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Revolutionizing home care with SIRAMAH: A smart system for supporting family members with mobility impairments

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Abstract

Many families independently care for patients with physical mobility disorders at home. One effective intervention to enhance family caregivers' knowledge and skills is the implementation of a telenursing application. This study aims to evaluate the effectiveness of the SIRAMAH telenursing application in improving the knowledge and skills of families caring for individuals with physical mobility impairments. The research was conducted in two stages. The first stage involved designing the telenursing system using a prototype method. In the second stage, the system was tested using a Pre-Experimental One Group Pretest-Posttest design. A simple random sampling technique was employed, with 30 family caregivers participating. The application was assessed through Black-Box testing, with content validity evaluated by experts. The Aiken index value (V) was 0.76, indicating high validity, while the application received a 78% validity rating from experts and a 90% rating from general respondents. Results showed a significant improvement in both knowledge and skills following the intervention. The average knowledge score increased from 58.00 before the intervention to 78.67 afterward. Similarly, the average skill score rose from 64.93 to 92.10. Statistical analysis revealed that the SIRAMAH telenursing application significantly enhanced the knowledge and skills of family caregivers ($p < 0.001$). The SIRAMAH telenursing application has proven to be a feasible and effective tool for improving the care provided by families to individuals with physical mobility impairments at home. The application meets the required feasibility standards and successfully boosts caregivers' knowledge and skills.

Keywords: Caregivers; mobility disorders; telenursing; skills of family; home care

Introduction

The hospital paradigm as the primary center for healing and patient care is increasingly shifting towards home care (Gaillard & Russinoff, 2023). Rising hospital treatment costs, declining purchasing power, and BPJS insurance packages tied to length of stay have encouraged patients to opt for earlier discharge (Kanagala et al., 2023). Many financially disadvantaged families choose to bring patients home for continued care. Home care is a comprehensive health service provided to individuals and/or families in their homes, enabling clients to maintain health, prevent disease and relapse, and engage in rehabilitation independently (Leff et al., 2006). Effective treatment in the hospital can be compromised if not continued at home, potentially resulting in relapse and readmission (Romagnoli, Handler, & Hochheiser, 2013). Engaging family members in care from the onset of hospital treatment can strengthen their capability to care for patients at home, thus preventing recurrence (Sya'diyah, Nursalam, Mahmudah, & Efendi, 2022). A family's role in recognizing health issues includes making informed health decisions, caring for ill family members, adapting the environment, and utilizing available health services (Teixeira, Abreu, Costa, & Maddocks, 2020). Discharge planning is essential in preparing patients for home care, with nurses providing education on care routines (Urbietè, Lesauskaitė, & Macijauskienė, 2020). However, families often forget this information once home. In some cases, family members receiving the education may not be the primary caregivers at home, leading to gaps in care knowledge. To foster independence in patients and their families, post-discharge monitoring is crucial, especially when care shifts to the home (Gonçalves-Bradley, Lannin, Clemson, Cameron, & Shepperd, 2022).

Patients needing further home care often have physical mobility impairments and rely heavily on family support (Yasmeen, Krewulak, Grant, Stelfox, & Fiest, 2020). According to Riskesdas data from the Indonesian Ministry of Health (2019), stroke prevalence in individuals over 15 years old is 10.9%, with head injury prevalence at 11.9%. Injuries to the

head are the third most common, following injuries to lower and upper limbs, with prevalence rates of 67.9% and 32.7%, respectively. At Emanuel Banjarnegara Hospital, between January and November 2022, 807 patients presented with these conditions, including 56.5% with strokes, 35.68% with fractures (extremities, spine), and 7.8% with chronic kidney disease (CKD). Additionally, 1.36% of patients with these conditions left the ICU at their own request. Physical mobility impairments are often caused by factors such as joint stiffness, limited movement, delayed reaction times, instability while walking, poor balance, circulatory issues, and sensory impairments (Ariska, Handayani & Hartati, 2020). These limitations lead to a high dependency on family members for fulfilling daily needs, including bathing, dressing, mobility, and eating. Telemedicine and telenursing have emerged as vital resources, not only due to the pandemic but also for their potential to expand remote care options (Nguyen, King, & Stirling, 2023). Telenursing, in particular, offers mobile-based solutions to assist families caring for members with physical mobility limitations at home (Graven et al., 2021). While efforts to enhance family knowledge and skills for home care are common, specific approaches to address physical mobility challenges via e-telenursing are rare. This research proposes developing a website-based telenursing application for educating families on managing physical mobility impairments at home. Such applications can reduce hospital stays, lower costs, expand the reach of nursing services, and improve the quality of home care.

Telenursing is a rapidly evolving field within telehealth that utilizes telecommunications technology to deliver nursing care and support remotely (Yuan et al., 2024). It encompasses a wide range of services, including health assessments, patient education, monitoring of chronic conditions, and follow-up care (Chiang, Chen, Dai, & Ho, 2012). The fundamental concept of telenursing lies in its ability to bridge geographical barriers, allowing nurses to provide care to patients who may be unable to access traditional healthcare settings due to distance, mobility issues, or other constraints (Gijsbers et al., 2022). Leveraging technologies such as video conferencing, mobile health applications, and remote monitoring devices enhances the accessibility of healthcare services, improves patient outcomes, and promotes continuity of care. This model is particularly valuable in rural or underserved areas where healthcare resources are limited, as it allows for timely interventions and ongoing support (Kruse et al., 2018). Despite its potential benefits, the application of telenursing faces several research gaps that hinder its widespread implementation in various countries. One significant gap is the lack of standardized protocols and guidelines for telenursing practices. Many healthcare systems have not yet developed comprehensive frameworks that outline best practices, ethical considerations, and legal implications associated with remote nursing care. This absence of standardization can lead to inconsistencies in care delivery and may compromise patient safety.

Furthermore, there is a need for more empirical research to evaluate the effectiveness of telenursing interventions across diverse populations and healthcare settings. While some studies have demonstrated positive outcomes, more rigorous, large-scale research is necessary to validate these findings and establish evidence-based guidelines that can be universally applied. Another critical area of concern is the technological divide and the disparities in access to digital health resources. In many countries, particularly in low- and middle-income regions, inadequate infrastructure, limited internet connectivity, and a lack of technological literacy among both healthcare providers and patients pose significant barriers to the effective implementation of telenursing. These challenges not only limit the reach of telenursing services but also exacerbate existing health inequities. Additionally, there is a need for research focusing on patient perceptions and experiences with telenursing, including their comfort levels with technology and their willingness to engage in remote care. Understanding these factors is essential for designing user-friendly telenursing interventions that cater to the needs of diverse patient populations. Addressing these research gaps is crucial for advancing the field of telenursing and ensuring that it can be effectively integrated into healthcare systems worldwide. The telenursing application model in this study builds upon previous models by integrating three key features: video tutorials, theoretical instruction, and live consultations, all within a single platform. In contrast, earlier models typically used simpler setups with limited functionality. This study conducts a thorough analysis of the implementation of telenursing educational applications for families managing physical mobility impairments at home. The objective of this research is to design and develop an effective telenursing application model to support families in caring for members with physical mobility limitations at home. Additionally, it aims to measure changes in family knowledge and caregiving skills for patients with physical mobility disorders before and after the intervention.

Method

The research methodology applied in this study follows a research and development approach comprising two primary stages. The first stage involves designing a telenursing system using a descriptive research design with the prototype method. The second stage evaluates the system using a pre-experimental one group pretest-posttest research design. During the first phase, conducted from June to August 2023, the application was designed using the prototype method,

which includes five key steps: communication, modeling and quick design, prototype construction, deployment delivery, and feedback. Communication: At this initial stage, researchers conducted interviews through Focus Group Discussions (FGD) with several stakeholders, including four ICU patient caregivers, four ICU nurses, and two IT experts at Emanuel Banjarnegara Hospital. Quick Plan: Based on findings from the Communication stage, researchers identified two primary needs: system requirements and basic application development requirements. Modeling and Quick Design: In this step, researchers developed a preliminary design for the application's workflow, detailing the roles (e.g., user and admin modules) and processes to be integrated into the application. Prototype Construction: A prototype was created by implementing design concepts, developing programming scripts, and designing the user interface.

In the second phase, researchers tested the effectiveness of the SIRAMAH telenursing educational application in enhancing family members' knowledge and skills for caring for relatives with physical mobility impairments at home. Data collection occurred from September 12 to November 6, 2023, using a one group pretest-posttest design—a pre-experimental approach with only one group selected via accidental sampling. This design was chosen due to the limited sample size, constrained research timeline, and the developmental nature of the SIRAMAH application as a research tool. The research aimed to evaluate changes in family caregivers' knowledge and skills before and after intervention. The sample included 30 family members who cared for patients discharged from Emanuel Hospital with impaired physical mobility. Patients included 12 post-hospitalization cases with conditions such as stroke, spinal injury, head trauma, lower extremity fractures, and brain tumors. The study process began with administering a pre-test to participants. Then, intervention was conducted, allowing respondents to learn through the SIRAMAH application, with monitoring by researchers every two days for up to two weeks. A post-test followed after the two-week treatment period, comparing pre-test and post-test results to accurately determine the intervention's impact. Bivariate analysis was conducted to assess the relationship between the two variables using the Shapiro-Wilk test, given the sample size of fewer than 100. Results showed p-values of 0.000 for pre-test knowledge, 0.001 for post-test knowledge, 0.036 for pre-test skills, and 0.000 for post-test skills, indicating $p < 0.05$. These results suggest a non-normal data distribution, prompting the use of the non-parametric Wilcoxon test. Statistical significance was defined by p-values less than 0.05. Ethical approval for this study was granted by the Research Ethics Commission of the Faculty of Health Sciences, Universitas Jenderal Soedirman under protocol number 1233/EC/KEPK/IX/2023 (September 11, 2023).

Results

Stage 1

The design of the SIRAMAH telenursing educational application offers a comprehensive approach to supporting families in caring for patients with physical mobility impairments at home (**Figure 1**). The SIRAMAH application includes three main features: video tutorials, theoretical tutorials, and an interactive consultation service (**Figure 2**). These features aim to equip caregivers with the knowledge and skills needed for effective home care, helping to prevent complications, reduce hospital readmissions, and enhance patient outcomes. Video Tutorials: This feature provides step-by-step visual guidance on essential caregiving tasks. Each video is designed to be user-friendly, covering various aspects of home care for patients with limited mobility. The tutorials address daily care activities like bathing, feeding, positioning, and mobility exercises. Observing demonstrated techniques can confidently apply best practices in real-life situations, reducing the likelihood of caregiver errors and patient injury. Theoretical Tutorials: In addition to the practical video guides, the theoretical tutorials offer detailed information on the principles and rationale behind each caregiving task. These text-based modules provide context for the skills demonstrated in the videos, covering essential knowledge areas such as the causes and complications of physical mobility impairments, proper body mechanics, safe patient handling, and preventive strategies for common health issues that may arise during at-home care. This dual learning approach, combining both visual and theoretical guidance, helps caregivers build a solid understanding of the "why" and "how" behind each caregiving activity. Consultation Feature: To support caregivers further, the consultation feature allows users to interact directly with healthcare professionals for personalized guidance and troubleshooting. Caregivers can ask questions, seek clarification on techniques, or receive advice on unique challenges they may encounter in their caregiving role. This interactive feature is invaluable for users who may feel uncertain or need extra support to handle specific situations effectively.

The SIRAMAH application is designed for flexibility and accessibility, allowing it to be used on various devices, including smartphones and computers, as long as they are connected to the internet. This flexibility makes it possible for caregivers to access the resources they need in real time, whether they are at home, on the go, or even in a healthcare facility preparing to bring a patient home. Before being deployed for research and general use, the SIRAMAH application undergoes a rigorous testing process. This testing phase ensures that the application is user-friendly, reliable, and

functional across different devices and internet environments. During the testing phase, usability testing is conducted with a diverse group of users, including both healthcare providers and family caregivers, to gather feedback on the ease of navigation, clarity of instructional content, and effectiveness of the consultation feature. Any issues or bugs identified during testing are promptly addressed to optimize user experience. In addition to functionality testing, content validation is conducted to confirm that all educational materials adhere to evidence-based healthcare standards and are accurate, relevant, and understandable to non-professional caregivers. Refining the application based on testing feedback ensures that SIRAMAH meets the practical needs of its users and aligns with the highest standards in home care education. Once testing is complete, SIRAMAH is ready for both research and widespread use. For research, the application serves as an intervention tool to assess its impact on caregiver knowledge and skill levels. Measuring pre- and post-intervention knowledge and skills among caregivers can evaluate the effectiveness of the application and identify areas for further improvement (Table 1).

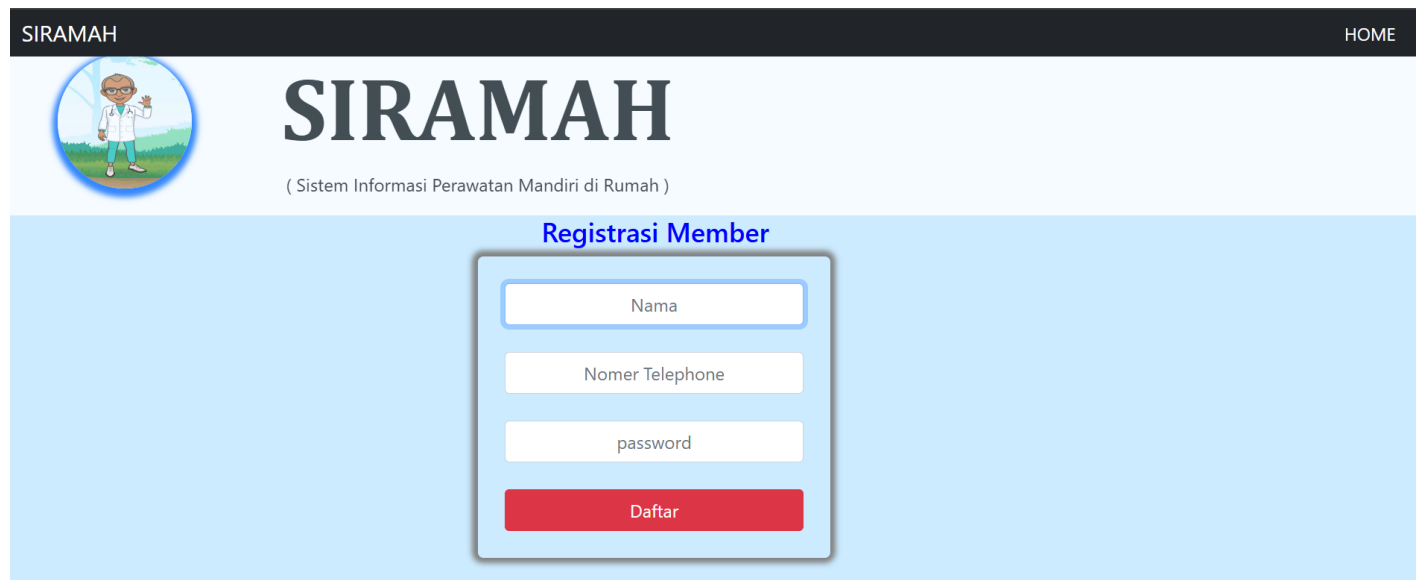


Figure 1. SIRAMAH.

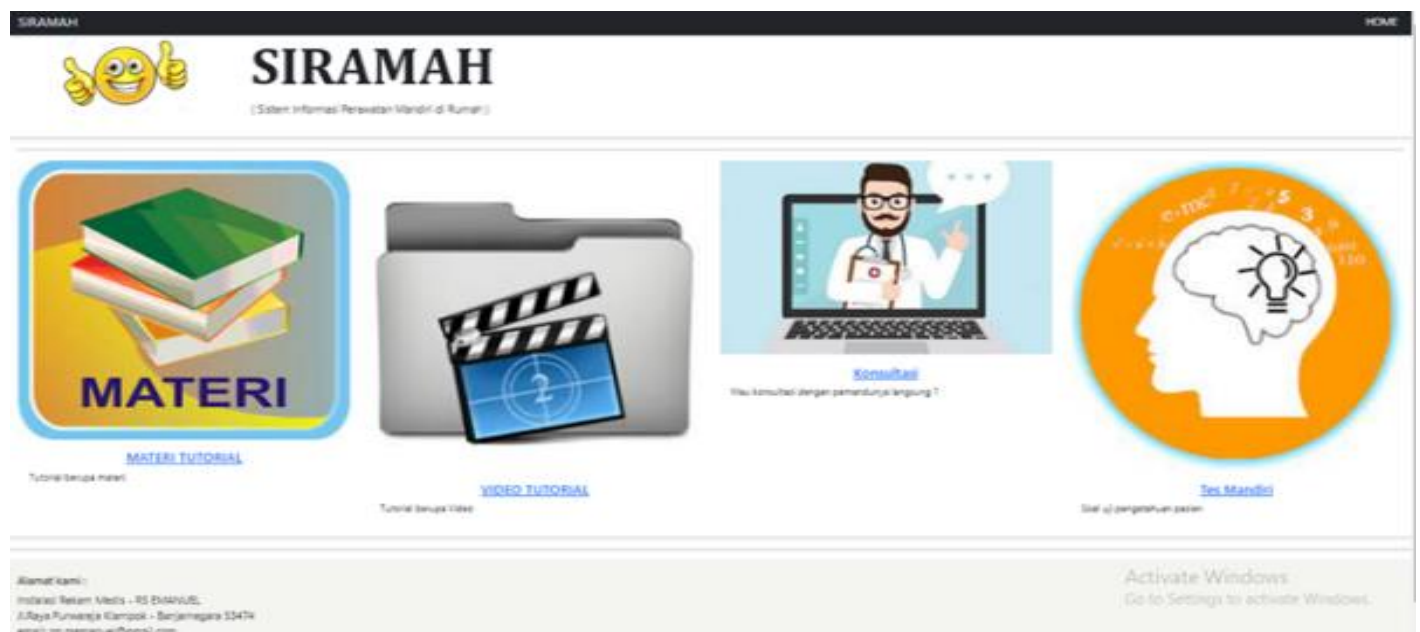


Figure 2. Features of SIRAMAH.

Table 1. Testing results.

Table	Test type	Result	Feasibility Index
1	Black-Box testing	Works fine	Valid
2	Expert testing		
	a. Test content validity	Aiken Index V = 0.76	Valid
	b. Test the validity of the application	Percentage value P = 78%	Very good
3	General respondent testing	Percentage value P = 90%	Very good

Stage 2

The analysis of respondent characteristics describes the frequency distribution based on gender, age, and education (**Table 2**). As indicated in table, this study involved 30 family members of patients as respondents, with 83.3% being female and 16.7% male. This suggests that female family members play a more significant role in caring for patients at home. The frequency distribution based on age reveals that among the 30 respondents, there were two primary age groupings: the most represented group was elderly individuals aged 45-59 years, comprising 56.7% of the respondents, followed by adults aged 19-44 years, who made up 43.3%. In terms of educational characteristics, the majority of respondents had completed elementary school (36.7%), followed by high school (30%), junior high school (23.3%), and those holding a bachelor's degree (10%). The study also examined the differences in respondents' knowledge and skill scores before and after the intervention. The results are summarized in table, which indicates a notable difference in the average knowledge scores of respondents: the pre-test score was 58.00, while the post-test score increased to 78.67, resulting in an improvement of 20.67 points (**Table 3**). Additionally, the family skill level pre-test score was 64.93, which increased to 92.10 in the post-test, reflecting an improvement of 27.17 points. Statistical analysis using the non-parametric Wilcoxon test demonstrated significant results, with a p-value of 0.000 ($p < 0.005$) for both knowledge and skill levels. This indicates a positive influence of telenursing education on the knowledge and skill levels of families caring for members with physical mobility impairments at home. The findings of this research highlight the effectiveness of the SIRAMAH telenursing application in enhancing the capabilities of family caregivers. The significant improvements in both knowledge and skills underscore the importance of tailored educational interventions in supporting families who provide care for individuals with mobility disorders. This research contributes valuable insights into the role of telenursing in promoting better care practices and outcomes for patients within the home environment.

Discussion

The preparation of the SIRAMAH telenursing application followed a development process using the prototype method. This application underwent thorough testing, including Black-Box testing, which confirmed that the application functions well and is valid. Experts evaluated the content validity, resulting in an Aiken index value (V) of 0.76, indicating high validity. The percentage value for application validity testing was 78% (very good), and the overall application test percentage value from general respondents was 90% (very good). The researchers highlighted that the SIRAMAH telenursing application met the feasibility test requirements and could be utilized as both a research instrument and for general use. Although previous studies have examined the effectiveness of telenursing, most did not involve the development of an application. For instance, studies used telephones and a website to transmit data (McDermott et al., 2018), while a study employed an Instagram application on smartphones (Liang, Hann Lin, Yu Chang, Mei Wu, & Yu, 2021). Other researchers primarily used telephones for remote interventions and evaluations (Rezaei, Jalali, Heydarikhayat, & Salari, 2020). Notably, none of these studies utilized research and development methods. In this present study, researchers identified significant differences in family knowledge and skills in caring for patients with physical mobility disorders before and after the intervention.

The knowledge level test results indicated an increase in scores by 20.67, while the skill level test showed an improvement of 27.17. The average knowledge score before the intervention was 58.00, which increased to 78.67 after the intervention. Similarly, the average skill level score rose from 64.93 before the intervention to 92.10 afterward. Statistical tests yielded a p-value of 0.000 ($p < 0.005$), indicating a positive influence of the SIRAMAH telenursing application on enhancing family knowledge and skills in caring for family members with physical mobility issues at home. These findings align with research on the effect of health education on Range of Motion (ROM) exercises, which demonstrated significant improvements in family skills for stroke patients in the neurology ward of RSUP Dr. M. Djamil

Padang in 2013 (Agonwardi & Budi, 2016). In that study, the average skill score increased from 16.27 before training to 77.67 afterward, with a p-value of 0.001, confirming the impact of health education on family skills.

Table 2. Participants' characteristics.

Variables	n	%
Gender		
Male	5	16.7
Female	25	83.3
Age		
Adults 19-44 years	13	43.3
Elderly 45-59 years	17	56.7
Education		
Elementary School	11	36.7
Junior High School	7	23.3
Senior High School	9	30
Bachelor's Degree	3	10

Table 3. Knowledge and skills analysis.

Variables	Mean	Median	Min	Max	SD	p	n
Knowledge level (X1)							
Pre-test	58.00	60.00	30	80	+11.32	<0.001	30
Post-test	78.67	80.00	50	100	+12.27		
Skill level (X2)							
Pre-test	64.93	64.50	33	86	+12.07	<0.001	30
Post-test	92.10	93.00	71	100	+8.01		

The finding highlights a change in the knowledge and skills of families caring for patients with physical mobility disorders due to education provided through the SIRAMAH telenursing application. The inclusion of video tutorials and educational materials allowed respondents to better understand the presented content. The SIRAMAH telenursing application enables access to educational materials anytime and anywhere, allowing users to review the information as needed. Additionally, the application provides a platform for consultations when respondents experience confusion. The increase in average scores for family knowledge and skills indicates that families have effectively absorbed the information provided by the researchers. The health education facilitated by the researchers led to significant changes in the knowledge and skill levels of families caring for patients with physical mobility disorders. This aligns with studies which posit that behavior formation in adults begins in the cognitive realm, where individuals first gain knowledge about stimuli in the form of material or objects (Creber et al., 2023). This knowledge then leads to new skills and attitudes, ultimately resulting in actionable responses toward the stimulus (Ariyanto & Rosa, 2024). Providing health education through the SIRAMAH telenursing application, families are empowered to effectively train in caring for patients with physical mobility disorders, gaining new information and learning experiences that enhance their caregiving capabilities.

The role of nurses in the implementation and success of the SIRAMAH telenursing application is multifaceted and crucial. Nurses serve as the primary facilitators of health education and support for families caring for patients with physical mobility disorders (Khraisat, Al-Bashaireh, & Alnazly, 2023). Their expertise in clinical practice allows them to tailor educational content within the application to address specific needs and challenges faced by caregivers. Utilizing the SIRAMAH platform can provide real-time consultations, guidance, and feedback, ensuring that families feel supported and empowered in their caregiving roles. Additionally, nurses are instrumental in assessing the effectiveness of the application by collecting data on user experiences and outcomes, which can inform future iterations of the program (Williams & Shang, 2024). This continuous feedback loop not only enhances the quality of care provided but also fosters a collaborative environment where nurses can share best practices and innovative approaches to telenursing. The government plays a pivotal role in the successful integration and promotion of the SIRAMAH telenursing application within the broader healthcare system. Establishing policies that prioritize telehealth and digital health solutions, the government can facilitate funding, resources, and training programs necessary for the effective deployment of the application (Maroju, Choudhari, Shaikh, Borkar, & Mendhe, 2023). Moreover, government agencies can promote awareness of the SIRAMAH

application among healthcare providers and the public, ensuring that families are informed about the availability of such resources. Regulatory frameworks must also be developed to ensure the safety, security, and privacy of patient information shared through the application (Chen et al., 2023). Supporting research initiatives that evaluate the impact of telenursing on patient outcomes can validate the effectiveness of SIRAMAH and advocate for its integration into standard caregiving practices, ultimately enhancing the quality of care for patients with mobility disorders.

Furthermore, collaboration between nurses and government entities is essential for maximizing the potential of the SIRAMAH telenursing application. Joint initiatives can be established to train nurses in the use of digital tools and telehealth practices, ensuring they are well-equipped to leverage the application effectively. Additionally, government support can help facilitate partnerships between healthcare institutions and technology developers, leading to the continuous improvement and adaptation of the SIRAMAH application based on user feedback and emerging healthcare trends. Fostering a culture of innovation and collaboration, both nurses and the government can work together to address the evolving needs of families caring for patients with physical mobility disorders. This partnership not only enhances the accessibility and quality of care provided through the SIRAMAH application but also promotes a holistic approach to health education and patient support, ultimately leading to better health outcomes for the community at large.

Conclusion

The SIRAMAH telenursing application represents a transformative approach to home care for family members with mobility impairments, effectively bridging the gap between healthcare professionals and caregivers through innovative technology. Providing accessible educational resources, real-time support, and tailored interventions empowers families to enhance their caregiving skills and improve the quality of life for their loved ones. For future studies, it is recommended to explore the long-term impacts of the SIRAMAH application on patient outcomes and caregiver well-being, as well as to investigate the integration of advanced features such as artificial intelligence for personalized care recommendations. Additionally, research should focus on expanding the application's reach to diverse populations and settings, ensuring that it meets the unique needs of various communities and contributes to equitable healthcare access.

Author's declaration

All authors contributed significantly to the conception and design of the study, ensuring a comprehensive approach to the research objectives.

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Availability of data and materials

All data are available from the authors.

Competing interests

The authors declare no competing interest.

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Authors' insight

Key points

- Many families independently care for patients with physical mobility disorders at home
- The SIRAMAH represents a transformative approach to home care for family members with mobility impairments
- It is recommended to explore the long-term impacts of the SIRAMAH application on patient outcomes and caregiver well-being

Emerging nursing avenues

- How does the SIRAMAH enhance the skills and knowledge of family caregivers?
- What specific features of the SIRAMAH contribute to improving communication?
- In what ways can future research expand the functionality of the SIRAMAH system to better address the diverse needs?

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