



The Impact of Robotic Technology on Nursing Care: A Systematic Review

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ABSTRACT

The rapid development of technology has given birth to various sophisticated innovations, one of which is robot technology. In the context of today's evolving nursing world, attention to nurses' ability to deal with technological developments, including the use of robots, is becoming increasingly important to consider the steps that need to be taken in order to achieve and maintain patient health with the help of robots as intelligent tools. The aim of this study was to thoroughly assess the impact of the use of robotic technology in nursing care through a systematic review of relevant literature. This type of research is a systematic literature review. The sample in this study was 17 articles using the prism diagram method. Article retrieval was carried out using the Sage Journal search engine, PubMed, ProQuest, Google Scholar. Based on the results obtained positive and negative impacts of the use of robotic technology in nursing services. Positive impacts include aspects of mobilization, psychology, independent needs, nutritional fulfillment, safety, logistical needs, time management. However, the main challenges include economic, psychological, management, collaboration, social values. These studies meet the five assessments of service quality; Physical appearance, reliability, responsiveness, assurance, empathy. Apart from these five assessments, there are economic, management, collaboration challenges that need to be considered.

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1. INTRODUCTION

The very rapid development of technology has produced various sophisticated innovations, one of which is robot technology. Robotic technology has developed rapidly in the last few decades [1]. Technological breakthroughs are occurring at an ever-increasing rate thereby revolutionizing health care and human well-being. Technological advances have drastically changed the structure and organization of the healthcare industry. McKinsey Global Institute estimates that 800 million workers worldwide will be replaced by robots by 2030 [2].

Technological advances have become available to help nurses do their jobs and care for patients more efficiently and safely. Nursing today is not the same as it was 30 years ago. There has been a robotic revolution in healthcare where robots have made tasks and procedures more efficient and safer. From technological advances such as robot-assisted surgery which could one day replace surgeons and nurses in operating rooms

[3], humanoid nursing robots which have the possibility of replacing human nurses in hospital wards [4], companion robots designed to provide assistance. useful and socially acceptable to people who require special attention such as the elderly, autistic children, or disabled people [5], automatic dispensing robots that will eliminate the responsibility of nurses in administering medication coupled with the great progress seen in the development of increasingly sophisticated artificial intelligence that enables machines to make critical decisions in healthcare and patient care coordination. In caring for patients with various characteristics, nurses are expected to always listen to the patient's complaints and wishes and respond well, in accordance with the patient's hopes and demands. Patient satisfaction is a positive result of various aspects of the services provided. Evaluation of services is only a small part of the activities that occur in hospitals. Usually, if a patient is dissatisfied, the complaint is more related to the behavior and attitude of hospital staff. Complaints that often arise include delays in service by nurses, lack of friendliness and responsiveness of nurses to patient needs, long waiting times for examinations, order, comfort and security in hospitals [6].

The results of research conducted by [7] regarding patient experiences during hospitalization indicate that the aspects that patients consider pleasant when interacting with nurses are when nurses provide care with full attention, are friendly, always ready to help whenever needed, do not show anger, responsive to patient calls, frequent visits to the patient's room, behave politely, smile often, attend regularly during the day and night, and always monitor the patient's condition. Nursing services must meet the requirements: available, appropriate, continue, acceptable, accessible, affordable, efficient and quality. This is related to efforts to increase satisfaction with nursing services which always accompany, care for and serve patients as users of health services [8].

One of the main reasons why artificially intelligent machines appear to threaten the nursing profession is the possibility that they will outperform human thinking. However, these machines cannot truly outperform human thinking because performance is subjective, constantly changing, and particularly individual in most scenarios. Despite its potential benefits, adoption of robotic technology in nursing has not always been smooth. There are concerns regarding aspects such as patient privacy, data security, and human-robot interactions that may impact acceptance of this technology both by medical personnel and by patients. Compassion and empathy are very difficult to model in machines. Unlike machines, human nurses can react to unpredictable aspects of humanity, especially including the emotional context of a situation. Receiving medical care is a highly emotional experience, and machines may not be able to truly understand aspects of another person [9] stated that human nurses can provide better care to patients because of their ability to understand their humanity and emotions.

Nurses see the positive effects of using robots such as helping to reduce workload and fatigue, but at the same time causing negative impacts such as reduced interaction and communication between nurses and patients, as well as obstacles in operating the robot [10]. In the current context of the developing world of nursing, attention to nurses' abilities in dealing with technological developments, including the use of robots, is becoming increasingly important. When robotic technology is used in patient care, it is important to consider the steps that need to be taken to achieve and maintain patient health with the help of robots as intelligent tools [2]. Based on preliminary studies and various related literature, the use of robots can have positive effects such as reducing nurses' workload, but can also have negative effects such as reducing interactions and attitudes. caring carried out by nurses on patients [11].

2. METHODS

Articles were searched using the PUBMED, SAGE Journal, Proquest, and Google Scholar databases with PRISMA Flow Diagram technique. The formulation of the search strategy includes inclusion and exclusion of criteria, keywords, and selection of research reports. The keywords used were "impact of "robotic" technology on "nursing care" NOT REVIEW ARTICLE, Impact Of Robotic Technology On Nursing Care, *Dampak Teknologi Robotik Terhadap Pelayanan Keperawatan*"

2.1. Eligibility Criteria

The criteria in this study is based on the PICOC framework criteria:

- 1) Journal articles published in the last 10 years.
- 2) Journal articles that can be accessed in full text.
- 3) Journal articles indexed by Sinta for Indonesian language journals and Scopus indexed for English language journals.

- 4) Indonesian and English journal articles regarding "The Impact of Robotic Technology on Nursing Services: Systematic Review"

3. RESULTS AND DISCUSSION

The final results of the research were 17 journal articles written in Table 1. From the review carried out by the author, it was found that the impact of robotic technology on nursing services included: Positive impact There are several aspects that have been assisted by robotic technology in nursing services, including: Mobilization, Psychology, Independent needs contained, Caregiver workers, Fulfillment of nutrition, Safety included, Logistical requirements, Time management. Negative impact including Economic challenges, Psychological challenges, Management challenges, Collaboration challenges, Challenges to the social values.

Table 1. Research results on the impact of robotic technology on nursing services

| No | Writer & Year | Title | Conclusion |
|----|-----------------------------|---|--|
| 1 | Yoshimi et al., 2024 [12] | Robotic Care Equipment Improves Communication between Care Recipient and Caregiver in a Nursing Home as Revealed by Gaze Analysis: A Case Study | Resyone plus come for help nurse in patient transfer |
| 2 | Liu et al., 2024 [13] | Reminiscent music therapy combined with robot-assisted rehabilitation for elderly stroke patients: a pilot study | The results show that group A produces more patients who have effective self-management, increased self-efficacy and positive emotions. |
| 3 | Kowalski et al., 2023 [14] | A rule-based robotic assistance system providing physical relief for nurses during repositioning tasks at the care bed | Use robot KUKA (Keller und Knappich Augsburg) as a robot to support the repositioning process (from supine position to lateral position) in patients |
| 4 | Warmbein et al., 2023 [15] | Barriers and facilitators in the implementation of mobilization robots in hospitals from the perspective of clinical experts and developers | However, there is currently a lack of understanding of the important factors needed to integrate this technology into appropriate care, therefore this study addresses costs, adjustment process, lack of exception, inability adapt to the varying conditions of the patient population and the lack of support from producer/developer identified as a challenge |
| 5 | Otaka et al., 2024 [16] | Positive Emotional Responses to Socially Assistive Robots in People With Dementia: Pilot Study | This research suggests that socially helpful robots may be more effective at evoking positive emotions when there is a lot of sensory stimulation |
| 6 | Bradwell et al., 2022 [17] | Implementing Affordable Socially Assistive Pet Robots in Care Homes Before and During the COVID-19 Pandemic: Stratified Cluster Randomized Controlled Trial and Mixed Methods Study | This study uses animal-like robots as a comfort for elderly patients with dementia and helps reduce neuropsychiatric symptoms (reduced delusions, depression, anxiety, apathy) and increase positive emotions in the sample. Each respondent received 2 JFA (Joy For All) devices in the form of 1 cat and 1 dog. |
| 7 | Pournajaf et al., 2023 [18] | Neurophysiological and Clinical Effects of Upper Limb Robot-Assisted Rehabilitation on Motor Recovery in Patients with Subacute Stroke: A Multicenter Randomized Controlled | The UL-RAT robot assists in motor recovery and rehabilitation in the healing process of stroke patients in the first weeks. |

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| 8 | Trzmiel et al., 2023 [19] | Trial Study Protocol The Effect of Using a Rehabilitation Robot for Patients with Post-Coronavirus Disease (COVID-19) Fatigue Syndrome | A before/after comparison showed that the intervention group had better improvement. The intervention group consisted of neurological rehabilitation measures (independence therapy such as eating, bathing and dressing) and robotic rehabilitation (hand and upper arm muscle exercises). |
| 9 | Korchut et al., 2022 [20] | Assistive Technology in Multiple Sclerosis Patients—Two Points of View | This research provides RAMCIP as a technology that assists in the daily life of people with MS (Multiple Sclerosis) from providing food, taking medication, exercise to ensuring the safety of users. |
| 10 | Ohneberg et al., 2022 [21] | Study protocol for the implementation and evaluation of a digital-robotic-based intervention for nurses and patients in a hospital: a quantitative and qualitative triangulation based on the Medical Research Council (MRC) framework for developing and evaluating complex interventions | The use of robotic assistance systems in the field of nursing includes various challenges: These challenges relate to technological, clinical, financial, insurance, psychological, social, ethical and legal issues. Technological challenges include indoor navigation, manipulation, IT security, telecommunications and integration of the robot with existing technology in the hospital. |
| 11 | Kato et al., 2022 [22] | A rise-assisting robot extends life space and improves facial expressions of nursing home residents | Before implementation, participants had limited living space, but after the Resyone Plus wearing intervention, they frequently visited the destination room. This study shows that Resyone Plus can enrich care activities for individuals with severe disabilities. |
| 12 | Kato et al., 2021 [23] | Identification of care tasks for the use of wearable transfer support robots – an observational study at nursing facilities using robots on a daily basis | Before implementation, participants had limited living space, but after the Resyone Plus wearing intervention, they frequently visited the destination room. This study shows that Resyone Plus can enrich care activities for individuals with severe disabilities. |
| 13 | Waycott et al., 2022 [24] | Technology-Mediated Enrichment in Aged Care: Survey and Interview Study | This research was conducted to enrich / facilitate the lives of the elderly in elderly care.. |
| 14 | Bajones et al., 2018 [25] | Hobbit: Providing Fall Detection and Prevention for the Elderly in the Real World | In this study the Hobbit was designed specifically for fall detection and prevention, providing a variety of tasks (e.g., picking up objects from the floor, patrolling the flat, and using the reminder function). |
| 15 | Kim et al., 2022 [26] | Social Values of Care Robots | This research discusses the social values of care robots into healthcare labor value, innovative and economic value. This research also discusses the challenges of safety guidelines for robots and the cost of robots. |

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|----|----------------------------|--|--|
| 16 | Sommer et al., 2024 [27] | Potential of Assistive Robots in Clinical Nursing: An Observational Study of Nurses' Transportation Tasks in Rural Clinics of Bavaria, Germany | This study highlighted transportation as a common and time-consuming nursing task involving non-medical and medical items. |
| 17 | Sørensen et al., 2024 [28] | Care-receivers with physical disabilities' perceptions on having humanoid assistive robots as assistants: a qualitative study | Some respondents would consider replacing human helpers with robots; elsewhere, they see robots as a complement to human assistance. |

Service quality assessment can be carried out by considering the following five guidelines: Tangible, Reliability, Responsiveness, Assurance, Empathy. In the review above, the author obtained results related to assessing service quality. Tangibles: In another study, elderly patients were happier with RoBoHoN, Chait, and Amaenbou-Nekochan which provided visual motor stimulation shaped like animals and dolls. This stimulation helps patients to evoke positive emotions in elderly patients [16]. Not much different from other research which also uses robots that resemble animals (Joy For All) Which resembling cats and dogs as patient entertainers. Because the shape of the robot is cute, it can be a medium of entertainment for patients by increasing positive emotions and reducing neuropsychiatric symptoms such as reducing delusions, depression and anxiety in patients [17]. From the research above, it can be concluded that the physical appearance of robots is very important to attract patient interest and can lighten the workload of nurses as entertainment for patients which can increase positive emotions in patients.

Reliability: In another study, Resyone Plus helped nurses in transferring patients from one bed to another bed or from one place to another [12]. Almost the same as previous research, this study explains the impact of regular use of Resyone Plus which helps patients become more active and enrich their activities [22]. Similar to research discussing Resyone Plus. This research offers a technology called KUKA (Keller und Knappich Augsburg) as a robot that assists nurses in repositioning patients (from the supine position to the lateral position) [14]. In another study, the UL-RAT robot was used to assist in motor recovery and rehabilitation in the healing process of stroke patients in the first weeks. The UL-RAT robot is used in conjunction with passive exercises commonly used in stroke treatment [18]. In another study, it explains the use of robots as a transportation medium for nurses in transporting non-medical and medical goods. This technology helps nurses shorten the time in picking up goods. When the robot takes the goods, it can make it easier for nurses to prepare other important things [27]. From the research above, it can be interpreted that robotic technology can help nurses in terms of mobilization and time management to complete certain tasks with high consistency, reduce nursing errors and increase trust in health services.

Responsiveness: In another study, robots were used to assist nurses in serving patients Post-Coronavirus Disease Fatigue Syndrome by applying neurological therapy (independence therapy such as eating, bathing and dressing) and therapy involving robots (hand and upper arm muscle training) [19]. In another study, the RAMCIP robot was used in MS patients (Multiple Sclerosis) as technology that helps in everyday life (starting from providing food, reminding you to take medication and helping with exercise) [20]. Robots that assist in elderly care by assisting patients in toileting are also in research [23]. Some respondents in other studies would consider replacing caregivers with robots, this is because the respondents felt very helped by the presence of robots that could help with their independent needs [28]. From the research above, it was found that robot technology can help and respond to patients' daily independent needs quickly and precisely, where caregivers are usually the ones who provide these services.

Assurance: Apart from being able to help with daily needs, the RAMCIP robot also maintains and ensures user safety through fall prevention in its system [20]. In another study there was also a Hobbit robot specifically designed for fall detection and prevention, providing a variety of tasks (e.g., picking up objects from the floor, patrolling the flat, and using a reminder function) [25]. From the research above, it can be judged that robots can guarantee user safety. However, after the research above, there is other research which says that the safety and responsibility if an accident occurs from robotic technology in its use still has to be questioned [26].

Empathy: Some robots are designed to provide emotional support such as the JFA, resyone plus, RoBoHoN, Chait, and Amaenbou-Nekochan robots as well as robots produced by Guangzhou Yikang Medical Equipment Industry Co Ltd which collaborates robots and music therapy so that patients can increase positive emotions and the effectiveness of self-management. However, behind the benefits obtained, there are things that need to be considered, namely the attitude and acceptance of nurses and patients that still need to be considered. On the one hand, care professionals and people who need care are open to robotic systems [13].

On the other hand, technology is seen as having the potential to contribute to stigmatization and dehumanization. In addition to the uncertainty in handling robotic systems, the technical complexity of the system and the lack of user participation in the development and implementation process also impact acceptance [21].

Apart from the 5 principles above, there are economic, management and collaboration challenges that need to be considered. As with the economic aspect, cost coverage is also a challenge for hospitals. These robotic devices are usually purchased or rented by individual hospitals without subsidies or contributions from health insurance companies. Furthermore, in the management aspect, health services that want to install robotic systems must pay attention to technical conditions (WLAN coverage and stable electricity supply), making integration difficult. The premises are also not designed for the integration of robotic systems: room size, noise level, floor load and heat generation are issues, so additional costs must be invested in conversion measures [15].

Integration into daily workflow has proven difficult, with robot-assisted therapy taking more time than conventional therapy or disrupting daily routines due to noise or lack of space. The lack of additional downtime for key users also led to one integration failure. Finally, from the collaboration aspect it can be seen that the lack of support from producers/developers is identified as a challenge; too little public funding and short funding periods for the development of robots adapted to practical needs, as well as difficulties in obtaining approval for such robots and a lack of education about technology and robotics in training to become nurses or physiotherapists [15]. As well as staff and client limitations, organizational support, and rejection family is also still an issue that needs attention [24].

4. CONCLUSION

Based on research results regarding the Impact of Robotic Technology on Nursing Services: Systematic Reviews, So it can be concluded that there are positive and negative impacts obtained from the 17 studies that have been collected. These studies fulfill five service quality assessments; tangible, reliability, responsiveness, assurance, empathy. Apart from the five assessments above, there are economic, management and collaboration challenges that need to be considered.

5. LIMITATION

Robotic technology is intended to reduce nurses' workload and improve patient self-care, but it has not been well implemented. This study still has shortcomings of searching the literature to a wider and more diverse database, Limited studies conducted in specific contexts such as certain types of nursing services, Use of strict inclusion criteria to select high-quality studies, Ensuring that the studies conducted represent the use of robotic technology used in real life in daily nursing practice and not just in research or trial settings, Involving nursing personnel in the research process to gain deeper insight into their perceptions and experiences of the use of robotic technology.

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