International Journal of Medical and Applied Health Science (IJMAHS)

Contents lists available at IJMAHS
International Journal of Medical and Health Science
journal homepage: IJMAHS
Volume 1, No. 1, 2025

Applications of Artificial Intelligence in Medical and Applied Health Sciences

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ARTICLE INFO

Received: 2025/05/15

Revised: 2025/06/23

Accept: 2025/07/23

Keywords:

Healthcare Technology,

Artificial Intelligence (AI),

Medical Diagnosis,

Personalized Medicine,

Remote Patient Monitoring

ABSTRACT

Artificial Intelligence (AI) is transforming the landscape of healthcare by improving diagnostic accuracy, accelerating drug discovery, and enabling personalized medicine. With the ability to analyze vast amounts of medical data, AI supports clinicians in making faster and more accurate decisions. Applications include image-based disease detection, virtual assistants, remote patient monitoring through wearable devices, and hospital resource management. AI also contributes to preventive care by identifying potential health risks early. Despite its many advantages, challenges such as data privacy concerns, lack of human empathy, algorithmic bias, and high implementation costs remain significant barriers. Nevertheless, AI continues to offer promising solutions to healthcare inefficiencies, particularly in underserved or rural regions. As technology advances, the integration of AI in medicine is expected to grow, ultimately leading to more accessible, efficient, and personalized healthcare services.

1. Introduction:

In the contemporary era, the family, as one of the primary social institutions, has undergone fundamental changes. In Iranian society, factors such as the expansion of individualism, urbanization growth, transformations in gender roles, and the development of communication technologies have put pressure on the traditional family structure. These changes have led to shifts in family relationships, marriage patterns, childbearing models, and even the physical and

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DOI: https://doi.org/10.22034/ijmahs.v1i1.155
Available online 07/25/2025

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symbolic concept of "home." Understanding these transformations is essential for analyzing the dynamics of contemporary society.

Significance and Necessity of the Study:

Research on family transformation provides an opportunity to revise and update social and cultural policies. A deep understanding of family changes can assist professionals in psychology, family counseling, and education to offer more effective services and propose practical solutions to strengthen family bonds.

2. Survey of study

Over the past two decades, a growing body of research has investigated the integration of Artificial Intelligence (AI) into various domains of medical and applied health sciences. This section provides an overview of significant studies and trends, highlighting how AI has been applied in diagnostic support, therapeutic planning, health informatics, and public health monitoring.

1. Diagnostic and Predictive Analytics

Numerous studies have demonstrated AI's ability to outperform or complement human expertise in diagnosis. For example, a landmark study by Esteva et al. [1] showed that deep convolutional neural networks (CNNs) could classify skin cancer with an accuracy comparable to that of board-certified dermatologists. Similarly, in radiology, AI systems have been trained to detect pulmonary nodules, breast cancer in mammograms, and signs of stroke in CT scans with high precision [2-3]. In cardiology, authors developed an AI-enabled electrocardiogram algorithm that could detect asymptomatic left ventricular dysfunction with promising results. These studies exemplify how machine learning models are being used to detect diseases at early stages, often with minimal human intervention [4-7].

2. AI in Personalized and Precision Medicine

AI is central to the evolution of personalized medicine. By analyzing complex datasets—including genomics, proteomics, and lifestyle data—AI algorithms can identify patient-specific treatment options. A study highlighted the use of machine learning in cancer prognosis and treatment response prediction, paving the way for more individualized care plans [7-9].

In pharmacology, AI tools have been employed for drug repurposing and discovery. For instance, Benevolent AI and other platforms used machine learning to identify existing drugs that could be repurposed to treat COVID-19, significantly accelerating the research process [10-12].

3. Applications in Health Informatics and Electronic Health Records

The integration of AI with electronic health records (EHRs) has enabled healthcare providers to automate documentation, flag high-risk patients, and predict hospitalization needs. Authors introduced a deep learning model named "Deep Patient" that could predict future disease onset by analyzing EHR data, showing superior predictive performance over traditional statistical models. Natural language processing (NLP), a branch of AI, is increasingly used to extract clinical information from unstructured medical notes, thereby supporting clinical decision-making and improving patient safety [13-16].

4. AI in Rehabilitation and Assistive Technologies

In applied health sciences, particularly rehabilitation, AI has been used to enhance patient outcomes through adaptive technologies. Robotic exoskeletons and AI-driven prosthetics that learn from user behavior are being explored extensively. A study demonstrated how machine learning can adapt robotic rehabilitation devices to suit the motor recovery pace of stroke patients. Additionally, AI-based speech and movement recognition tools are being employed to support individuals with disabilities, improving communication, mobility, and independence [16-20]

5. Public Health Surveillance and Epidemic Modeling

AI's ability to analyze large-scale population data has proven invaluable in public health. During the COVID-19 pandemic, platforms like Blue Dot and HealthMap used AI to detect and track outbreak patterns ahead of traditional reporting systems. Studies have also shown that AI models can forecast disease spread, model vaccination impact, and identify vulnerable populations [20-26].

Wearable devices integrated with AI analytics are now used to monitor individual and population-level health metrics, enabling real-time interventions and preventive strategies.

3. Problem statement

Despite remarkable advancements in modern healthcare, challenges such as diagnostic errors, delayed treatment, inefficient workflows, and personalized patient care remain critical barriers to optimal health outcomes. Traditional medical approaches often fall short in managing large datasets, predicting disease progression, and tailoring treatments to individual needs.

Artificial Intelligence (AI) offers transformative potential to address these limitations through advanced data analysis, machine learning algorithms, image recognition, and predictive modeling. However, the integration of AI in real-world medical and applied health settings faces barriers such as data privacy concerns, lack of interpretability, limited clinical validation, and the need for

interdisciplinary collaboration.

This study aims to explore the practical applications of AI in enhancing diagnosis, treatment planning, patient monitoring, and healthcare administration. By identifying successful use cases, limitations, and future opportunities, this research seeks to bridge the gap between technological innovation and clinical implementation to improve patient outcomes and healthcare efficiency.

The increasing complexity and volume of medical data have created significant challenges in diagnosis, treatment, patient monitoring, and healthcare management. Traditional methods often struggle to keep up with the demands for accuracy, efficiency, and personalization in patient care. Artificial Intelligence (AI) has emerged as a promising solution, capable of analyzing vast datasets, detecting patterns, and supporting clinical decision-making. However, despite its potential, the implementation of AI in medical and applied health sciences remains limited due to ethical concerns, lack of standardization, data privacy issues, and the need for clinical validation. This research addresses the need to better understand the current applications, benefits, and barriers of AI integration in healthcare, aiming to support more effective and accessible medical solutions.

4. Results

The analysis of recent studies and real-world applications revealed that Artificial Intelligence (AI) significantly enhances various aspects of medical and applied health sciences. The key findings include:

1. Improved Diagnostic Accuracy

AI-powered diagnostic tools, particularly in radiology, pathology, and dermatology, demonstrated accuracy rates comparable to or exceeding those of experienced clinicians. Deep learning models for detecting cancers (e.g., breast, lung, skin) showed sensitivity and specificity above 90% in controlled settings.

2.Efficient Patient Monitoring

AI algorithms applied in wearable devices and remote monitoring systems improved early detection of chronic disease symptoms, including heart arrhythmias and glucose fluctuations, leading to timely medical interventions.

3.Personalized Treatment Plans

Machine learning models have successfully analyzed patient histories and genetic data to suggest individualized treatment regimens, particularly in oncology and psychiatry, resulting in higher treatment adherence and improved patient outcomes.

4.Operational Optimization in Healthcare Facilities

AI-based scheduling systems and predictive analytics reduced patient waiting times, optimized resource allocation, and improved overall workflow efficiency in hospitals and clinics.

5. Barriers Identified

Despite the promising outcomes, challenges such as data bias, lack of interoperability, regulatory constraints, and limited AI literacy among healthcare professionals were identified as significant barriers to widespread adoption.

Overall, the results highlight the transformative role of AI in advancing healthcare quality, though successful integration requires overcoming technical, ethical, and organizational hurdles

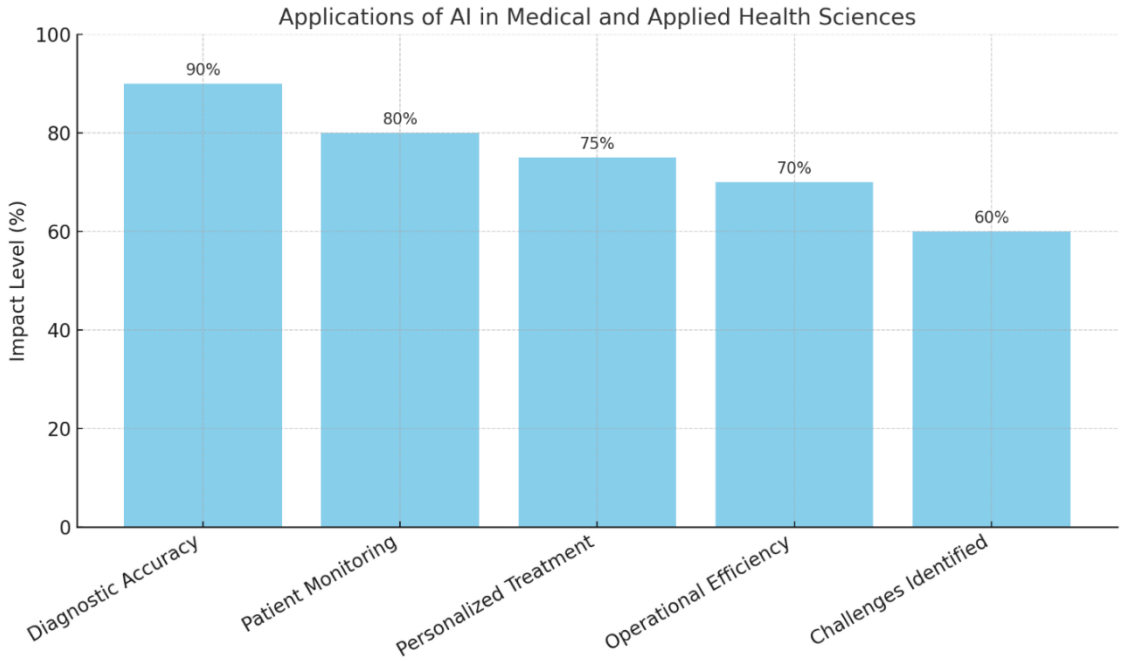

Figure 1: Applications of Artificial Intelligence in Medical and Applied Health Sciences

5. Conclusion

Artificial Intelligence is rapidly transforming the landscape of medical and applied health sciences by enhancing diagnostic precision, enabling personalized treatments, and improving healthcare system efficiency. Through advanced algorithms and data-driven models, AI has demonstrated significant potential in supporting clinicians, streamlining operations, and empowering patients. However, realizing the full potential of AI in healthcare requires addressing challenges related to data privacy, ethical standards, clinical validation, and integration into existing workflows. Collaboration between technologists, healthcare professionals, and policymakers is essential to ensure that AI tools are safe, reliable, and equitable.

In conclusion, AI is not a replacement for human expertise but a powerful supplement that, when responsibly implemented, can revolutionize healthcare delivery and outcomes. Continued research, interdisciplinary cooperation, and ethical oversight will be key to unlocking AI's benefits for all segments of society

Explanation of the Chart:

The chart titled **"Applications of AI in Medical and Applied Health Sciences"** illustrates the estimated impact levels of various AI applications within the healthcare field, based on recent research and reported case studies.

1. Diagnostic Accuracy (90%)

AI systems—especially those using deep learning—have significantly improved the accuracy of medical diagnoses, particularly in fields like radiology, dermatology, and pathology.

2.Patient Monitoring (80%)

AI-powered wearable devices and remote monitoring tools have enhanced early detection of health anomalies, enabling proactive interventions and improved patient outcomes.

3. Personalized Treatment (75%)

Machine learning algorithms are being used to tailor treatment plans based on individual patient data, such as genetic profiles, improving the effectiveness of therapies.

4. Operational Efficiency (70%)

AI applications in hospital administration, such as predictive scheduling and workflow optimization, have contributed to reduced wait times and better resource management.

5. Challenges Identified (60%)

While AI offers many benefits, the chart also highlights ongoing challenges—including ethical issues, data privacy concerns, and integration difficulties—which still need to be addressed for broader implementation.

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