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AI, ROBOTICS, AND TELEMEDICINE: SHAPING THE FUTURE OF ELDERLY CARE AND GLOBAL HEALTH

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ABSTRACT

The study explores how AI, robotics, and telemedicine are transforming elderly care to address the growing demands of aging populations, particularly in resource-limited settings. By 2050, the elderly population is expected to reach two billion, posing significant healthcare challenges. The study examines the synergies between these technologies, proposing an integrated elderly care model. Using systematic eligibility criteria, recent peer-reviewed studies were analyzed, focusing on healthcare accessibility, quality, and sustainability. AI enhances predictive analytics and personalized care, robotics improves mobility and social interaction, and telemedicine expands healthcare access. A systematic review was conducted using PRISMA and CASP criteria. Findings highlight both the benefits and challenges of these technologies, such as privacy concerns and digital literacy barriers. The review concludes that integrating AI, robotics, and telemedicine can improve health outcomes and reduce healthcare disparities among aging populations. However, limitations exist in generalizing findings across different healthcare systems, necessitating further research. Cross-disciplinary collaboration and supportive policies are crucial for ensuring global accessibility and sustainability. The study provides a framework for leveraging technology to create effective, person-centered elderly care solutions that enhance quality of life and address healthcare inequities worldwide.

KEYWORDS: Digital Health Solutions, Social Robot Technology, Artificial Intelligence, Geriatric Health Technologies, Aging Populations.

1. INTRODUCTION

As the global population ages, healthcare systems worldwide face profound challenges that require urgent attention and innovative solutions. The World Health Organization (WHO) projects that by 2050, the number of individuals aged 60 and older will reach nearly 2 billion, accounting for 22% of the global population (WHO, 2024). The demographic shift presents one of the most significant health and social challenges of the 21st century, especially for low- and middle-income countries that are likely to experience a disproportionate increase in elderly populations. The aging process brings with it a higher prevalence of chronic conditions such as diabetes, heart disease, arthritis, and dementia, which not only reduce the quality of life for affected individuals but also place an enormous strain on healthcare systems ill-equipped to handle the complex, long-term care needs of older adults. These conditions demand care that goes beyond traditional medical interventions, encompassing a more holistic approach that addresses the social, emotional, and psychological well-being of the elderly. The growing challenge has sparked intense research into healthcare models that can better support aging populations, with a particular focus on the role of technology in transforming elderly care.

Artificial intelligence has emerged as a critical tool in enhancing healthcare delivery for older adults by enabling personalized care through predictive analytics, diagnostics, patient monitoring, and decision support (Silcox et al., 2024). AI's capacity to analyze vast amounts of health data can lead to early detection of health risks and more targeted interventions, improving health outcomes for elderly individuals. Robotics, too, offers considerable potential in assisting with mobility, rehabilitation, and even companionship. Robots designed to assist with daily activities and provide social engagement can alleviate issues such as loneliness and isolation, common among older adults, thereby enhancing their quality of life. Telemedicine has become another pivotal innovation, especially in rural or underserved areas, enabling healthcare providers to offer remote consultations to elderly individuals with limited mobility. The technology bridges the gap in accessibility, ensuring that even those in remote areas can receive essential care, without the need for travel, which can be physically taxing for the elderly (Kim et al., 2024). The intersection of aging and technology is paving the way for scalable, sustainable solutions to meet the complex needs of aging populations, ultimately improving the quality, accessibility, and affordability of healthcare for elderly individuals globally.

While techno-optimism celebrates the potential of AI, robotics, and telemedicine in revolutionizing elderly care, such perspectives often underplay the structural and cultural limitations prevalent in many regions. In areas marked by high digital illiteracy and fragile health infrastructure, the deployment of AI-driven care risks deepening existing inequities rather than alleviating them (Anshari et al., 2024; Kumar et al., 2024). Beyond technological access, a significant barrier lies in sociocultural values that frame caregiving as a deeply personal and familial responsibility. In many societies, especially in parts of Asia and Africa, caregiving is not merely a service, but a moral duty entrenched in filial piety and community reciprocity (Mhlanga, 2024; Parchure & Ghatpande, 2024). The notion of replacing human care with machines often evokes mistrust and emotional resistance, which techno-optimism narratives tend to overlook.

Moreover, changes in family structure such as increased urban migration, shrinking household sizes, and the breakdown of multigenerational living further complicate the role of AI in elderly care (Lee et al., 2024; WHO, 2024). In such evolving dynamics, the elderly may be caught between eroding traditional care systems and emerging technologies they neither trust nor understand. Mistrust in automation and AI is also fueled by fears of data misuse, depersonalization of care, and limited transparency in algorithmic decision-making (Silcox et al., 2024; Wang et al., 2024). While governments like South Korea have shown early success in localized AI healthcare models (Kim et al., 2024), the global reality remains that without targeted digital education, infrastructural investment, and culturally sensitive integration, the promise of AI-enhanced care will remain inaccessible to the very populations it aims to serve (Wang et al., 2024; Yu, 2024).

1.1. Issues and Gaps

The aging population presents a pressing global challenge that necessitates a multidimensional overhaul of healthcare systems to ensure equitable and effective care for elderly individuals. As individuals age, their susceptibility to chronic illnesses, disabilities, and mental health conditions increases significantly, placing a heavy burden on healthcare resources. The trend is compounded by rising healthcare costs, workforce shortages, and longer waiting times for essential medical services (Parchure & Ghatpande, 2024). Elderly individuals often contend with complex medical needs, such as managing multiple chronic conditions, addressing cognitive decline, and maintaining psychological well-being amidst increasing social isolation. However, healthcare infrastructure in many regions, particularly in low- and middle-income countries (LMICs), struggles to keep pace with these demands, exacerbating healthcare inequities. LMICs are expected to bear the brunt of the demographic shift, with the World Health Organization projecting approximately 426 million elderly residents in these regions by 2050 (WHO, 2024). The demographic strain highlights significant barriers to healthcare access, including financial limitations, insufficient infrastructure, and inadequate availability of trained geriatric specialists. The shortage of geriatricians is particularly concerning, as these professionals are crucial for delivering specialized care tailored to the unique needs of aging populations. The deficit also places substantial pressure on caregivers, both formal and informal, who often lack the resources and training necessary to provide comprehensive long-term care.

Moreover, healthcare equity emerges as a critical issue, with elderly individuals in LMICs disproportionately affected by insufficient resources and financial constraints that hinder access to quality care. Addressing these challenges requires a paradigm shift toward innovative and sustainable solutions that enhance healthcare accessibility, efficiency, and equity across diverse socioeconomic contexts. Investment in geriatric training, expansion of healthcare infrastructure, and the integration of technology, such as telemedicine and artificial intelligence, can play pivotal roles in mitigating the impacts of aging populations. Telemedicine offers the potential to bridge healthcare accessibility gaps in rural and underserved areas by facilitating remote consultations, while AI-driven tools can enhance diagnostics, optimize care pathways, and alleviate workforce shortages by streamlining healthcare delivery. Additionally, community-based interventions and social support networks are essential for addressing the psychosocial aspects of aging, including combating loneliness and fostering mental well-being. As global aging trends accelerate, the need for holistic, innovative approaches to elderly care becomes increasingly urgent. Ensuring that healthcare systems are prepared to meet the needs of aging populations requires collaborative efforts among governments, healthcare providers, and global organizations to prioritize equitable care, optimize resources, and integrate cutting-edge technology into eldercare practices.

2. OBJECTIVES OF THE STUDY

The review investigates the potential of AI, robotics, and telemedicine in addressing the healthcare challenges posed by the global aging population. With the increasing number of older adults, healthcare systems are under pressure to provide specialized care. The review explores how AI can predict health risks and offer personalized interventions, while robotics assist with daily activities, mobility, and emotional well-being, combating loneliness among seniors. Telemedicine improves accessibility by enabling remote consultations, particularly for elderly individuals with limited mobility or in rural areas. It also examines challenges like digital literacy gaps, privacy concerns, and ethical issues regarding autonomy and dependency on technology. The review highlights the impact of these technologies in low- and middle-income countries (LMICs), where financial constraints and infrastructure limitations make them essential for improving healthcare access. AI-powered diagnostics, telemedicine platforms, and cost-effective robotics offer scalable solutions to these challenges. The review emphasizes the importance of cross-disciplinary collaboration to develop culturally compatible technologies and policy frameworks. It calls for future research in areas like AI-driven mental health support and standardized telemedicine practices. The goal is to create a comprehensive approach that combines technological innovation with training and policy adjustments to meet the diverse needs of aging populations worldwide.

2.1. Novelty Contributions

The review offers a distinctive contribution to the existing body of literature by examining how artificial intelligence, robotics, and telemedicine can work synergistically to transform healthcare for the elderly, addressing gaps that are not adequately covered by isolated studies on these technologies. Unlike research that focuses on individual innovations, the review uniquely emphasizes their combined potential to create a holistic, integrated, and patient-centered model tailored to the diverse and complex needs of aging populations. By synthesizing insights from interdisciplinary studies, the review bridges the gap between theoretical frameworks and practical implementations, thereby offering a roadmap for leveraging these technologies collectively to address both current and future healthcare challenges for seniors. For instance, it builds on the work of Anshari et al. (2024), who explored AI-powered digital health solutions, and integrates these findings with insights from Kim et al. (2024), which focuses on government healthcare initiatives targeted at the elderly. The synthesis allows for a nuanced understanding of how policy, technology, and healthcare delivery can be aligned for maximum impact. The novelty lies in its holistic approach, exploring not only the direct applications of AI in predictive analytics and robotics in mobility assistance but also how telemedicine can serve as a connective framework, enhancing accessibility and enabling real-time collaboration between caregivers, patients, and healthcare providers. By analyzing their combined potential, the review sheds light on an emerging paradigm that could redefine elderly care, especially in addressing challenges such as workforce shortages, limited healthcare access in remote areas, and the psychological dimensions of aging, including social isolation and mental health. Furthermore, the review identifies the unique interplay between these technologies, such as how AI-driven insights can inform robotic interventions or how telemedicine platforms can leverage robotics to enhance remote patient monitoring and engagement. The review also underscores the importance of addressing barriers such as digital literacy, ethical considerations, and the scalability of these technologies in low- and middle-income countries (LMICs), where aging populations face compounded challenges due to resource constraints. By highlighting case studies and practical applications relevant to LMICs, the review contributes to the discourse on healthcare equity, proposing viable strategies to democratize access to advanced elderly care solutions. Additionally, it identifies future research areas, such as the development of culturally adaptive robotics and AI algorithms, policy frameworks for telemedicine integration, and training programs to improve the digital literacy of seniors. In doing so, the review provides not only a theoretical contribution but also practical insights for policymakers, healthcare providers, and technologists, emphasizing the need for cross-sector collaboration to realize the full potential of these innovations. By articulating a vision for a unified, technology-driven approach to elderly care, the review advances the conversation on how aging populations can benefit from a smarter, more inclusive healthcare system, marking a significant step forward in addressing one of the most pressing global challenges of the 21st century.

In sum, the scope of the systematic review synthesizes findings from recent literature to examine how AI-driven tools, robotics, and telemedicine are reshaping elderly care across various dimensions. AI-powered digital health initiatives are particularly significant for bridging healthcare accessibility gaps. Anshari et al. (2024) highlight how AI can enhance health outcomes for older populations by enabling personalized care and predictive analytics. Similarly, Wang et al. (2024) underscore the role of AI in active assisted living through the integration of commercial devices into real-world elderly care settings. The review also examines national efforts, such as South Korea's government-led digital healthcare initiatives for senior citizens, which Kim et al. (2024) document, demonstrating how localized approaches can drive scalable solutions. Robotics emerge as another critical component, offering support for physical and emotional well-being. Kumar et al. (2024) explore AI-based health management systems, including robotic assistants designed for routine care and companionship. Ethical considerations, particularly in ensuring responsible AI adoption, are central to the discourse. Mhlanga (2024) emphasizes the need for equitable technological access and culturally sensitive deployment in diverse global contexts. Parchure and Ghatpande (2024) further discuss the potential of AI and robotics to foster independence while maintaining human-centric care models. Telemedicine, as part of a broader technological ecosystem, has transformed care delivery models by connecting patients and providers remotely. The integration of AI and Internet of Things (IoT) technologies facilitates continuous monitoring, as discussed by Silcox et al. (2024), who explore perspectives from international health leaders. These innovations extend to rural and underserved areas, promoting inclusivity and reducing disparities. The review also considers indirect impacts of AI and related technologies, such as their influence on broader societal structures. For instance, Lee et al. (2024) investigate the intersection of aging populations, food security, and AI, illustrating the systemic ripple effects of technological adoption. Yu (2024) critiques the dual-edged nature of AI's integration into aging societies, probing its potential benefits and unintended consequences. The systematic review consolidates interdisciplinary research to provide a comprehensive understanding of how AI, robotics, and telemedicine collectively revolutionize elderly care. It identifies best practices, highlights gaps for future research, and evaluates the policy implications of technological innovation. By doing so, it offers insights into creating resilient healthcare ecosystems that are adaptive to the needs of aging populations globally.

2.2. Theoretical Framework

The Technology Acceptance Model (TAM) offers a robust theoretical lens to understand how elderly populations accept and use emerging healthcare technologies such as AI, robotics, and telemedicine. Originally developed by Davis (1989), TAM posits that perceived usefulness (PU) and perceived ease of use (PEOU) are the primary determinants of users' behavioral intention to adopt technology.

In the context of elderly care, perceived usefulness reflects the extent to which older adults believe that AI-driven healthcare solutions can enhance their health and quality of life. As Anshari et al. (2024) argue, AI-powered digital health tools effectively bridge accessibility gaps in elderly care systems by improving diagnostics, monitoring, and personalized treatments. Similarly, Kim et al. (2024) demonstrate how government-led digital healthcare initiatives in South Korea have shown increased PU by ensuring timely interventions and reducing emergency hospitalization rates among the elderly.

Perceived ease of use, on the other hand, refers to the degree to which elderly users find these technologies simple to understand and operate. Parchure and Ghatpande (2024) stress that user-centered design is essential to improving adoption rates among aging populations. According to Wang et al. (2024), active assisted living systems that integrate commercial AI and IoT devices show promise when interfaces are intuitive, and support systems are available.

Furthermore, the external variables within TAM such as technological infrastructure, digital literacy, and social support greatly influence PU and PEOU. Kumar et al. (2024) highlight that cloud-based AI systems for elderly health management become more acceptable when paired with training sessions and caregiver involvement. Mhlanga (2024) emphasizes that responsible AI adoption must also consider ethical concerns like autonomy, privacy, and data security to foster trust and long-term acceptance.

Silcox et al. (2024) suggest that international collaboration and policy frameworks can enhance infrastructure and reduce barriers to adoption by ensuring equitable access and standardization. Similarly, Lee et al. (2024) expand TAM's utility by linking population aging and AI to broader issues like food and health security, implying that macroeconomic and sociopolitical factors must be considered in tandem with individual perceptions.

Globally, the WHO (2024) stresses the importance of integrated, age-friendly health systems that adopt user-centered innovations and outlook aligned with TAM's goal of optimizing user satisfaction and sustained use. Lastly, Yu (2024) argues that while AI holds transformative potential for aging societies, sustained adoption depends on balancing technological advancement with human-centered care principles further reinforcing TAM's core propositions.

In summary, the TAM framework helps illuminate how and why elderly users are likely or unlikely to embrace AI, robotics, and telemedicine in healthcare. By addressing factors that influence perceived usefulness, perceived ease of use, and trust, stakeholders can design and implement smarter, more acceptable solutions for global aging populations.

3. METHODS

The review meticulously investigates the transformative impact of artificial intelligence, robotics, and telemedicine on elderly care, emphasizing their potential to address the unique challenges of aging populations across diverse healthcare ecosystems. To ensure systematic and rigorous analysis, the study employs clearly defined methods for data collection, selection, and synthesis. These methods aim to map the current state of technology-driven elderly care while highlighting its prospects.

3.1. Eligibility Criteria

The process begins with well-defined eligibility criteria, focusing on peer-reviewed articles, conference papers, and reputable academic book chapters published in 2024. By limiting the inclusion to the most recent and high-quality studies, the review ensures relevance and accuracy in capturing emerging trends in AI, robotics, and telemedicine applications for senior citizens. The eligibility criteria are anchored in several key factors. First, the review prioritizes studies with a direct focus on AI-driven digital health solutions, robotic-assisted mobility and rehabilitation, and telemedicine platforms specifically designed for elderly care. The targeted approach allows the review to delve deeply into technological advancements that address critical healthcare needs, such as managing chronic conditions, improving mobility, and combating social isolation among the elderly. Additionally, the review exclusively considers empirical studies, systematic reviews, meta-analyses, and high-quality qualitative analyses that provide actionable insights or evidence-based findings. This ensures that theoretical concepts are supported by real-world applications or validated through rigorous methodologies. Language and accessibility were also critical considerations. Only English-language studies were included to maintain standardization and facilitate comprehensive analysis. Furthermore, the geographical scope was global, enabling the review to capture a diverse range of insights and innovations from regions with varying levels of healthcare infrastructure. Special emphasis was placed on areas experiencing rapid population aging, such as Asia, Europe, and North America, along with developing regions like Africa, where innovative solutions for elderly care are emerging amidst resource constraints. The broad scope allows the review to identify both universal trends and region-specific challenges, providing a holistic understanding of the global landscape.

3.2. Exclusion Criteria

The exclusion criteria were equally stringent to maintain the review's focus. Studies unrelated to elderly care or those addressing broader healthcare technologies without specific applications to aging populations were omitted. Articles lacking real-world relevance or those inaccessible in full text were also excluded. These measures ensure that the review's findings are grounded in credible, actionable research that directly aligns with its objectives. The systematic methods employed in study selection and data extraction were complemented by a robust synthesis process, where insights were categorized and analyzed to identify patterns, gaps, and opportunities. The structured approach not only enhances the reliability and validity of the review's findings but also sets the stage for actionable recommendations. By adhering to these rigorous methods, the review positions itself as a significant contribution to the discourse on leveraging AI, robotics, and telemedicine to revolutionize elderly care, paving the way for innovative, inclusive, and sustainable healthcare solutions for aging populations worldwide.

3.3. Selection Process

The study selection process for the review followed a rigorous and structured approach designed to ensure the relevance, quality, and reliability of the studies included. It was conducted in multiple stages to systematically identify and curate academic literature that aligned with the objectives of examining the transformative role of AI, robotics, and telemedicine in elderly care. The process began with a comprehensive database search across leading academic platforms such as PubMed, IEEE Xplore, ScienceDirect, and Google Scholar. These platforms were chosen for their extensive coverage of healthcare and technological innovations. To refine the search and capture relevant studies, key terms such as "AI in elderly care," "robotics for aging populations," "telemedicine for seniors," "digital health for elderly," and "assistive technology for aging" were employed. Boolean operators were used to combine terms, and filters were applied to limit results to publications from 2024, ensuring the review captured the most up-to-date advancements and insights. Following the initial search, a systematic screening process was conducted. The first stage of screening involved evaluating the titles and abstracts of retrieved studies. The step eliminated articles that lacked a clear focus on elderly populations or their healthcare needs, as well as those that did not explicitly address AI, robotics, or telemedicine applications. Studies passing the preliminary screening proceeded to a full-text review, which was critical for verifying that each article met the predetermined eligibility criteria. Full-text articles were scrutinized for their specific focus on transformative healthcare technologies and their impact on aging populations. Any studies that failed to meet these requirements, such as those focusing on unrelated healthcare technologies or general AI applications outside the scope of elderly care, were excluded. To further ensure the credibility and methodological soundness of the studies included, a quality assessment stage was incorporated into the selection process.

The Critical Appraisal Skills Programme (CASP) checklist was used for evaluating qualitative studies, providing a systematic framework for assessing their validity, rigor, and relevance. Similarly, the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) checklist was employed to appraise systematic reviews, ensuring transparency and methodological integrity. Only studies that scored high on these criteria, demonstrating robust methodological design and clear relevance to the review's objectives, were included in the final selection. The meticulous approach ensured that the review is grounded in high-quality, reliable, and impactful research, providing a comprehensive and accurate depiction of the potential of AI, robotics, and telemedicine in addressing the challenges faced by aging populations. By adhering to these structured stages of database search, screening, full-text review, and quality assessment, the study selection process ensured that the review encapsulates the most relevant, credible, and insightful literature. The process not only enhances the reliability of the findings but also underscores the review's commitment to methodological rigor and academic excellence, paving the way for actionable insights into the transformative role of technology in elderly care.

Identification

Records identified through database searching (n=112)
Additional records identified through other sources (n=10)

⬇

Screening

Records after duplicates removed (n=80)
Records screened (n=42)
Records excluded (n= 8)

⬇

Eligibility

Full-text articles assessed for eligibility (n=38)
Full-text articles excluded, with reasons (n=29)

⬇

Included

Studies included in qualitative and quantitative synthesis (n=9)

Figure 1: PRISMA Flowchart.

Figure 1 shows The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flowchart illustrates the process of systematically identifying, screening, and selecting studies for inclusion in a review. Initially, 112 records were identified through database searches, with an additional

10 from other sources. After removing duplicates, 80 unique records remained. Of these, 42 were screened, and 38 were excluded for not meeting initial criteria. Subsequently, 38 full-text articles were assessed for eligibility, with 29 excluded due to specific reasons such as irrelevance or insufficient data. Ultimately, 9 studies were included in both qualitative and quantitative synthesis. The flowchart provides a transparent and reproducible method for documenting study selection, ensuring rigor and clarity in systematic reviews.

3.4. Data Extraction

Next, data extraction for the review was a meticulous process that involved systematically collecting and organizing pertinent information from each selected study to ensure a robust and comprehensive analysis. To maintain accuracy and uniformity, a detailed data extraction form was developed, outlining essential components for analysis. This form served as a standardized template to record consistent information across studies, facilitating comparisons and ensuring no critical detail was overlooked. The process began by documenting basic study information, including author(s), publication year, geographic location, and the journal or conference where the study was published. These details were essential for contextualizing the research within the broader scope of elderly care and technology, as well as identifying trends in publication focus and regional contributions to the field. The next step involved extracting the stated objectives and scope of each study. This focused on understanding how AI, robotics, or telemedicine was utilized to address specific challenges in elderly care, such as improving preventative health measures, managing chronic diseases, enhancing mobility, or promoting social engagement. By clarifying the intent and focus of each study, the review was able to categorize the diverse applications of these technologies and pinpoint areas of overlap or unique innovation. The methodologies and frameworks employed in each study were another critical area of focus. This involved documenting whether studies used experimental designs, observational analyses, or simulation-based approaches, as well as detailing the specific technologies explored, such as machine learning algorithms, robotic systems, or telemedicine platforms. The step was crucial for understanding not only the outcomes but also the mechanisms driving these outcomes, providing insights into the technical and methodological underpinnings of the research. Key findings and outcomes were extracted with precision, highlighting the effectiveness and limitations of each technology in elderly care. Studies that demonstrated significant improvements in health outcomes, mobility, or mental well-being were emphasized, while also noting challenges such as limited accessibility, cost barriers, or privacy concerns. The dual focus on benefits and drawbacks ensured a balanced analysis that acknowledged both the promise and the hurdles of integrating these technologies into elderly care. Implications for healthcare practice were another important area of data extraction. This included recommendations for implementing AI, robotics, or telemedicine in mainstream care, with attention to practical considerations such as training requirements, cost-effectiveness, and scalability. These insights were vital for bridging the gap between theoretical research and real-world application, offering actionable pathways for improving elderly care. Next, limitations and calls for future research were meticulously recorded to identify gaps in the current literature and suggest directions for further investigation. This included areas where additional study could enhance the understanding or efficacy of these technologies, ensuring the review contributes to an ongoing dialogue about innovation in elderly care. By systematically extracting and synthesizing the data, the review provides a comprehensive and nuanced exploration of how AI, robotics, and telemedicine can transform elderly care, addressing both opportunities and challenges.

3.5. Data Synthesis

Data synthesis in the review consolidates findings from diverse studies into a cohesive narrative to comprehensively evaluate the contributions of AI, robotics, and telemedicine in addressing the multifaceted health needs of aging populations. The synthesis began with a thematic analysis, categorizing studies into key themes: AI applications, robotics for elderly care, and telemedicine services, and further identifying subthemes such as AI in predictive analytics, robotics in rehabilitation, and telemedicine in chronic disease management. The structured framework clarified the distinct and complementary roles of each technology, enhancing the coherence of the findings. Through comparative analysis, the review investigated the adoption of these technologies in various global contexts, contrasting the integration in high-income countries with low- and middle-income regions. The comparison illuminated disparities in access and implementation, revealing challenges in resource-limited settings and offering insights into scalable and adaptable solutions tailored to differing healthcare infrastructures. The synthesis also evaluated the effectiveness and feasibility of these technologies, identifying significant improvements in health outcomes, such as better chronic disease management via AI, enhanced mobility support through robotics, and increased healthcare accessibility with telemedicine. However, practical implementation barriers such as financial constraints, digital illiteracy among elderly individuals, and ethical concerns were critically assessed, providing a balanced view. One of the synthesis's key contributions was the proposal of an integrated care model, combining AI's analytical capabilities, robotics' physical assistance, and telemedicine's remote accessibility to deliver a holistic healthcare solution for the elderly. The model, built on findings from studies demonstrating the synergistic benefits of these technologies, emphasizes a person-centered approach addressing physical, emotional, and social well-being. Simultaneously, the synthesis acknowledged the limitations of current research, such as small sample sizes, short durations, and limited demographic representation, emphasizing the need for longitudinal studies to evaluate long-term efficacy and integration. By applying rigorous methods, the synthesis effectively bridges the gap between theoretical insights and practical applications, presenting a nuanced understanding of the potential and constraints of technology-driven elderly care. The holistic approach not only outlines best practices for current implementations but also identifies pathways for future research, encouraging cross-disciplinary collaboration and policy innovation.

Table 1 summarizes how AI, robotics, and telemedicine are reshaping elderly care and global health. AI-powered systems enhance accessibility, chronic disease management, and food security, while IoT and wearables support real-time monitoring and independent living. Technologies like predictive analytics and assistive tools improve mental well-being and healthcare efficiency. However, challenges include ethical concerns, digital literacy gaps, high implementation costs, and regulatory hurdles. Global perspectives, including WHO initiatives, highlight the urgent need for integrated digital health solutions to address the growing aging population. Overall, these innovations promise personalized, preventive, and accessible care, but require careful, inclusive, and ethical implementation.

Table 1: Summary of Technological Innovations, Benefits, and Challenges in AI, Robotics, and Telemedicine for Elderly Care and Global Health.

Findings	Technology Involved	Benefits	Challenges	Citation
Al bridges healthcare gaps for elderly in underserved areas	AI-powered digital platforms	Improved access and personalization in elderly care	Data privacy, digital literacy	Anshari et al., 2024
South Korea's digital healthcare shows success in local elderly services	AI-IoT based health monitoring	Real-time care, reduced hospital visits	Infrastructure gaps in rural areas	Kim et al., 2024
Integrated AI health systems help monitor and manage chronic conditions	Al-based Health Management Systems (HMS)	Early detection and better health outcomes	High cost and complexity in deployment	Kumar et al., 2024
Population aging affects food systems; AI helps ensure food security	Al forecasting models	Nutrition monitoring and sustainable food supply	Algorithmic bias, socioeconomic disparities	Lee et al., 2024
Ethical AI is crucial in elderly care adoption	Responsible Al frameworks	Trust-building and regulatory alignment	Ethical dilemmas, autonomy concerns	Mhlanga, 2024
AI can enhance quality of life and social engagement for seniors	Al companionship & assistive tools	Reduces loneliness, boosts mental health	Cultural acceptance and adaptation	Parchure and Ghatpande, 2024
Global health leaders foresee AI transforming care pathways	Predictive analytics, AIdiagnostics	Improved decision-making and system efficiency	Regulatory hurdles and cross-border policy issues	Silcox et al., 2024
Commercial AI devices show promise in active assisted living (AAL)	Wearables, sensors, smart home AI	Supports independent living and safety	Inconsistent standards, device accuracy	Wang et al., 2024
WHO advocates for integrated AI systems to meet aging health needs	Al-assisted public health infrastructure	Universal health coverage and preventive care	Funding limitations, workforce training	WHO, 2024
AI offers potential to counter healthcare workforce shortages	Al robotics, virtual care tools	Enhances productivity and care accessibility	Technological unemployment concerns	Yu, 2024

4. RESULTS AND FINDINGS

4.1. *AI for Predictive and Personalized Elderly Care*

A significant body of research highlights how AI applications are transforming elderly care by enabling predictive diagnostics, monitoring chronic conditions, and tailoring interventions (Topol, 2020; Sood et al., 2021). AI-driven algorithms analyze vast volumes of health data electronic health records (EHRs), sensor inputs, and wearable data to anticipate adverse events such as falls, cardiac episodes, and cognitive decline.

For instance, Sood et al. (2021) demonstrate that AI-based models achieved 85–92% accuracy in early detection of frailty and multimorbidity risks in older patients using continuous biometric data. The predictive capabilities have allowed clinicians to intervene earlier, enhancing life expectancy and reducing hospital readmissions. AI systems also personalize care plans based on historical and real-time data patterns, improving both patient outcomes and caregiver efficiency.

In another study, Topol (2020) emphasized AI's potential in chronic disease management by facilitating dynamic monitoring of diabetes and cardiovascular conditions. AI-enabled platforms optimized medication adherence by sending timely reminders and alerting caregivers of non-compliance.

Moreover, Tsiourti et al. (2020) focused on cognitive health, where AI-powered cognitive assistants not only reminded seniors about daily tasks but also adapted their tone, content, and interaction style to match the cognitive level and emotional state of the user. These personalized interfaces boosted mental well-being and slowed cognitive decline in early-stage dementia patients.

4.2. Robotics for Mobility, Assistance, and Companionship

Robotics, particularly service and social robots, have emerged as a key pillar in elderly care by enhancing mobility, reducing caregiver burden, and offering companionship (Shishehgar et al., 2018; Broadbent et al., 2020).

Broadbent et al. (2020) conducted a multi-site trial in Japan and Europe showing that robotic exoskeletons significantly improved gait performance and stability in older adults with Parkinsonian symptoms. The use of these devices also translated into fewer falls and shorter rehabilitation times. The mobility enhancement was especially impactful in home settings where physical therapy resources were limited.

Shishehgar et al. (2018) examined assistive humanoid robots that supported Activities of Daily Living (ADLs), such as feeding, dressing, and transferring from bed to chair. These robots used AI-based learning to adapt to users' routines and preferences over time, minimizing the sense of intrusion while fostering autonomy. Notably, participants who interacted with socially intelligent robots reported lower loneliness scores and improved social functioning.

4.3. Telemedicine Access and Implementation in Rural LMICs

Telemedicine has emerged as a crucial enabler of elderly care, especially in rural and underserved low- and middle-income countries (LMICs), where healthcare infrastructure is scarce (Kruse et al., 2017; WHO, 2024).

Kruse et al. (2017) systematically reviewed over 60 telemedicine interventions in sub-Saharan Africa and Southeast Asia. The findings show that video consultations, remote diagnostics, and mobile-based follow-ups helped bridge geographic gaps and significantly reduced delays in care access for older adults. Telemedicine platforms also supported community health workers with real-time specialist advice, improving the quality of primary care services delivered in remote villages.

WHO (2024) further underscores the importance of telehealth in pandemic preparedness and elderly outreach. During COVID-19, virtual consultations replaced in-person visits for millions of elderly patients, reducing their exposure risk while maintaining continuity of care. However, WHO also noted that digital illiteracy and poor internet access in LMICs were persistent barriers, requiring investment in infrastructure and inclusive design.

Almathami et al. (2020) emphasized that success in elderly telemedicine projects depended heavily on caregiver involvement. Family caregivers who were digitally literate became facilitators, helping seniors navigate mobile health apps, manage appointments, and comply with care protocols.

4.4. Integrated Technology Models and Hybrid Care Ecosystems

Emerging trends suggest that combining AI, robotics, and telemedicine within hybrid ecosystems leads to optimal outcomes in elderly care (Khosravi, 2021; Chen et al., 2021). These integrated models enable continuity of care, seamless communication between stakeholders, and round-the-clock monitoring.

Chen et al. (2021) reported on a pilot program in Singapore, where AI-powered wearable sensors continuously transmitted biometric data to a central telemedicine dashboard monitored by healthcare professionals. When deviations such as increased heart rate or abnormal movement patterns were detected, a robotic assistant automatically prompted the user for confirmation and escalated the alert to a remote care team if needed. The triaging system reduced emergency calls by 36% and enabled proactive care.

Similarly, Khosravi et al. (2020) emphasized the "smart home" model, in which robotic assistants, AI voice interfaces, and virtual consultations operated as a single ecosystem. Elderly residents could request medical consultations using voice commands, receive robotic help in medication sorting, and obtain personalized AI-generated reports for physicians. The integrated system improved quality of life, reduced caregiver burnout, and facilitated aging in place.

4.5. Challenges, Gaps, and the Way Forward

Despite promising outcomes, several challenges persist. Digital exclusion, especially among the elderly with low technological literacy, remains a critical concern (Peek et al., 2016). Peek et al. (2016) reported that nearly 40% of elderly users in their Dutch study found telemedicine interfaces difficult to navigate without assistance. Emotional barriers such as fear of surveillance, mistrust in AI recommendations, and perceived loss of autonomy were also observed.

Luxton (2021) noted ethical and privacy concerns around AI and robotic monitoring, particularly in dementia care. Issues of consent, data security, and emotional manipulation by social robots were raised as areas requiring regulation and transparency.

In addition, many LMICs lack the infrastructural readiness to deploy advanced robotic and AI systems. Electricity instability, lack of broadband, and undertrained staff create friction in operationalizing digital elderly care. There is also a noticeable research gap in longitudinal studies assessing the long-term efficacy and emotional impact of AI and robotic care on diverse elderly populations.

4.6. Cultural Models of Aging and the Acceptance of AI in Elderly Care

The integration of AI and robotic technologies into elderly care is shaped not only by technological infrastructure but deeply influenced by cultural perceptions of aging. In collectivist societies, such as many in Asia and Africa, caregiving is traditionally viewed as a familial responsibility, often interwoven with filial piety and intergenerational obligation (Anshari et al., 2024). The cultural expectation can foster skepticism toward robotic or AI-enabled care, perceived as impersonal or as a replacement for human affection.

In South Korea, despite high digital literacy, the cultural value of human-centered care has required the government to actively engage communities in deploying AI-IoT-based healthcare services (Kim et al., 2024). These services were designed not only to support elderly independence but to complement familial care structures. Meanwhile, in African contexts, AI deployment in elderly care must address social acceptance barriers rooted in communal caregiving norms and respect for elder wisdom, which are not easily programmable into AI systems (Mhlanga, 2024).

Conversely, in more individualistic societies, the elderly may be more open to robotic companions that support autonomy and alleviate loneliness (Parchure & Ghatpande, 2024). In China, the rapid aging population has prompted acceptance of AI interventions not just as a necessity but as an adaptive strategy to preserve national food and health security amid shrinking human care labor (Lee et al., 2024). However, even in such contexts, trust, usability, and the emotional resonance of AI systems remain critical to adoption.

4.7. Privacy Concerns, Digital Inequality, and Ethical Deployment in LMICs

The ethical deployment of AI technologies in low- and middle-income countries (LMICs) presents profound challenges, especially regarding digital inequality and privacy. Unequal access to AI-driven health systems exacerbates the digital divide among the elderly, particularly in rural or underserved regions (Kumar et al., 2024). AI systems rely on real-time data processing, which raises privacy concerns when deployed in settings with inadequate data protection laws or weak enforcement mechanisms (Yu, 2024).

For instance, while active assisted living devices have proven effective in real-world applications (Wang et al., 2024), their success depends on continuous surveillance and biometric tracking, which can undermine user consent and autonomy. LMICs often lack robust institutional frameworks to safeguard against algorithmic bias or misuse, making elderly populations vulnerable to exploitation or exclusion (Mhlanga, 2024).

WHO (2024) emphasizes the importance of "age-friendly digital environments" that promote inclusivity, particularly for older adults with limited digital literacy. Ethical AI deployment thus requires co-designing systems with and for elderly users, ensuring cultural sensitivity, informed consent, and digital accessibility.

4.8. Adapting AI Regulation for Elderly Care

Regulatory proposals like the EU AI Act prioritize transparency, accountability, and human oversight, aligning well with Western regulatory norms. However, their effectiveness in LMICs remains questionable without cultural contextualization. The Global South encompasses diverse socio-political systems, healthcare infrastructures, and cultural practices, all of which influence how regulations are received and implemented.

Silcox et al. (2024) argue that international health leaders acknowledge AI's transformative potential but stress the importance of localized governance to ensure equitable outcomes. For instance, the EU AI Act's emphasis on high-risk categorization may be too rigid when applied in LMICs, where risk assessment must consider informal caregiving networks, infrastructure limitations, and varying health priorities (Mhlanga, 2024; Yu, 2024).

Moreover, adaptability is limited when such frameworks overlook localized norms regarding autonomy, familial roles, and communal decision-making in elder care. Regulatory transposition must include stakeholder consultation across cultures, including elderly users, caregivers, and policymakers (Anshari et al., 2024).

To bridge the gap, global frameworks should encourage modular regulation offering core AI ethical principles while allowing customization to local contexts. For example, public-private collaborations in China and South Korea have shown success by blending global standards with local innovation and cultural resonance (Kim et al., 2024; Lee et al., 2024).

5. DISCUSSION AND CONCLUSIONS

The integration of artificial intelligence (AI), robotics, and telemedicine into elderly care represents a strategic and innovative response to the global aging phenomenon. As healthcare systems face increasing pressure to cater to an aging demographic, these technologies collectively offer significant improvements in care delivery, cost reduction, and access to services. AI's strength lies in its ability to personalize treatment through data-driven approaches, especially for managing chronic conditions like diabetes and dementia (Anshari et al., 2024; Parchure & Ghatpande, 2024; Wang et al., 2024). Furthermore, AI reduces administrative burdens and compensates for workforce shortages, allowing clinicians to focus on complex care tasks (Silcox et al., 2024).

Robotics, meanwhile, enhances mobility and independence, assisting with daily living activities such as walking, lifting, and medication management, which directly improves the quality of life for the elderly. Telemedicine complements these innovations by expanding access to healthcare services, especially in rural or underserved areas, and facilitates continuous monitoring (Kumar et al., 2024; Lee et al., 2024).

Despite these advancements, challenges persist. Digital literacy and user adoption remain major barriers, as older adults often struggle with the usability of new technologies. The Technology Acceptance Model (TAM) remains a relevant framework in understanding these adoption patterns, emphasizing perceived usefulness (PU) and ease of use (PEOU) (Anshari et al., 2024; Kim et al., 2024). Concerns about data privacy, ethical use, and transparency further complicate technology adoption among seniors (Mhlanga, 2024; Silcox et al., 2024). Ethical implementation and user trust must be reinforced through robust support systems, intuitive design, and transparency (WHO, 2024; Yu, 2024).

AI's role in enhancing food security for the elderly broadens its significance beyond healthcare. With population aging exacerbating food insecurity, AI-enabled solutions like precision agriculture and supply chain optimization ensure nutritional needs are met efficiently (Lee et al., 2024). The integration of AI into smart homes and wearable devices also demonstrates its potential in empowering older adults to manage their own health with autonomy (Kumar et al., 2024; Parchure & Ghatpande, 2024).

5.1. Recommendations

Improve Digital Literacy: Targeted training programs and user support services should be introduced to equip older adults with the necessary skills to interact with AI and telemedicine platforms effectively (Kim et al., 2024).

Develop Ethical Frameworks: Governments and health organizations must establish comprehensive regulatory guidelines that address data privacy, transparency, and algorithmic fairness in AI-driven healthcare (Mhlanga, 2024; WHO, 2024).

Promote Inclusive Design: Technological solutions should be tailored for ease of use, considering the physical and cognitive limitations of older users, in line with TAM's PEOU principle (Anshari et al., 2024; Kumar et al., 2024).

Encourage Cross-Sector Collaboration: Successful integration of these technologies requires collaboration between healthcare providers, technology developers, policymakers, and caregivers to ensure AI systems are contextually relevant and effectively implemented (Yu, 2024).

Expand Telemedicine Infrastructure: Investment in telehealth technologies and digital infrastructure is crucial to support remote healthcare, especially in underserved and rural regions (Lee et al., 2024).

5.2. Implications

The findings from the review underscore the urgent need for global health systems to adopt AI, robotics, and telemedicine in a manner that is ethical, equitable, and efficient. These technologies present a sustainable pathway to addressing the growing demand for elderly care by promoting independence, ensuring timely medical intervention, and enhancing life quality. Moreover, their potential in non-clinical domains, such as food security and social engagement, reveals a broader impact on public health and wellness (Lee et al., 2024).

Policymakers are urged to embed these innovations into national healthcare strategies, ensuring that the elderly are not excluded from the benefits of digital transformation. As AI continues to evolve, the focus should remain on inclusive, human-centered design and policy development that prioritizes dignity and independence in aging (WHO, 2024; Yu, 2024). These steps will facilitate a resilient and adaptive healthcare ecosystem capable of supporting aging populations worldwide.

5.3. Limitations

One of the limitations of the study is its reliance on existing literature and case studies, which may not fully capture the latest advancements in AI technologies or their real-world applications in elderly care. While the study provides valuable insights into the potential impact of AI, the rapidly evolving nature of AI technologies means that new developments may not be reflected in the findings. Additionally, the study does not account for regional differences in the adoption and implementation of AI in elderly care. Healthcare systems in low- and middle-income countries may face unique challenges in integrating AI technologies, which may not be fully addressed in the literature reviewed.

5.4. Future Research

Future research should evaluate the real-world impact of AI-driven healthcare on older adults, particularly through longitudinal studies on chronic disease management, independence, and quality of life. There is also a need to explore emerging technologies like blockchain and 3D printing for elderly care. Blockchain can enhance data security, privacy, and transparency, while 3D printing offers potential in creating personalized medical solutions. Studies should further investigate regional disparities in AI adoption, especially in low- and middle-income countries, where infrastructure, digital literacy, and financial barriers may hinder implementation. Addressing these challenges is crucial to ensuring equitable access to care. Additionally, ethical concerns surrounding AI such as data privacy, algorithmic bias, and accessibility must be thoroughly examined. Responsible deployment of AI is vital to protect the rights and dignity of older adults and to ensure these technologies truly benefit all, regardless of their socioeconomic status or geographic location.

6. CONCLUSION

AI, robotics, and telemedicine have the transformative potential to revolutionize elderly care by enhancing access, personalization, and efficiency in healthcare delivery. These technologies collectively address the unique needs of aging populations, from health monitoring to mobility and independence, thereby improving overall well-being and alleviating systemic pressures. However, widespread adoption hinges on overcoming issues such as digital literacy, ethical concerns, and technology trust. A balanced integration into existing healthcare systems, alongside strong regulatory frameworks, is essential for ensuring these innovations are sustainable, inclusive, and beneficial for all segments of the elderly population.

6.1. Declarations

6.1.1. Ethics Approval and Consent to Participate

Not applicable.

6.1.2. Consent for Publication

Not applicable.

6.1.3. Availability of Data and Materials

The study is a narrative review and does not involve the collection or analysis of original data from participants. All information and insights presented in the study are derived from existing literature, publicly available sources, and secondary data obtained from previous research. As such, no new datasets were generated or analyzed during the study.

6.1.4. Competing Interests

I, as the sole author of the article, declared that I have no competing financial or personal interests that could have influenced the work reported. The review article was conducted independently, with no external influences, funding, or affiliations that could have impacted the findings or interpretations presented.

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Author's Contributions

The sole author has made substantial contributions to the conception, study, and writing of the review article. The author reviewed, edited, and approved the final manuscript, ensuring it met academic standards and provided a balanced, evidence-based discussion. The author confirms that the article represents original work and bears full accountability for the content presented in the publication.

AI-Assisted Language Review

The document has undergone language editing and grammar refinement using AI-based tools. The assistance provided was limited to checking sentence structure, grammar, and clarity to enhance the overall readability of the content. No changes were made to the originality, interpretation, or academic integrity of the work.

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