business models. The healthcare sector is not growing as rapidly as it might be. There is great potential for AI to improve public health. AI will ultimately replace in-person interactions because of the potential cost savings at the centre of healthcare delivery. There is widespread speculation that AI will cause radical changes in the medical sector.

The "virtual branch" of AI refers to the research on health management systems, the in-depth knowledge processing of electronic health data, and the active monitoring of doctors' medical judgments. There has been a significant uptick in research into how AI systems may help doctors make accurate diagnoses. When this AI is upgraded to more robust technology and given access to more comprehensive data, it will also be able to detect other diseases. More treatment options for patients with better outcomes are two obvious benefits of healthcare technology, while fewer referrals, lower costs, and more effective use of time are potential additional benefits. This helps to decrease occupational segregation and boosts recruitment and retention in rural areas. As a result, this contributes to more healthcare parity between high- and low-income countries.

4. Conclusion

Artificial intelligence (AI) must be used in several areas of healthcare, including management, decision-making (including predictive analysis), diagnosis, and treatment. Promoting early acceptance, guaranteeing sustainable deployment in health systems, not considering the user perspective, and making sub-optimal use of technology are only some of the difficulties associated with using AI in the public health sector. The use of AI in the clinic raises several ethical concerns, including those related to the technology's safety, effectiveness, privacy, information, consent, right to choose, "right to try," cost, and access. Healthcare providers contemplating the use of AI should give some thought to the following before moving forward:

- Ethical and responsible data access practices are required since healthcare data is highly confidential, inconsistent, siloed, and not optimal for machine learning development, testing, implementation, and adoption.
- To get the necessary data, one must access domain expertise/previous knowledge to develop rules that may be applied to the dataset. Thanks to cloud computing, we can pool enough computers together to generate real-time options.

- There is a need for rigorous evaluation, analysis, and investigation into the problems that arise when deploying "trustworthy" AI algorithms incorporated into correct procedures.

Artificial intelligence improvements promise a more individualized, precise, predictable, and portable future in healthcare. Whether we will see gradual or dramatic adoption of these technological improvements is still being determined. However, the impact of these technologies and the digital renaissance they will bring requires health systems to consider how best to adapt to the changing environment. Future healthcare providers may be able to draw from the asset pool and spend more time on patient care if freed up to employ such technologies. From "the pinnacle of human knowledge" to "pushing the boundaries of science," patients always get top-notch care from the most qualified doctors available, whenever and wherever they need it. The use of AI has the potential to become a game-changer in the fight for universal health care.

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