

Robotics and artificial intelligence (AI) in healthcare for the elderly: A review



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Abstract

The aging population has increased the use of artificial intelligence (AI) technology in elderly care around the world. However, as AI technologies improve, there is still a lack of clarity on the types and uses of AI technology in aged care. This scoping review sought to offer an in-depth analysis of AI technologies and robotics in old healthcare by investigating the various types of AI technologies and applications of robotics used and determining their functions in elderly care based on existing research. Overall, robotics has the potential to dramatically transform the healthcare industry. Advances in robotic technology are promoting the development of novel therapy mechanisms by improving patient outcomes and decreasing healthcare expenses while giving alternative care devices. Over the last decade, the use of assistive therapy robots to provide care is growing.

Keywords: AI technologies, robotics, elderly care

1. Introduction

The term "geriatrics" describes the medical treatment of the aged. The "examination of physical and psychological changes which are common to old age" is known as gerontology. Throughout this shift, there has been a decrease in mortality, a decrease in fertility, and an increase in the number of elderly people. The global aging population poses significant challenges for healthcare systems and providing elderly care. It is imperative to know geriatric issues to promptly identify and address them, enhance the lives of the aged, and lessen the burden on the nation. Robotics and artificial intelligence (AI) have surfaced as promising solutions to address these issues by improving older folks' quality of life and enabling independence in recent years (1–4). AI and robotics applications in elder care may encourage independence, track health, enable help, and enhance relationships. Numerous industries, including public health, medicine, physiotherapy, and other allied health services for the aged, are changing as a result of these innovations. They can aid in the creation of novel medications, customize treatment regimens, and aid in the anticipation of health risks and occurrences (5–7).

2. AI-based health monitoring technologies

AI-based health monitoring solutions comprise a variety of instruments and frameworks intended to enhance healthcare using artificial intelligence. These technologies assess patient health, anticipate

possible health problems, and provide insights for improved healthcare management by gathering, analyzing, and interpreting data from a variety of sources. The following are the main domains that AI-based health monitoring is impacting: These technologies assess patient health, anticipate possible health problems, and provide insights for improved healthcare management by gathering, analyzing, and interpreting data from a variety of sources. The following are the main domains that AI-based health monitoring is impacting: (8–11).

2.1. Wearable devices

Over the past ten years, there has been a notable surge in the creation and application of wearable technology. These devices, which range from fitness trackers to smartwatches, are rapidly being outfitted with advanced sensors that collect a wide range of health data.

Here are some of the most common types of AI-powered wearables used in healthcare:

- **Smartwatches:** These adaptable gadgets can monitor heart rate, sleep patterns, activity levels, and even the electrocardiogram (ECG).
- **Smart patches:** When placed directly to the skin, these adhesive patches can wirelessly transfer data and continuously record vital signs.
- **Smart clothing:** Wearable sensors can be used to monitor vital signs such as heart rate, respiration rate, and body temperature. This technique is mainly useful for athletes and others with chronic illnesses (12–16).

2.2. Predictive analytics

Predictive analytics, which is a component of personal emergency response systems, is being transformed in numerous ways by eldercare technology.

- **Automated alerts and notifications:** AI detects a potential health issue. Medical personnel, family members, and caretakers are automatically alerted. These notifications may contain comprehensive information regarding the identified problem.
- **Personalized health data:** These are based on past data and the specific health profile of the senior. Both long-term care planning and daily health management can benefit from these findings.
- **Predictive health monitoring:** AI systems examine past health information. It recognizes trends and forecasts possible health problems. Before they occur, they are heart attacks or strokes. Vital sign monitoring constantly aids in the early identification of irregularities (17–19).

2.3. Observing mental health

In a world where mental health is becoming a bigger problem, using AI in the field of mental health represents a type of digital healthcare where the aim is to expand accessibility. Machine learning (ML) and Natural language processing (NLP) are two easily accessible components that make up artificial intelligence (AI).

- **Machine learning:** The everyday applications of machine learning (ML) have changed the IT sector. This technology is currently being adopted by several rich countries to improve their healthcare services. This begs the question of whether machine learning will be an effective tool for improving research on aging. Developing a diagnosis that is correct and timely is one of the most challenging aspects of providing care for the elderly. These patients bring multiple medical histories and unique clinical situations to healthcare facilities, thus improving patient outcomes for this population must be a priority. ML is based on a statistical foundation. It enables an individual to provide a computer program with vast amounts of data, which the system may then analyse and use to generate data-driven recommendations and decisions based only on the data provided (20,21).
- **Natural language processing:** A group of clinical disorders known as "aging disorders" are prevalent in older persons and have a significant impact on their health and well-being. Aging syndromes include identifiable groups of symptoms and indicators, including weakness, falls, delirium, dementia, incontinence, and several chronic illnesses. Precise recognition and documentation of these syndromes are crucial for providing superior individualized treatment as well as for informing service design and research concerning these syndromes. The broad term "natural language processing" (NLP) describes the automated use of statistical, computational, and machine-learning methods to analyse human language to generate text or extract meaning (22).

2.4. AI in diagnostic

- **Imaging analysis:** To find anomalies and support diagnosis, AI systems examine medical pictures (MRIs, CT scans, and X-rays).
- **Pathology:** Techniques for artificial intelligence Examine pathology slides to identify mobility problems and improve prognostic validity.

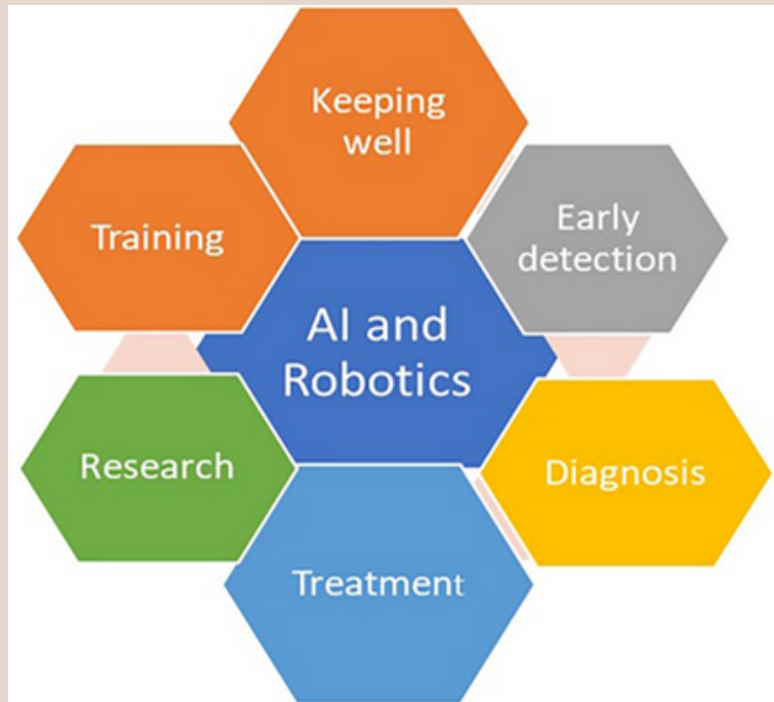


Figure 1. Applications of AI and Robotics

3. Robotics in elderly care

By enabling high-quality patient care, optimizing clinical procedures, and fostering a safer patient environment, the integration of robotics in healthcare has completely transformed the sector (23). The significant types of robots in healthcare are:

3.1. Social robots

Social robots are a revolutionary advancement in the care of the elderly, providing them with amusement, support, and companionship. Because of their artificial intelligence (AI) capabilities, these robots can communicate and interact with people in ways that are similar to those of humans. Social robots are capable of many different duties, such as conversing with users, helping with home chores, and reminding users to take their medications. Social robots ease the strain on caretakers and encourage independence in the elderly by offering company and useful assistance. To preserve mental clarity and cognitive function, social robots can also be used as cognitive stimulation aids by involving users in games and puzzles.

Among the elderly, loneliness and social isolation are common challenges that can lead to a variety of physical and mental health issues. Social robots, which provide company and social contact, present a fresh way to lessen loneliness. These robots are intended to hold deep discussions with people, exchange jokes and anecdotes, and offer emotional support. Additionally, by facilitating virtual chats with friends and family, social robots can strengthen social bonds and overcome geographic distances.

3.2. Assistive robots

Seniors who require physical assistance with domestic tasks, mobility assistance, or personal hygiene can receive it from robotic devices that are fitted with sensors and actuators. A new generation of intelligent robots is being developed to assist senior patients in hospitals with their therapy. By interacting with humans on a physical level, these robots can influence their social, emotional, and physical health. In addition, studies have shown that older individuals' attitudes have improved.

3.3. Robots for radiotherapy

Robotics has been introduced into radiotherapy and radiosurgery. The Robotic treatment couches are among the best instances. Before therapy starts, these couches assist in precisely maintaining the patient's position. They also enable medical professionals to move patients without getting into the treatment area (23).

4. Benefits of integrating medical robots in healthcare

- Decreased human error and danger
- Increased efficiency in procedures
- Decreased the requirement for direct patient contact, therefore lowering the risk of infection in hospitals.
- Robots work precisely within the parameters of time and work assigned to them.

5. Ethical concerns and challenges

The healthcare industry must navigate an intricate network of ethical issues as it embraces the transformational potential of robotics and artificial intelligence. Robotics and artificial intelligence (AI) offer unique ethical challenges that must be carefully considered and resolved, even if they have great potential to improve medical care and speed up processes. Robust security protocols and well-defined permission processes are necessary to satisfy privacy concerns over the collection and use of personal health data. However, cloud-based technologies that facilitate data sharing and real-time data analytics from several sources across integrated companies need to be carefully considered. In addition, information security needs to be preserved and the likelihood of cyberattacks reduced. When elderly individuals use robots, there's a possibility that they will be tricked, regress to infantile behaviour, and question why their human caregivers are utilizing technology instead of face-to-face interaction. Differences in diagnosis and treatment could arise from AI systems' inadvertent bias persistence in historical healthcare data. Algorithms that reduce bias and advance fairness in healthcare choices must be created. By prioritizing patient welfare, fairness, and collaboration, healthcare institutions, technologists, legislators, and healthcare practitioners may ensure that AI and robotics contribute positively to healthcare while upholding the highest ethical standards. The goal of developing new technology is always to benefit society, and artificial intelligence (AI) gives us tremendous new tools with which to assist others and improve the world. But we must decide to act in an ethical manner if we want to improve the world. With the combined efforts of several people and institutions, we can expect artificial intelligence (AI) technology to assist us in creating a better world. (6,24,25,26).

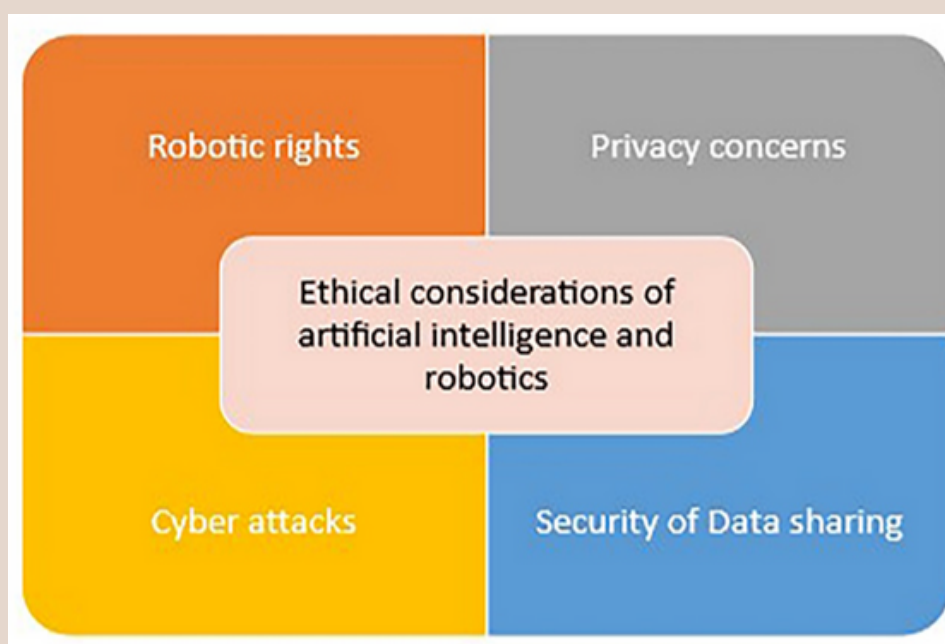


Figure 2. Ethical considerations of artificial intelligence and robotics

6. Future directions and conclusion of AI and robotics in geriatrics

The growing global issue of population aging demands creative and quick fixes to promote the independence and overall well-being of older persons. Promising technologies in artificial intelligence and robotics can help meet the healthcare needs of the rapidly aging senior population. This review looked at the many ways that artificial intelligence and robots are being used in the care of the elderly, highlighting how important they are for encouraging independence, keeping an eye on health, fostering social engagement, and supporting geriatric rehabilitation. Personalized help is made possible by AI-powered solutions, enabling senior citizens to live independently for longer. Artificial intelligence (AI) algorithms in cutting-edge home technology quickly identify emergencies and changes in behavior patterns, guaranteeing timely answers and increased safety. Wearables powered by artificial intelligence (AI) track vital signs, encourage seniors to lead healthier lifestyles, identify health hazards, and provide personalized treatment recommendations via telemedicine platforms. Combining robots with AI enhances mental health in older persons, efficiently combats social isolation, and offers priceless physical support and companionship. Health robots will undoubtedly change if machine learning, data analytics, computer vision, and other technologies continue to progress (2–4,7,11,16). To ensure privacy and data security, maintain human connection and autonomy, and apply AI and robotics in elder care, ethical issues are crucial. By carefully regulating and utilizing these technologies, we can enhance the standard of senior care and enable older individuals to have happy lives.

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