INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN PROGRESSIVE EDUCATION & DEVELOPMENT

OPEN ACCESS JOURNAL

Vol 14, Issue 3, (2025) E-ISSN: 2226-6348

Organizational Change in Rehabilitation Settings: The Integration of Robotic Technologies

Yew Chung Khian[1], Nomahaza Mahadi[2]

[1]Hospital Sultanah Bahiyah, Kedah, [2]Azman Hashim International Business School (AHIBS), Universiti Teknologi Malaysia

Corresponding Author Email: nomahaza.kl@utm.my

DOI Link: http://dx.doi.org/10.6007/IJARPED/v14-i3/26170

Published Online: 14 August 2025

Abstract

The integration of robotic technologies into rehabilitation settings represents a transformative phase in healthcare delivery, especially within the context of Malaysia's Fourth Industrial Revolution (4IR) and its national "Health White Paper." This organizational change underscores a strategic shift from traditional rehabilitation methods to technology-enhanced practices aimed at improving patient outcomes, particularly in stroke recovery. Robotic rehabilitation devices, such as exoskeletons and robotic gloves, enable intensive, repetitive, and task-specific therapies that are essential for restoring upper and lower limb functions. Their role becomes even more critical in addressing therapist shortages and accommodating rising patient demands, a challenge further intensified by the COVID-19 pandemic which highlighted the need for remote rehabilitation solutions. Drawing on Weiner's (2009) Theory of Organizational Readiness for Change, this study explores the dual dimensions of change commitment and change efficacy as essential components for successful implementation. It discusses the technological, human, and organizational factors influencing the adoption of robotic technologies, including leadership support, resource availability, staff training, and user acceptance. Key barriers include resistance due to fear of depersonalized care and concerns over usability, especially in resource-limited settings. This paper emphasizes the importance of a supportive organizational culture, effective communication strategies, and continued workforce development to ensure sustainable integration. Additionally, it highlights the potential of robotic technologies to revolutionize rehabilitation by offering personalized and data-driven care, particularly through home-based and telerehabilitation platforms. Ultimately, the integration of robotic technologies aligns with Malaysia's strategic healthcare goals, offering a scalable solution to enhance rehabilitation services and expand access. Future research and policy efforts should focus on cost-effectiveness, accessibility, and building collaborative ecosystems between stakeholders to maximize the transformative potential of these technologies in advancing national and global rehabilitation standards.

Keywords: Robotic Rehabilitation, Organizational Change, Healthcare Innovation, Fourth Industrial Revolution (4IR)

Introduction

The Fourth Industrial Revolution (4IR) introduces major transformations across various sectors, including healthcare in Malaysia. Malaysia's "Health White Paper" initiated by former Health Minister Khairy Jamaluddin outlines a strategic blueprint to transform its healthcare system to meet the challenges and leverage the opportunities presented by 4IR (National Fourth Industrial Revolution Policy, 2021). This transformation signifies a pivotal phase of organizational change, where traditional healthcare methodologies are augmented with advanced technological solutions, promising to enhance healthcare outcomes significantly (Health White Paper for Malaysia, 2023). Organizational change refers to the deliberate and methodical evolution within a business's structure, operations, or culture that is carried out to effectively address shifts in the market or internal challenges. This type of change is intended to ensure the long-term success and sustainability of an organization by adapting its processes, workforce, and technological systems to meet its strategic goals (Weiner, 2009). Organizational change, in this context, refers to the process by which rehabilitation facilities modify their operations, strategies, structures, and technologies to incorporate robotic devices that assist in patient care and therapy.

Robotic technologies in rehabilitation, are robotic devices that are designed to be worn by patients, improving or restoring their ability to move and perform daily functional activities. Such technologies can significantly enhance therapy's effectiveness and reach by supporting therapists in delivering uniform training over prolonged durations and gathering data for monitoring progress (Jeffrey et al., 2016; Giuk, Lee., 2022, Beatrice et al., 2023). The integration of robotic technologies in rehabilitation settings is not just a technological upgrade but a significant organizational change that has profound implications for patient care, therapist roles, and overall healthcare service delivery. This change is propelled by the increasing demand for more efficient, effective, and patient-centered rehabilitation therapies. The significance of this topic lies in its potential to drastically improve patient outcomes, enhance the quality of care for individuals with mobility impairments, and optimize the utilization of healthcare resources. It aligns with the Health White Paper's objectives to tackle the complex health challenges of the 21st century, including the use of technology to advance healthcare delivery and outcomes (Health White Paper for Malaysia, 2023).

According to Johnson and colleagues (2019), the Global Burden of Disease Stroke Statistics Worldwide Survey in 2016 revealed a concerning projection for Malaysia. By 2040, it's estimated that one in four Malaysians will experience a stroke if preventive measures are not implemented. These strokes often lead to enduring physical impairments, requiring ongoing rehabilitation interventions. Therefore, there is a necessity for the advancement of robotic technologies in rehabilitation settings, especially for addressing upper and lower limb impairments following a stroke, within the present healthcare landscape in Malaysia. The relevance of this organizational change is to align with Malaysia’s commitment to the 4IR, which emphasizes the importance of adopting advanced technologies to improve societal well-being (National Fourth Industrial Revolution Policy, 2021). Impairments in upper limb function affect a considerable proportion of stroke survivors, impacting their daily activities and overall quality of life, while impairments in lower limb function affect mobility and independence (Pollock et al., 2014). Emerging robotic technologies in rehabilitation, such as robotic gloves for upper limbs and lower limb exoskeletons introduce a potential shift in the

approach to stroke rehabilitation. These technologies offer a mechanism for intensive, repetitive, task-specific training that is crucial for motor recovery, potentially increasing the effectiveness of rehabilitation interventions (Lo et al., 2010; Beatrice et al., 2023). Additionally, they provide opportunities for more accessible rehabilitation, including options for home-based therapy via telerehabilitation (Tiara et al., 2018; Hemanth et al., 2021) that can enhance patient engagement and adherence to treatment plans. The capacity of these devices to deliver immediate feedback and performance analysis provides valuable information, enabling the customization of therapy to meet individual patient needs (Aprile et al., 2016).

The importance of robotic technologies has become increasingly apparent with the onset of the COVID-19 pandemic, which accelerated the move towards remote rehabilitation services. This adaptation was essential in maintaining access to rehabilitation care while adhering to preventive measures against the virus. Home-based robotic rehabilitation with telerehabilitation frameworks can effectively monitor patient progress remotely and enhance patient engagement during the COVID-19 outbreak (Tiara et al., 2018; Hemanth et al., 2021). The pandemic underscored the critical role of technology in facilitating ongoing access to essential therapy services, marking a transition towards a healthcare model that integrates technology and patient care for more effective rehabilitation outcomes. Moreover, in an era where the healthcare sector is constantly striving for innovation to meet the evolving needs of patients, the role of robotic technologies cannot be overstated. These technologies also represent a promising solution to the growing challenges in rehabilitation services, such as the therapist shortage and increasing patient loads (Katherine et al., 2005; Karen et al., 2017; Anette et al., 2021).

Literature Review

The Theory of Planned Behaviour (TPB) proposed by Ajzen (1991) explains intentional behaviour through attitudes, subjective norms, and perceived behavioural control, providing a strong basis for understanding decision-making processes. Complementing this, the Technology Acceptance Model (TAM) by Davis (1989) focuses on perceived usefulness and perceived ease of use, making it a practical framework for predicting technology adoption, and together, these models offer a robust lens for examining the behavioural and technological dimensions of this study.

Integrating robotic technologies into rehabilitation settings, especially for stroke recovery, involves a multifaceted process influenced by a range of factors. These factors can be broadly categorized into organizational, human, and technological elements, each contributing to the complexity and outcomes of the integration process. From an organizational perspective, readiness for change, encapsulated in the commitment to and efficacy of implementing new practices, is critical (Weiner et al., 2009; Julien et al., 2015). Organizations with a culture of innovation and continuous improvement are more adept at incorporating robotic technologies. The availability of resources, both financial and human, cannot be overstated. The initial investment and ongoing maintenance costs, coupled with the need for skilled personnel to operate these technologies, present significant challenges to widespread adoption. Leadership plays a vital role in this process, with proactive support from management being essential for overcoming barriers and facilitating the smooth integration of new technologies (Donal et al., 2010; Anette et al., 2021).

On a human level, the attitudes and perceptions of both therapists and patients towards robotic technologies significantly influence their acceptance and use. Positive attitudes, driven by an awareness of the potential benefits of these technologies, can enhance acceptance (Ananda et al., 2012). Conversely, resistance, potentially rooted in concerns over technology replacing human touch or skepticism about the effectiveness of these devices, can impede their adoption (Tiara et al., 2018; Jure et al., 2018). Training and developing competence among healthcare professionals are indispensable for ensuring the effective use of wearable robotic technologies. Comprehensive training programs that build proficiency and confidence in using these devices are essential for their successful integration into rehabilitation practices.

Technologically, the usability and compatibility of robotic technologies with existing rehabilitation protocols are paramount. Devices that seamlessly integrate into current practices and require minimal adjustment to established therapeutic routines are more likely to be adopted. Usability, characterized by ease of use and minimal training requirements, significantly impacts staff and patient acceptance of these technologies (Karen et al., 2017; Marlena et al., 2022). The strong evidence supporting the benefits of robotic technologies, including their role in enhancing patient outcomes and their effectiveness in promoting motor learning and recovery after a stroke, presents a persuasive argument for incorporating these devices into rehabilitation services (Lo et al., 2010, Beatrice et al., 2023).

Overview of a Theory

The Theory of Organizational Readiness for Change, developed by Weiner in 2009, offers a comprehensive framework that is highly pertinent to the topic of integrating robotic technologies in rehabilitation settings. This theory posits that the readiness of an organization for change is a critical antecedent to the successful implementation of new processes, technologies, and practices within healthcare environments. Organizational readiness, as defined by Weiner (2009), encompasses two key components of change commitment and change efficacy.

Change Commitment

Change commitment refers to the organizational members' shared resolve to implement new technologies or practices (Weiner, 2009). In the context of integrating robotic technologies in rehabilitation settings, change commitment would manifest in a collective determination among healthcare professionals, administrators, and stakeholders to adopt and utilize these advanced tools for stroke rehabilitation. The commitment is driven by a recognition of the potential benefits that such technologies can offer in enhancing patient care, improving therapy outcomes, and addressing challenges in rehabilitation processes.

Change Efficacy

Change efficacy, on the other hand, pertains to the shared belief within an organization in its collective capability to execute the change effectively. This involves the confidence of the rehabilitation team in their ability to learn, adapt, and proficiently use robotic technologies in treatment protocols. It also encompasses the organization's capacity to train staff, manage the logistical aspects of technology integration, and overcome barriers to change. Efficacy is bolstered by prior successes with technological innovations, available resources, and the support provided for the change process (Weiner, 2009).

The Theory of Organizational Readiness for Change is particularly relevant to the integration of robotic technologies in rehabilitation settings for several reasons. First, it highlights the importance of a supportive organizational culture and climate that values innovation and continuous improvement. Organizational culture can significantly affect the resistance, especially in settings less supportive of innovation or lacking in leadership endorsement for new technologies (Tiara et al 2018). Second, it underscores the necessity for effective communication strategies to build consensus and foster a positive attitude toward change among all organizational members. Lastly, it acknowledges the challenges and uncertainties associated with implementing new technologies and proposes a structured approach to managing these complexities through planning, training, and evaluation.

Discussion

The integration of robotic technologies into rehabilitation practices, especially for stroke recovery, has gained attention within the healthcare sector. This focus is driven by the potential of such technologies to transform rehabilitation services by offering more personalized, efficient, and accessible care options. The literature review reveals a consensus on the benefits of robotic technologies, including their capacity to enhance patient outcomes and address broader challenges such as therapist shortages and increasing patient demands. However, the transition toward incorporating these advanced technologies requires navigating a complex landscape of technological, organizational, and human factors. A key similarity across studies is the acknowledgment of the effectiveness of robotic technologies in improving the rehabilitation process. Technologies such as robotic gloves for upper limbs and lower limb exoskeletons are recognized for their potential to improve motor recovery, offer intensive, repetitive, task-specific training, and ultimately, enhance patient outcomes (Jeffrey et al., 2016; Karen et al., 2017). This is further highlighted by the increased need for such technologies in the wake of the COVID-19 pandemic, which has underscored the importance of remote and accessible rehabilitation services. Robotic technologies, by facilitating home-based and telerehabilitation services, have emerged as essential tools in ensuring continuity of care during such global health emergencies (Hemanth et al., 2021).

On the other hand, differences in the literature stem from the varied perceptions of readiness and the challenges associated with the adoption of these technologies. While some researchers point to concerns over the depersonalization of care, others emphasize structural barriers such as insufficient resources, lack of training, and inadequate support from organizational leadership as significant impediments to technology integration (Tiara et al., 2018, Anette et al., 2021). There's a divergence in strategies recommended for integrating robotic technologies into rehabilitation settings. While some emphasize the need for fostering a culture of innovation and continuous improvement, others focus on the technical aspects, such as improving the usability and compatibility of robotic devices with existing rehabilitation protocols (Anette et al., 2021; Beatrice et al., 2023). Future studies could explore specific strategies that enhance organizational readiness for change, examining successful case studies within Malaysia and other countries undergoing similar technological transformations in healthcare. Understanding the barriers to organizational change and the factors that facilitate a smoother integration of technology into healthcare practices would be invaluable. Additionally, future research should collaborate with technology companies in prioritizing developing more affordable and adaptable robotic devices. This is particularly crucial for ensuring seamless integration into existing rehabilitation protocols, especially in

smaller, rural hospitals. The focus should be on innovation that reduces costs without compromising the quality of care, making advanced rehabilitation accessible to a broader segment of the Malaysian population.

Strategic investments and funding models must be developed to support the adoption of robotic technologies in rehabilitation settings. This includes subsidies for healthcare providers, incentives for technology developers, and financial support for patients requiring these interventions. Additionally, longitudinal studies assessing the long-term outcomes and cost-effectiveness of robotic-assisted rehabilitation are essential. Such research can provide evidence to support policy decisions and healthcare investments, demonstrating the value of robotic technologies in improving patient outcomes and overall healthcare system efficiency. Organizations are recommended to promote lifelong learning among employees, ensuring they possess the necessary skills and knowledge to leverage robotic technologies effectively. This can be achieved through continuous education and hands-on training sessions through workshops. Cultivating an organizational culture that values innovation and involving employees in decision-making processes can help mitigate resistance to change. Effective communication and providing ample support in terms of resources and technical assistance are also important for the successful adoption of robotic technologies in rehabilitation settings. By addressing these aspects, healthcare organizations can maximize the potential benefits of robotic technologies in rehabilitation. This effort sets the stage for these technologies to become a standard part of rehabilitation services, ultimately aiming to improve the quality and accessibility of patient care.

Conclusion

Integrating robotic technologies into rehabilitation settings marks a significant shift in healthcare, aiming to notably improve patient care. This transition requires a multifaceted strategy, emphasizing the importance of organizational readiness, commitment to innovation, and the creation of a supportive and inclusive environment. By adopting this approach, healthcare organizations are well-equipped to effectively manage the adoption of these advanced technologies. This initiative is expected to normalize the use of robotic technologies in rehabilitation services, thereby enhancing the quality of care and making it more accessible to patients. This move towards integrating advanced rehabilitation technologies aligns with Malaysia's broader goals for healthcare transformation and positions the country as a leader in adopting innovative, technology-driven rehabilitation practices in the era of the Fourth Industrial Revolution. This significant shift towards advanced rehabilitation methods is poised to address the challenges of improving patient outcomes and making efficient use of healthcare resources.

To fully achieve its transformation objectives and become a leader in this technological advance, Malaysia needs to focus on several key areas. Future research should focus on assessing the long-term effectiveness of robotic-assisted rehabilitation, finding cost-effective ways to make these technologies more accessible, and developing training programs to prepare the workforce. Additionally, policy efforts should aim to create supportive regulatory frameworks, encourage technological innovation, and promote partnerships between the public and private sectors to ensure the smooth integration of these technologies into the healthcare system. By concentrating on these essential areas, Malaysia can leverage the full potential of robotic technologies in rehabilitation, representing a significant advancement in

its commitment to providing high-quality, accessible healthcare services. This progress not only benefits the nation's healthcare system but also sets Malaysia as an example of innovative healthcare solutions on the global stage.

References

Ananda, H.-W., Ham, H., & Seelen. (2012). Embracing change: Practical and theoretical considerations for successful implementation of technology assisting upper limb training in stroke. *Journal of NeuroEngineering and Rehabilitation, 9*(1), 52. https://doi.org/10.1186/1743-0003-9-52

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*, 179–211. https://doi.org/10.1016/0749-5978(91)90020-T

Anette, G., Matérne, M., Lundqvist, L.-O., & Duberg, A. (2021). Navigating change - managers' experience of implementation processes in disability health care: A qualitative study. *BMC Health Services Research, 21*(1), 1–11. https://doi.org/10.1186/s12913-021-06570-6

Aprile, I., Pecchioli, C., Loreti, S., Cruciani, A., Padua, L., & Germanotta, M. (2019). Improving the efficiency of robot-mediated rehabilitation by using a new organizational model: An observational feasibility study in an Italian rehabilitation center. *Applied Sciences, 9*(24), 5357. https://doi.org/10.3390/app9245357

Beatrice, L., Braghin, F., Pedrocchi, A., & Gandolla, M. (2023). Technology acceptance model for exoskeletons for rehabilitation of the upper limbs from therapists' perspectives. *Sensors, 23*(3), 1721. https://doi.org/10.3390/s23031721

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319–340. https://doi.org/10.2307/249008

McAnaney, D., & Williams, B. (2010). Internalising disability management: Using action research to explore organisational change processes. *Journal of Disability Management and Rehabilitation, 5*(2), 32–39. https://doi.org/10.1375/JDMR.5.2.32

Lee, G. (2022). Special issue on robotic-based technologies for rehabilitation and assistance. *Applied Sciences, 12*(16), 8022. https://doi.org/10.3390/app12168022

Ministry of Health, Malaysia. (2023). *Health white paper for Malaysia: Strengthening people's health, future-proofing the nation's health system.*

Manjunatha, H., Pareek, S., Jujjavarapu, S. S., Ghobadi, M., Kesavadas, T., & Esfahani, E. T. (2021). Upper limb home-based robotic rehabilitation during COVID-19 outbreak. *Frontiers in Robotics and AI, 8*, 612834. https://doi.org/10.3389/frobt.2021.612834

Laut, J., Porfiri, M., & Raghavan, P. (2016). The present and future of robotic technology in rehabilitation. *Current Physical Medicine and Rehabilitation Reports, 4*(4), 312–319. https://doi.org/10.1007/s40141-016-0139-0

Johnson, C., Nguyen, M., Roth, G., Nichols, E., Alam, T., Abate, D., Abd-Allah, F., Abdelalim, A., Abraha, H., Abu-Rmeileh, N., Adebayo, O., Adeoye, A., Agarwal, G., Agrawal, S., Aichour, A., Aichour, I., Alahdab, F., Ali, R., & Murray, C. (2019). Global, regional, and national burden of stroke, 1990–2016: A systematic analysis for the Global Burden of Disease Study 2016. *The Lancet Neurology, 18*, 439–458. https://doi.org/10.1016/S1474-4422(19)30034-1

Pollack, J., & Pollack, R. (2015). Using Kotter's eight stage process to manage an organisational change program: Presentation and practice. *Systemic Practice and Action Research, 28*(1), 51–66. https://doi.org/10.1007/s11213-014-9317-0

Baloh, J., Zhu, X., & Ward, M. M. (2018). Implementing team huddles in small rural hospitals: How does the Kotter model of change apply? *Journal of Nursing Management, 26*(5), 571–578. https://doi.org/10.1111/jonm.12584

Chua, K. S. G., & Kuah, C. W. K. (2017). Innovating with rehabilitation technology in the real world: Promises, potentials, and perspectives. *American Journal of Physical Medicine & Rehabilitation, 96*(10), 1–6. https://doi.org/10.1097/PHM.0000000000000799

Klein, K. J., & Knight, A. P. (2005). Innovation implementation: Overcoming the challenge. *Current Directions in Psychological Science, 14*(5), 243–246. https://doi.org/10.1111/j.0963-7214.2005.00373.x

Lo, A. C., Guarino, P. D., Richards, L. G., Haselkorn, J. K., Wittenberg, G. F., Federman, D. G., Ringer, R. J., Wagner, T. H., Krebs, H. I., Volpe, B. T., Bever, C. T., Jr., Bravata, D. M., Duncan, P. W., Corn, B. H., Maffucci, A. D., Nadeau, S. E., Conroy, S. S., Powell, J. M., Huang, G. D., & Peduzzi, P. (2010). Robot-assisted therapy for long-term upper-limb impairment after stroke. *The New England Journal of Medicine, 362*(19), 1772–1783. https://doi.org/10.1056/NEJMoa0911341

Klaic, M., Fong, J., Crocher, V., Davies, K., Brock, K., Sutton, E., Oetomo, D., Tan, Y., & Galea, M. P. (2022). Application of the extended technology acceptance model to explore clinician likelihood to use robotics in rehabilitation. *Disability and Rehabilitation: Assistive Technology*, 1–8. https://doi.org/10.1080/17483107.2022.2060356

Economic Planning Unit, Prime Minister's Department. (2021). *National Fourth Industrial Revolution Policy.* Putrajaya, Malaysia: Author. ISBN 978-967-5842-29-0

Pollock, A., Farmer, S. E., Brady, M. C., Langhorne, P., Mead, G. E., Mehrholz, J., & van Wijck, F. (2014). Interventions for improving upper limb function after stroke. *The Cochrane Database of Systematic Reviews, 2014*(11), CD010820. https://doi.org/10.1002/14651858.CD010820.pub2

Izrinda, T., Bahari, M., Ismail, W., & Hanafi, M. H. (2018). Exploring barriers that affect telerehabilitation readiness: A case study of rehabilitation centre in Malaysia. In *International Conference on Human-Computer Interaction* (pp. 761–771). Springer. https://doi.org/10.1007/978-3-319-99007-1_70

Weiner, B. (2009). A theory of organizational readiness to change. *Implementation Science, 4*, 67. https://doi.org/10.1186/1748-5908-4-67