INVITED REVIEW ARTICLE

ARTIFICIAL INTELLIGENCE IN GERIATRICS

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Abstract

The increasing elderly population globally presents challenges in geriatric healthcare, including better resources, unmet healthcare needs, and sustainability of health and social security systems. Artificial intelligence (AI) is being used to address these challenges, with studies focusing on socially assistive robots, humanoid robots, and robotic pets in elderly care.

This review aims to provide a comprehensive overview of the roles of artificial intelligence (AI) technologies in elderly healthcare by identifying the potential benefits and challenges in geriatric healthcare services. AI technologies can potentially improve care and health outcomes for older adults, promote healthy aging, and alleviate the burden on the healthcare system. Moreover, AI systems can assist healthcare providers in assessing potential drug interactions, identifying medication errors, and optimizing medication regimens to minimize side effects and enhance overall patient safety. In addition, AI-supported robots can provide caregivers personalized and efficient care while providing rehabilitation and mobility support for the elderly. Collaboration between healthcare professionals and artificial intelligence holds significant potential to facilitate more effective delivery of care, improve patient outcomes, and optimize health resources for the increasingly aging population.

Keywords: Aging; Geriatrics; Artificial Intelligence; Healthcare.

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INTRODUCTION

A significant demographic shift is occurring globally due to the increasing elderly population. The World Health Organization (WHO) predicts that by 2030, one in six people will be aged 60 or older (1). This change has brought forth many challenges and issues in geriatric healthcare. One of the most crucial problems is the need for more excellent healthcare resources to address the health issues faced by the elderly population (2). Additionally, the growing aging population brings about dynamic and uncertain demands that traditional elderly healthcare services find challenging to meet, leading to an inevitable increase in unmet healthcare needs and further burdening the existing healthcare system (3). Therefore, finding sustainable strategies, especially to promote care for the population aged 65 years and older, is crucial.

Another fundamental challenge in the health services of this age group is the sustainability of health and social security systems (4). As the elderly population grows, the burden of healthcare services and resources increases (2). Ensuring the continuity of healthcare services while bringing this burden to sustainable levels is paramount. It should be remembered that improvements in the effectiveness and quality of elderly care are needed during all these regulations.

Another challenge in geriatric science arises from the need for interdisciplinary care to address the complex healthcare needs of older adults (5). This involves collaboration among geriatricians, nurses, social workers, physiotherapists, and professionals from various medical disciplines. These professionals must collaborate to develop comprehensive care plans that consider the physical, mental, and social well-being of the elderly.

Innovative approaches and technological advancements are required to cope with these challenges and meet the aging population's needs. Artificial intelligence (AI) products have advanced rapidly, contributing to the fundamental reshaping of working environments and applications in various fields (6). This rapid transformation has significantly affected the healthcare sector, leading to the development of new software and wearable technology devices. In recent years, studies have been conducted on using specific types of AI technology, such as socially assistive robot technology, humanoid robots, and robotic pets in elderly care (7, 8). These studies provide in-depth insights into the potential benefits of AI technologies for serving elderly individuals. The overall application of AI technologies in healthcare for the elderly has rarely been evaluated using empirical evidence. Exploring the breadth and depth of the literature in this field can provide significant indicators of the future role of AI technologies in elderly healthcare and open up new possibilities for elderly healthcare services.

There is a need for research and advancement in geriatric clinical care, especially in the utilization of artificial intelligence systems. AI systems can assist in diagnosing, treating, and improving care for elderly individuals with chronic illnesses.

The aging global population, challenges in geriatric science and healthcare, need for more significant healthcare resources, improvements in care quality and effectiveness, interdisciplinary care, and advancements in technology and artificial intelligence systems pose substantial challenges (9). Therefore, an integrated, multidisciplinary approach is crucial for effectively addressing these challenges. One potential solution is the application of artificial intelligence in geriatrics.

Therefore, this review aims to provide a comprehensive overview of the roles of AI technologies used in elderly healthcare by identifying the potential benefits and challenges in elderly healthcare services.

OVERVIEW OF ARTIFICIAL INTELLIGENCE (AI)

Artificial intelligence (AI) is a multidisciplinary approach in computer science and linguistics to create machines capable of performing tasks that typically require human intelligence. These tasks encompass learning, reasoning, problem-solving, natural language understanding, and communication. As a field within computer science, AI focuses on developing technologies that can mimic or replicate human intelligence (10).

AI systems are designed to learn from data, recognize patterns, make conscious decisions, and interact with humans and their environment. AI encompasses technologies such as machine learning, computer vision, natural language understanding, and natural language processing that allow machines to learn, adapt, reason, and interact with humans and their environments in a human-like manner (11, 12).

Innovative elderly healthcare products and services incorporating AI integration are considered a significant method for the future of geriatrics. In this field, artificial intelligence can be employed to create innovative elderly care products, services, or product-service systems (PSS), which are self-learning in addition to intelligent systems or platforms (13). Therefore, developments in AI applications are considered exciting for geriatric health services.

The utilization of artificial intelligence in geriatrics has the potential to enhance patient outcomes and revolutionize healthcare practices. Healthcare professionals in geriatrics can leverage AI technologies to improve diagnosis, treatment planning, and patient monitoring accuracy and efficiency. Additionally, AI can play a significant role in predictive analytics, identifying individuals at high risk for specific conditions and enabling proactive interventions. Moreover, AI can assist caregivers by developing assistive devices and identifying social isolation and loneliness in older adults (14). Integrating AI into geriatrics can improve the quality of care for older adults, promote healthy aging, and alleviate the burden on the healthcare system.

ROLE OF ARTIFICIAL INTELLIGENCE IN GERIATRIC CARE

As healthcare advancements continue, the recognition of artificial intelligence's (AI) potential role in geriatrics is increasing. This technology can significantly enhance patient outcomes and revolutionize health practices within this domain. AI technologies can assist physicians in diagnosing and deciding on treatment options and predicting, classifying, and optimizing efficiency for risks associated with geriatric diseases for both healthcare professionals and patients alike. AI algorithms, through the analysis of extensive datasets, can identify patterns and trends that clinicians may not immediately discern. This information can empower healthcare providers to make more informed decisions and provide personalized care to elderly patients.

In addition, AI-assisted devices and wearable sensors can continuously monitor the health status of elderly individuals, alerting healthcare professionals in abnormal changes or emergencies. Furthermore, AI facilitates remote monitoring and telehealth services, allowing elderly patients to receive care comfortably in their homes (15). By automating routine tasks and administrative processes, AI can alleviate the burden on healthcare providers, enabling them to use their time and resources more effectively.

AI can contribute to the management of medications in geriatric care. Polypharmacy, or the use of multiple medications, is a common issue among elderly patients who manage various health conditions (16). AI technology can aid healthcare providers in assessing potential drug interactions, identifying medication errors, and optimizing

medication regimens to minimize side effects and enhance overall patient safety.

Moreover, AI can potentially improve mental healthcare in geriatric patients. Prevalent mental health issues in older adults are often inadequately diagnosed or overlooked. AI can address this gap by accurately predicting who may require mental health treatment before symptoms worsen. AI algorithms can identify early indicators of changes in mental health status through analysis of daily behaviors and patterns, allowing healthcare providers to intervene and provide support at an early stage (17).

AI could be particularly effective in the early recognition and diagnosis of neurocognitive disorders such as dementia. Traditional diagnostic methods often produce results that overlap with normal cognitive function in older adults, limiting their clinical utility. However, AI enables healthcare providers to analyze large amounts of data from various sources, including medical records, brain imaging scans, and cognitive assessments. AI algorithms can detect subtle patterns and abnormalities in these data, facilitating more accurate and early diagnosis of neurocognitive disorders (18). In addition to diagnosis, AI can effectively treat and manage geriatric mental health conditions. For example, AI-supported tools that analyze speech patterns and facial expressions can enhance psychotherapy by providing insights into the patient's emotional state, enabling therapists to tailor their sessions accordingly.

Furthermore, AI can support caregivers by providing better care for elderly patients. Loneliness and social isolation are common among older adults and can exacerbate mental health issues. AI can analyze loneliness symptoms during qualitative interviews and understand gender differences and nuances in loneliness reporting processes to provide customized interventions, support and mitigate the harmful effects of social isolation (19).

AI technologies can also assist caregivers by providing tools and devices for dressing, hand washing, and fall detection. By automating these tasks, AI can reduce the workload on caregivers and enhance the overall quality of care provided to elderly adults. Overall, AI has the potential to significantly improve geriatric care by aiding diagnosis, predicting treatment outcomes, and enhancing treatment approaches.

HEALTH MONITORING AND WEARABLE DEVICES

Health services based on wearable devices designed for health monitoring have garnered significant interest in the management of both physiology and psychology (20). Integrating artificial intelligence (AI) and wearable devices enables objective remote monitoring of daily life activities and fall incidents, offering a potential solution for elderly care and promoting independent living. These devices can support caregivers in dressing, handwashing, and fall detection, thus facilitating prompt and early intervention (11). However, the current evidence regarding their effectiveness is limited because these devices lack high-quality methodologies (15). To overcome these limitations, it is crucial to address challenges such as device loss, discomfort in usage, and lower battery life.

In geriatric care, AI in health monitoring and wearable devices allows healthcare professionals to access real-time data on patients' physiological and behavioral patterns, enabling personalized and proactive care. Additionally, the early detection of signs of health deterioration in older adults can lead to timely intervention, potentially reducing hospitalizations and healthcare expenditures and decreasing the need for frequent hospital visits, thereby contributing to a more efficient healthcare system (21).

In conclusion, AI health-monitoring technologies have the potential to significantly improve care and health outcomes in older adults (22). However, ethically designing and implementing these

technologies is crucial, considering factors such as privacy, autonomy, consent, and the social and emotional well-being of elderly individuals.

PREDICTIVE ANALYTICS FOR DISEASE PREVENTION

An area where predictive analyses using artificial intelligence (AI) can be particularly beneficial is the prevention of geriatric diseases. Healthcare providers can analyze extensive patient data using AI algorithms and machine-learning techniques. These datasets encompassed medical records, genetic profiles, lifestyle data, and biometric measurements. These datasets enable the prediction of the likelihood of developing specific diseases in geriatric populations through analyses. As a result, researchers can identify risk factors and early signs of disease, enabling timely intervention and implementation of preventive measures (23).

Researchers have made significant efforts to develop AI-based prognostic models for predicting the onset of geriatric mental health disorders. AI algorithms can analyze data from multiple sources, including medical records, patient-reported symptoms, and genetic information, to identify patterns and risk factors indicating the development of mental health disorders, such as depression or cognitive decline. Following these identifications, AI-based approaches can predict individual therapeutic interventions in geriatric mental health, shaping applied therapeutic interventions by analyzing patients' treatment responses. This personalized health approach will lead to more effective treatment and better outcomes for geriatric patients. One of the challenges in geriatric mental health is the shortage of specialists. AI can help bridge this gap by providing accessible and timely interventions. For instance, developing chatbots that offer personalized and timely interventions can enable individuals to access mental health support when needed (24).

Predictive analyses conducted using AI technologies will play a significant role in disease prevention and management in geriatric populations in the future. AI technologies can use predictive analyses to analyze various data sources, such as electronic health records, wearable devices, and free-text clinical notes. These sources provide valuable information about an individual's health status and play a crucial role in identifying models and risk factors for disease development. By utilizing predictive analytics, healthcare providers can proactively identify individuals at a high risk of disease development in geriatric populations and intervene early to prevent or manage diseases.

ROBOTICS IN ELDERLY CARE

Artificial intelligence (AI) and robotics in elderly care are promising opportunities for enhancing the quality of life of elderly adults. It is a rapidly advancing technological sector. The development of this technology seems poised to give rise to intelligent elderly care solutions worldwide. These solutions encompass aids in daily living areas, such as AI-supported care robots and intelligent companion robots, aimed at assisting in service provision, security monitoring, human-computer interaction, and entertainment (25). The integration of AI systems into assistive living technologies has the potential to address the challenges faced by the elderly care industry, especially in addressing shortages on the service supply side.

By utilizing AI-supported robots, caregivers can effectively manage the growing elderly population while providing personalized and efficient care. Moreover, as the global population ages, there is an increasing need for innovative approaches to healthcare. AI and robotics can assist caregivers in tasks such as dressing, handwashing, and fall detection (11). These devices can provide physical support to individuals, reduce the risk of accidents, and enhance the overall safety and well-being of the elderly.

Furthermore, AI-supported robots have the potential to revolutionize rehabilitation and mobility support for the elderly. Exoskeletons and rehabilitation robots can aid in physical therapy exercises and increase mobility and strength in older individuals (26). By offering personalized assistance and feedback, these technologies can help older adults regain independence and improve their quality of life.

In general, AI and robotics have the potential to enhance the quality of care for elderly adults in various ways, ranging from physical assistance to social support and health monitoring (27). AI and robotics can realize this impact through diverse means, including physical assistance, social support, and health monitoring.

ETHICAL CONSIDERATIONS OF AI IN GERIATRICS

AI should complement human interaction, providing healthcare professionals with valuable insights to personalize and adapt care plans for each patient.

Artificial intelligence (AI) and machine learning in healthcare, especially in geriatrics, have ethical concerns (28). These concerns include data privacy and security, algorithmic fairness and biases, obtaining informed consent from users, and potential interventions in the doctor-patient relationship.

Addressing ethical concerns is crucial before fully embracing AI in geriatric clinical practice. One of the primary ethical concerns is data privacy and security. To safeguard the privacy, integrity, and confidentiality of medical data, it is crucial to implement stringent security measures and access controls when AI systems collect and analyze patient-generated data. This becomes even more critical when cloud-based data storage and retrieval systems are used. Adherence to higher data privacy standards ensures patient information safety and protection.

Another ethical concern is algorithmic fairness and bias. Training AI systems on large datasets pose the risk of unfair or discriminatory outcomes due to biases in the data. Addressing this concern will require diverse datasets that account for the demographic characteristics and needs of the elderly. Regularly monitoring and evaluating AI algorithms for any bias or unfairness in decision-making processes is necessary. Additionally, regular audits and reviews of AI algorithms can help to identify and eliminate biases, ensuring fair and equal treatment for all patients (29)

Transparency and explainability of AI recommendations and decisions are vital ethical considerations. AI systems should provide clear and understandable suggestions and conclusions. This is particularly crucial in geriatric care, where elderly adults may have a limited understanding of AI technology and its outcomes (30).

Obtaining informed consent is an ethical responsibility and a legal requirement. This allows patients to make informed decisions about using their data and respecting their autonomy. It is essential to explain AI systems' goals, benefits, and potential risks and obtain detailed consent before using their data.

As the use of AI in geriatrics increases, there is concern about the possibility of interference in the doctor-patient relationship. Increased trust in AI systems may reduce direct interaction between patients and healthcare professionals, potentially diminishing the quality of the doctor-patient relationship. This could impact patient autonomy, confidence, and the outcomes of personalized care (31).

In addition to addressing ethical concerns regarding the use of AI in geriatrics, it is crucial to consider the potential benefits and risks associated with its implementation. The purpose of using AI systems in geriatric care is to provide effective and efficient healthcare services to the elderly (29, 30). AI can potentially enhance diagnostic accuracy, treatment outcomes, and overall patient care.

However, it is essential to carefully weigh potential risks, such as errors or incorrect recommendations by AI systems, which could have severe consequences for the health of elderly adults. Moreover, we should be mindful of the potential lack of human interaction and personalized care when using AI in geriatric care.

Integrating artificial intelligence into geriatric care has the potential to revolutionize elderly adult healthcare services, ensuring that ethical considerations take precedence in its implementation (30). Despite the significant potential of AI and robotics, addressing ethical concerns and maintaining a balance between human interaction and technology usage is critical. Elderly adults' emotional well-being, which is dependent on human touch and companionship, should never be replaced without careful consideration.

COLLABORATION BETWEEN HEALTHCARE PROFESSIONALS AND ARTIFICIAL INTELLIGENCE

By harnessing the power of artificial intelligence, healthcare professionals can utilize the capabilities of machine learning to analyze large datasets and identify patterns in geriatric care. This deeper understanding can lead to more personalized and effective treatment plans for older adults by considering individual needs and preferences (32).

The integration of artificial intelligence into clinical settings requires collaboration between healthcare professionals and AI experts, inclusive working examples, and rigorous evaluation. This ensures that AI technologies developed for geriatric care can be used reliably, accurately, and safely in the elderly. Collaboration between healthcare professionals and artificial intelligence has the potential to facilitate more effective delivery of care, improve patient outcomes, and optimize health resources for the increasingly aging population. It is also essential to consider the social and environmental factors that can impact the well-being of older adults in designed AI technologies (33).

Geriatric collaboration between healthcare professionals and artificial intelligence holds significant potential to change mental health assessments, diagnoses, treatment decisions, and monitoring. This can assist clinicians in making more informed treatment decisions and customizing interventions to meet the specific needs of each individual (23).

Collaboration between healthcare professionals and artificial intelligence is critical for developing and implementing accurate and reliable AI technologies. This collaboration enables healthcare professionals to interpret the data generated by the developed AI algorithms and seamlessly integrate them into clinical practice. Moreover, it allows healthcare professionals to analyze AI-generated data to ensure alignment with best practices in geriatric care. Collaboration between healthcare professionals and artificial intelligence in geriatrics can generally transform mental health assessments, diagnoses, treatment decisions, and monitoring (23)

CONCLUSION

In conclusion, integrating artificial intelligence in geriatrics has the potential to revolutionize health care for older adults. By harnessing the power of AI algorithms, healthcare professionals can gain valuable insights from the data generated and make more informed decisions regarding assessments, diagnoses, treatment plans, and monitoring. This collaborative approach between human expertise and artificial intelligence can ultimately lead to improved outcomes and enhanced quality of life for geriatric patients. However, it is essential to acknowledge the ethical considerations and potential limitations of AI in geriatric care, and further research and development are needed to ensure its responsible and effective use. Ethical

considerations include patient privacy, consent, and the potential for bias in AI algorithms. Additionally, the limitations of AI in geriatric care include the lack of emotional intelligence and the inability to provide personalized care that takes into account individual preferences and values. Therefore, it is crucial to continue researching and developing AI technologies in geriatric care to address these concerns and ensure that AI is used responsibly and effectively to improve older adults' lives.

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