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TRANSFORMING DEMENTIA CARE GIVING: A COMPREHENSIVE REVIEW OF THE ROLE OF ASSISTIVE TECHNOLOGIES

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ABSTRACT

Background: Dementia caregiving presents significant challenges including managing daily tasks, ensuring patient safety, and addressing emotional and psychological needs. With the increasing global prevalence of dementia, caregivers often experience high levels of stress and burnout. Assistive technologies offer innovative solutions by providing tools that enhance caregiving efficiency, ensure patient safety, and improve overall quality of life. These technologies, ranging from monitoring systems to AI-based cognitive aids, have the potential to transform caregiving by supporting both caregivers and dementia patients. This study presents a comprehensive review of the role of assistive technologies in transforming dementia caregiving practices. Objectives: This review aimed to synthesize review-level evidence from published scientific literature to assess the role and effectiveness of assistive technologies in facilitating caregivers for managing patients with dementia. Methods: This systematic review is based on an analysis of peer-reviewed articles, case studies, and reports published between 2010 and 2025. To analyze the existing literature, a systematic literature search using PRISMA guidelines was conducted across databases such as PubMed, Science Direct, Google Scholar, and IEEE Xplore, using keywords related to dementia, caregiving, and assistive technologies. The inclusion criteria encompassed studies focusing on assistive technologies designed to support caregivers of patients with dementia. The findings were categorized based on the types of technologies (e.g., monitoring devices, AI tools, and communication aids) and their impact on caregivers' well-being and patient outcomes. Results: The applications of the latest technologies ranges from Communication assistance tools to memory aids and many more that can effectively manage the daily life routines of the Dementia Patients. Conclusion: Caring for individuals with dementia has been linked to adverse effects on the caregiver's health and can contribute to early placement of patients in nursing homes. Several factors, including gender, the caregiver's relationship to the patient, cultural background and personal traits and Dementia management using assistive technologies play a role in shaping the caregiving experience. While numerous interventions have been designed to reduce caregiver burden and care cum monitoring of the patients, research indicates that comprehensive, tailored interventions incorporating a variety of assistive devices can help reduce this burden, enhance caregivers' quality of life, and support them in providing care at home for a longer time.

KEYWORDS: Dementia Caregiving; Assistive Technologies; Caregiver Support; AI in Healthcare; Assistive Technologies in Healthcare; Dementia Management.

1. INTRODUCTION

Dementia is a condition that affects mental functions like memory, thinking, reasoning, and judgment, severely impacting a person's ability to perform daily tasks. It is typically caused by a group of progressive brain

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disorders that occur in older adults. The cost of caring for people with dementia is very high for both families and society, making it a significant challenge for public health and the global economy. The World Health Organization (WHO) estimates that around 50 million people worldwide have dementia, with 10 million new cases diagnosed each year. While studies in North America and Europe have provided valuable information on the causes of dementia, similar research in low- and middle-income countries (LMICs), such as those in South Asia (India, Pakistan, Bangladesh, Sri Lanka, etc.), is lacking. In the past, South Asian countries faced a high burden of communicable diseases, but public health efforts have significantly reduced this issue over the past two decades. As life expectancy increases and noncommunicable diseases like diabetes, hypertension, and heart disease become more common, the region is experiencing a shift toward these conditions as the primary health challenges. This transition now makes non-communicable diseases the leading cause of illness in the area. As life expectancy rises in South Asia, the proportion of people over 65 years old is also growing. A decrease in fertility rates has led to a larger elderly population. In India, for example, it is projected that by 2050, nearly 316 million people (about 19% of the population) will be aged 60 or older. Dementia is a major cause of disability among older adults, and as the number of older individuals increases, so will the burden of dementia. The WHO predicts that the global number of people with dementia will rise from 50 million today to 82 million by 2030 and 152 million by 2050. Given its large population, South Asia, especially India, will play a significant role in this rise (Ravindranath & Sundarakumar, 2021; Choudhary, Ranjan & Asthana, 2021).

As Dementia is a leading cause of disability, and its prevalence continues to rise. While individuals with dementia are living longer in the community, many eventually require nursing home care due to insufficient support for their physical and psychological needs. Technologies that enhance existing care have the potential to help individuals remain in their communities, preserve their autonomy, and encourage social engagement. However, these assistive devices have not been widely utilized in dementia care so far, and it is crucial to fully harness their potential to offer significant benefits to people with dementia. (Moyle, 2019).

1.1. RESEARCH OBJECTIVES

The primary research objectives of this paper are as under:

RQ1 To study the need of Assistive Technologies in Dementia Caregiving.

RQ2 To brief the importance of Assistive Technologies and identify their roles in the Dementia Management.

RQ3To understand the future trends and advancements in assistive technologies that could impact dementia caregiving.

2. Need of Assistive Technologies in Dementia Caregiving

Assistive devices are essential in dementia management as they help improve the quality of life for both individuals with dementia and their caregivers (Gibson

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et. al. 2015). As dementia progresses, people often experience memory loss, confusion, and difficulty with daily tasks, making it challenging for them to maintain independence (Steeman et. al. 2006). Assistive technologies such as medication reminders, GPS tracking devices, and home monitoring systems help ensure safety, reduce the risk of wandering, and offer caregivers peace of mind (David et. al. 2024; Mikula et. al. 2024). These devices also support communication, enhance cognitive function, and help manage health through realtime monitoring, allowing for personalized care. By easing the burden on caregivers and improving the autonomy of individuals with dementia, assistive devices are critical in promoting a higher quality of life, reducing stress, and enabling more effective care. Adoption of Assistive devices in patients with dementia significantly improve adherence to daily routines, helping patients feel more in control of their lives, leading to their independence (Thordardottir et. al. 2019). This increased independence can also lead to better mental well-being, as it allows patients to retain a sense of dignity and selfworth, which are often compromised as the disease progresses.

Additionally, assistive technologies contribute to safety by preventing wandering and falls, which are common among individuals with dementia. Research by Veermer (2020) indicates that wearable GPS trackers can alert caregivers if the patient strays from a designated area, providing peace of mind and reducing the risk of accidents. Monitoring systems equipped with sensors can detect falls and send automatic alerts to caregivers or emergency services, ensuring timely intervention and reducing the likelihood of serious injury. Thus, integrating assistive technologies into dementia caregiving can significantly enhance both the functional and emotional well-being of individuals with dementia, empowering them to live more independently and stay connected to their communities.

Importance of Assistive Technologies in Dementia

Assistive technologies play an integral role in dementia management by offering innovative solutions to address the multifaceted challenges faced by individuals living with dementia and their caregivers. Dementia, a progressive neurological condition, affects cognitive functions, memory, and the ability to perform daily tasks. The invention of assistive technologies has paved the way for solutions that enhance the quality of life, foster independence, and provide much-needed support to caregivers (Ma et. al. 2024). One of the most significant contributions of assistive technologies is their ability to improve safety and security (Lee 2017). Devices such as GPS trackers and location-monitoring tools are critical for individuals prone to wandering, a common symptom of dementia(David et. al. 2024; Mikula et. al. 2024). These tools allow caregivers to track and locate their loved ones in real-time, providing peace of mind and minimizing the risks associated with wandering. Similarly, smart home systems equipped with sensors

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and automated alerts can detect unusual activities, such as leaving the stove on or exiting the house during odd hours (Taiwo & Ezugwu, 2021). These systems ensure the safety of individuals with dementia while enabling them to remain in their homes longer.

In addition to safety, assistive technologies also address challenges in daily living. Electronic pill dispensers, for example, aid in medication management by dispensing the correct dosage at the right time, accompanied by drug reminders (Rosen et. al. 2004; Raisa et. al. 2023). This reduces the risk of medication errors and supports adherence to treatment plans. Interactive Voice Reminder apps and digital calendars help individuals with Dementia to maintain their routines and appointments. fostering a sense of normalcy and independence (Valdivia 2023). Cognitive stimulation and social engagement are other key areas where assistive technologies have made strides. Interactive digital tools, such as brain-training games and puzzles, help exercise cognitive functions and slow cognitive decline. Virtual reality (VR) applications provide immersive experiences that can evoke positive memories, reduce anxiety, and improve emotional well-being (Wojciechowski et. al. 2021). Additionally, communication aids, such as speech-to-text software and video calling platforms, bridge the communication gap between individuals with dementia and their loved ones, reducing social isolation (Mahmoudi-Dehaki, Nasr-Esfahani, & Vasan2025).For caregivers, assistive technologies offer tools to manage

care more effectively and alleviate the emotional and physical burden of caregiving. Remote monitoring systems allow caregivers to oversee their loved ones' activities and well-being from a distance, enabling them to balance caregiving with other responsibilities. Medical alert systems, which connect users to emergency services at the push of a button, ensure timely assistance during emergencies.

It is pertinent to add that assistive technologies are invaluable in the realm of dementia management. By addressing safety, daily living, cognitive health, and caregiver support, these technologies improve the quality of life for individuals with dementia and their families. As advancements continue, ongoing research and innovation will further enhance the potential of these tools, making dementia care more effective, compassionate, and empowering.

Role of Assistive Technologies in Dementia Management

Assistive Technologies are a set of powerful innovative tools that can help in Dementia Management in the individuals with dementia and their caregivers. With technological advancement, these innovative tools have revolutionized dementia care by offering practical solutions that enhance safety and improve the overall quality of life of the patients. Table 1 describes various assistive technologies and their role based on their applications in dementia management.



Figure 1: Role of Assistive Technologies in Dementia Management.

Assistive technologies profoundly transform the lives of individuals by playing crucial role (Fig. 1) in dementia management by addressing the unique challenges posed by the condition. They enhance safety and security, offering reassurance and reducing risks, which allows individuals to maintain a sense of stability. By supporting daily routines and activities, these technologies foster greater independence and dignity. Their role in cognitive stimulation promotes mental engagement, preserving cognitive abilities and improving overall well-being. Socially, they enable stronger connections with loved ones, mitigating the emotional toll of isolation. Moreover, by providing tailored solutions, assistive technologies ensure a personalized approach to care that respects the needs and preferences of each individual. Collectively, these advancements create a more supportive, empowering environment, improving quality of life and fostering hope for both individuals and caregivers.

Table 1: Applications of the Assistive Technologies in Dementia Management.

S.No.	Application	Description	Reference
1.	Memory Assistance	Smart reminders and alerts via smartphones or specialized watches help individuals with dementia manage medication, appointments, and daily tasks. Electronic calendars and clocks provide visual and audible cues for tracking time and dates, while digital photo frames displaying familiar faces or places can trigger memory recall and provide comfort.	Sanchez et. al. (2024)
2.	Communicative Assistance	Speech-generating devices assist individuals who struggle to speak, improving communication. Text-to-speech and voice recognition software aid in reading and writing, while social media platforms offer easy-to-use ways to stay connected with loved ones.	Ambegaonkar et. al. (2021)
3.	Cognitive Training	Brain-training apps and games stimulate cognitive function, memory, attention, and problem-solving. Interactive computers or tablets engage individuals in mental exercises to help those with early dementia stay active cognitively.	Kallio et. al. (2018)
4.	Environmental Control	Smart home technologies control lighting, temperature, and appliances, creating a safer, more comfortable environment. Fall detection systems and motion sensors alert caregivers or emergency services when a fall occurs, and smart locks or door alarms prevent wandering by notifying caregivers when doors are opened.	Gayathri & Easwarakumar(2016).
5.	Tracking and Monitoring	Tracking systems like GPS wearables help caregivers monitor the location of individuals with dementia, preventing them from getting lost. Health monitoring devices track vital signs, sleep, and activity, ensuring well-being and early detection of health issues.	Ray, Dash and De (2019)
6.	Telemedicine and Remote Care	With the advancement in the development of Assistive Technologies like Video Conferencing and Remote Monitoring Systemsallows caregivers and health professionals to provide consultations and support remotely along with monitor health metrics such as heart rate, activity, and other vital signs, transmitting data to caregivers or healthcare providers for real- time monitoring using RMS.	Lindauer et. al. (2017)
7.	Mobility	Smart Walking Aids with built-in sensors to assist with walking, offering support or stability while also detecting falls. While as, Personal Alert Systems in the form of Wearable devices like pendants or wristbands with emergency buttons for immediate help can be used in individuals with Dementia.	Lancioni et. al. (2023)
8.	Daily Living Assistance	Automated Medication Dispensers are the devices that provide the right dosage of medication at the correct time to ensure patient's adherence to their schedule. Electronic Pillboxes are also one of the examples of the Smart pillboxes that can remind the individual to take their medications and track doses.	Mutesi, 2021; Minaam and Fattah (2018)
9.	Memory Rehabilitation	Virtual Environment can be used to engage cognitive ability and evoke the memories through virtual reality experiences	Droes et. al. 2011

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DISCUSSION

The role of assistive technologies in dementia caregiving has gained significant attention in recent years, offering transformative solutions for both individuals with dementia and their caregivers. The integration of these technologies is reshaping dementia care by promoting greater independence, improving safety and enhancing the overall quality of life for individuals living with cognitive impairments. One of the primary ways assistive technologies improve dementia care is by addressing memory loss and cognitive decline. Memory aids, such as digital calendars, smart reminder systems, and photo frames, provide vital support by helping individuals recall daily tasks, appointments, and familiar faces. These tools help reduce confusion and anxiety, offering a sense of continuity and stability. Cognitive training tools, like brain-training apps and interactive devices, further enhance mental function by stimulating memory, attention, and problem-solving skills. These tools can help slow the progression of cognitive decline, enabling individuals with early-stage dementia to maintain their independence for a longer period. Moreover, communication remains a major challenge for many individuals with dementia. Speech-generating devices and text-to-speech software facilitate communication, allowing individuals to express themselves more easily and reducing frustration. By enabling more effective interaction, these technologies support emotional well-being and help individuals maintain meaningful relationships with family members and caregivers. Smart homes equipped with IoT devices can automatically adjust lighting, temperature, and even provide alerts for activities like door openings, ensuring a safer living space. Fall detection systems and motion sensors play a crucial role in preventing accidents by alerting caregivers if the individual is at risk, enabling rapid response times and reducing the potential for injury. Telemedicine and remote monitoring technologies have also become invaluable in dementia caregiving. These tools allow caregivers and healthcare providers to track the health and well-being of individuals remotely, collecting real-time data on vital signs, cognitive status, and daily activity levels. This continuous monitoring ensures that caregivers can intervene proactively if any concerning trends are detected, allowing for more timely and personalized care. Additionally, remote consultations through telehealth platforms reduce the burden of inperson visits, providing greater flexibility for caregivers while ensuring that care remains consistent. While advanced technologies have made significant strides in dementia management, their widespread usage and adoption remain crucial for realizing their full potential. There is a pressing need for greater integration of these technologies into everyday care practices, as well as continuous research and development to explore emerging innovations. As new technologies emerge, it is essential that they are accessible, user-friendly, and tailored to the needs of individuals with dementia, caregivers, and healthcare professionals. Only through the ongoing adoption and adaptation of these

advancements can we ensure better outcomes and an improved quality of life for those affected by dementia.

Future of Dementia Management with AI and IoT

The shift in paradigm with advancements in assistive technology, driven by AI and IoT, promises a transformative future for dementia management. AI can personalize care by analyzing behavioral patterns and predicting cognitive decline, enabling early interventions and tailored treatment plans. IoT devices, including wearables and smart home systems, enhance safety and independence by monitoring health, detecting falls, and automatically adjusting the environment to suit individual needs. Additionally, AI-powered VR and AR technologies offer interactive cognitive training and memory recall exercises, fostering mental stimulation. With telemedicine and remote monitoring, caregivers can track patients' health and provide continuous care, reducing the need for in-person visits. Together, these innovations will create more connected, efficient, and personalized dementia care, improving both the quality of life for individuals with dementia and the support provided to their caregivers.

CONCLUSION

Assistive technologies in dementia management refer to various devices and software aimed at supporting individuals with dementia and their caregivers. The most effective way to improve the quality of life for those living with dementia is by integrating these technologies into their daily routines. Assistive technologies can alleviate some of the burdens on caregivers by automating tasks such as medication reminders, location tracking, and health monitoring. These tools can significantly reduce the risk of accidents and enhance safety by helping individuals manage their daily routines more effectively. Technologies like memory aids, cognitive training tools, and communication devices individuals with dementia to maintain allow independence and continue engaging with their environment. Devices such as smart calendars, photo frames, and speech-generating tools help stimulate cognitive functions and preserve social connections. Environmental control systems like smart home technologies and fall detection devices ensure that individuals live in a safer and more comfortable environment. In the future, these technologies will continue to play a vital role in dementia care, offering both practical and emotional support to those affected by dementia and improving their overall well-being. These innovations also promote greater autonomy for individuals with dementia while providing caregivers with the tools they need to offer better support.

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