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Research Article

Usability Evaluation of an Artificial Intelligence-Based Full-cycle Rehabilitation Management Mini-program for Orthopedic Patients with Specialized Conditions

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Abstract

Objective: To evaluate the usability of the application by assessing orthopedic patients user behaviours and experiences with the Full-cycle Rehabilitation Management Mini-program. **Methods:** Developed an Artificial Intelligence-based comprehensive rehabilitation management model for orthopedic patients with specialized conditions; Using the convenience sampling method, 20 orthopedic patients hospitalized at a Tertiary Grade A Hospital in Guangzhou City from May to June 2023 were selected as study subjects. Participants continuously used the mini-program for 1 week. Patient usage behaviours and compliance were statistically analysed through backend management, while user experience feedback was collected via face-to-face, WeChat, or telephone-based qualitative interviews. **Results:** The 20 orthopedic patients completed 1318 viewings of rehabilitation training videos through the mini-program, achieving a rehabilitation check-in completion rate of 86.3% with a satisfaction rate of 100%. Orthopedic patients reported favourable user experiences with the mini-program, indicating good usability and willingness to continue usage. While obtaining beneficial experiences, they also provided suggestions for mini-program improvements. **Conclusion:** The AI-based full-cycle rehabilitation management mini-program for orthopedic specialty conditions demonstrates favourable application outcomes. It can provide informational support to orthopedic patients and promote their active self-management of rehabilitation training.

Keywords: Orthopedics; Artificial Intelligence; Comprehensive Rehabilitation Management; Application; Rehabilitation Training

Introduction

2020 National Health Commission Notice on Further Advancing the Pilot Work of Internet+Nursing Services [1]. It is emphasized that nursing service provision should be increased for patients with mobility impairments, actively promoting Internet Plus Nursing Services to deliver personalized and differentiated care. Due to prolonged rehabilitation cycles, shorter average hospital stays under rapid rehabilitation protocols, and insufficient community rehabilitation resources, most orthopedic patients opt for home-based rehabilitation training [2,3]. However, owing to weak rehabilitation awareness, insufficient knowledge reserves, and poor self-care abilities, only 28.75% of postoperative fracture patients mastered functional exercise routines and performed daily rehabilitation training three months after discharge [4,5]. Some patients struggle to maintain follow-up visits due to economic constraints or transportation difficulties, resulting in compromised postoperative rehabilitation outcomes and quality of life. This increases risks of complications such as surgical site infections and deep vein thrombosis [6].Survey data indicates that orthopedic patients exhibit substantial home care needs-multifaceted in content and diverse in form [7]. Compared with telephone follow-ups, outpatient reviews, or home visits, 47.2% of patients prefer remote consultations and virtual visits via online platforms. Chen Wei first proposed the concept of mobile health (mHealth) [8]. As an innovative medical model, mHealth is gaining widespread recognition and application within the global healthcare industry. Leveraging the convenience, accessibility, efficiency, and low cost of mobile health (mHealth), its integration into health management for orthopedic patients offers unparalleled advantages [9-11]. With the widespread adoption of smartphones, applications installed on these devices have become vital technological tools in mobile health development due to their convenience, real-time capabilities, accessibility, and interactivity. These applications are increasingly being utilized in medical care and chronic disease management [12,13]. Therefore, our research team focused on addressing the needs of orthopedic patients throughout their disease diagnosis and treatment journey. By incorporating mobile health principles, we have completed the development of a Full-cycle Rehabilitation Management Mini-program for orthopedic patients with specialized conditions (abbreviated as Zhi Gu Kang, Software Copyright Registration No. 11405051). This study aims to conduct a usability evaluation of the Full-cycle Rehabilitation Management Mini-program through mixed research methods, exploring its clinical applicability, patient-perceived benefits, and areas for improvement, thereby providing references for broader implementation of this application.

Subjects and Methods

Study Participants

From May to June 2023, 20 orthopedic inpatients at a Tertiary Grade A Hospital in Guangzhou City were selected as study participants using convenience sampling. **Inclusion criteria:** Diagnosed with osteoporotic fractures, spinal tumors, hip disorders in patients aged >80, brachial plexus injuries, tumor-type hip replacements, or tumor-type knee replacements; age ≥14 years; no cognitive impairment; awareness of medical condition; ability to independently read/write and proficiently operate smartphones; voluntary participation. **Exclusion criteria:** Critically ill patients; those with impaired consciousness or psychiatric disorders; unwillingness to participate. This study has been approved by the Ethics Committee (Approval No. Lun Shen [2022] 673).

Methods

Construction of Full-cycle Rehabilitation Management Model for Orthopedic Patients with Specialized Conditions

Design of an AI-based Mini-program for Full-cycle Rehabilitation Management in Orthopedic Patients with Specialized Conditions

This application, developed by our research team to address rehabilitation needs during different treatment stages for orthopedic patients, is compatible with both Android and iOS smartphones. The mini-program primarily includes modules such as Personal Information, Rehabilitation Reports, Rehabilitation Check-in, Follow-up Surveys, Knowledge Base, Self-assessment Tasks, and Interactive Zone. Module functionalities: **(1)** Personal Information. **(1)** Basic information of orthopedic patients, including hospitalization ID, height, weight, ethnicity, marital status, education level, current comorbidities, family history, smoking and drinking status, average nightly sleep duration, and exercise habits. **(2)** Rehabilitation reports. Allows real-time viewing of nurses assessment reports on mobile devices. **(3)** Rehabilitation check-ins. **(3)** Nurses send personalized rehabilitation exercise videos via computer terminals, setting exercise frequency and intensity. Patients watch these videos through the mini-program, complete corresponding exercises, and promptly check in upon completion. **(4)** Follow-up surveys. Automatically sends satisfaction surveys upon patient discharge. **(5)** Knowledge Base. Includes health education on orthopedic disease knowledge, dietary care, assistive device usage, functional exercise methods, and complication prevention**. (6)** Self-assessment tasks. According to different rehabilitation phases, patients regularly receive symptom self-assessments and specialized self-assessment tasks sent by nurses. After completing these assessments, patients submit their responses, and the results are uploaded to the backend

management system. Researchers can access relevant data through the server terminals backend webpage, enabling them to provide corresponding guidance to patients. **(7)** Interactive Zone. Both nurses and patients can engage in mutual messaging within the Interactive Zone. Nurses can address patient queries and concerns while monitoring rehabilitation progress.

Application of the Artificial Intelligence-based Full-cycle Rehabilitation Management Mini-program for Orthopedic Patients with Specialized Conditions

Orthopedic Advanced Practice Nurse [14] The Advanced Practice Nurse (APN) introduced the research purpose and application usage methods to participants, obtained signed informed consent forms, enabled the mini-program on each participants mobile device, and initiated a 1-week usage experience period for the mini-program. The APN provided relevant precautions to ensure patients and their families fully mastered the operation of the mini-program. During the usage period, participants could directly provide feedback to either the APN or the responsible nurse regarding any issues, with the APN offering timely solutions and guidance.

APN nurses managed research subjects according to the background management protocol of the application. Specific responsibilities included: ensuring normal operation of the mini-program, performing background monitoring and data entry, promptly resolving application-related issues, and seeking assistance from technical personnel when unable to resolve problems independently. Weekly summarization, analysis, and organization of background data; timely response to and processing of user messages with subsequent publication on the platform.

Usability Evaluation of the AI-based Mini-program for Comprehensive Rehabilitation Management in Orthopedic Patients with Specialized Conditions.

Usage Behaviour Evaluation

APN nurses documented technical faults encountered during subjects use of the mini-program, while the backend database recorded usage behaviours of research subjects. Usage behaviours encompass: user viewing time of rehabilitation videos in the mini-program, check-in completion rate post-viewing, frequency of messages and replies in the Interactive Zone, and number of content entries browsed - all recorded via backend data.

Evaluation of User Experience

Face-to-face qualitative interviews were conducted to assess participants usage experience. **(1)** Interview protocol included: How do you perceive the mini-program? Does it enable rapid task completion? Are error messages clearly instructive for troubleshooting? Can mistakes be corrected easily? Is information presentation sufficiently clear? Is the information layout logically organized? Is the interface user-friendly? Does it include all expected functionalities? Are text, colours, and graphics legible and comprehensible? Will you recall the operational procedures clearly next week? Are you satisfied with this mini-program? **(2)** Data analysis methodology: All interview materials were consolidated and analysed within 24 hours. Transcripts were thoroughly reviewed to extract significant statements. Recurring issues were coded systematically, with coded topics subsequently aggregated. **(3)** Sample size was determined by information saturation, meaning data repetition occurred during interviews with no new themes emerging.

Statistical Analysis

Data analysis was performed using SPSS 26.0 statistical software. Continuous data are presented as mean ± standard deviation ($\bar{x}\pm s$), categorical data as frequencies, and descriptive analysis was applied.

Results

General Characteristics of the Study Participants

The study included 20 orthopedic patients, aged 16-81 years with a mean age of 49.75 ± 20.6 years. There were 9 male and 11 female participants. The general characteristics of the participants are presented in Table 1.

ID	Age (years)	Gender	Education Level	Occupation	Underlying Diseases
P1	45	Female	Primary school or below	Other	Malignancy
P2	41	Male	Junior high school	Freelancer	Malignancy
P3	77	Female	College degree or above	Other	None
P4	33	Male	Junior high school	Freelancer	None
P5	32	Male	Junior high school	Unemployed	Malignancy
P6	66	Male	College degree or above	Other	Hypertension, Diabetes
P7	81	Female	Primary school or below	Other	Cardiovascular Disease
P8	60	Female	Junior high school	Freelancer	Hypertension, Diabetes
P9	65	Female	High school or secondary specialized school	Other	Hypertension
P10	28	Female	Junior high school	Employee	None
P11	32	Male	Junior high school	Other	None
P12	53	Male	Primary school or below	Farmer	Malignancy
P13	57	Female	Junior high school	Other	Hypertension
P14	26	Male	College degree or above	Freelancer	None
P15	78	Female	Primary school or below	Other	Hypertension
P16	48	Male	Primary school or below	Freelancer	None
P17	68	Female	College degree or above	Other	Hypertension
P18	16	Female	Junior high school	Student	Malignancy
P19	19	Male	College degree or above	Student	Malignancy
P20	70	Female	Primary school or below	Other	Hypertension, Diabetes

Table 1: Basic Information of Orthopedic Patients.

Results of Usage Behaviour

One week of backend data monitoring for 20 users showed: The application accumulated a total online browsing duration of 6,590 minutes, with an average daily browsing time of 47.1 minutes per user. The check-in completion rate after browsing was 86.3%. The Interactive Zone recorded 56 messages and replies. The most frequently viewed rehabilitation videos were "Pursed-Lip Breathing," "Ankle Plantarflexion and Dorsiflexion Exercises," "Quadriceps Isometric Contraction," "Chest Expansion Exercises," "Finger Mobility Exercises," and "Ankle Rotation Exercises."

Evaluation of User Perception

Program Functionality and Beneficial User Experiences

Targeted Rehabilitation Training with High Credibility Orthopedic patients consistently reported that the knowledge base provides disease-specific guidance with high credibility; Rehabilitation exercise videos are highly targeted, enabling personalized recommendations based on patient conditions with strong instructional value. P1: The knowledge base contains extensive content covering precisely the information I sought, proving significantly more reliable than Baidu searches. P11: The rehabilitation videos are exceptionally helpful, enabling me to easily grasp exercise techniques. The tailored video recommendations based on my recovery progress demonstrate remarkable professionalism.

Smooth and convenient operation with concise and practical interface Orthopedic patients reported the mini-program operates smoothly, presenting information comprehensively through videos, text, and images with high usability. Its interface is clean, simple, and warm. P7: The content on your mini-program uses pictures, text, and videos. Even an elderly person like myself understood it immediately and found it very easy to learn. P20: The text and graphics on your platform are very clear, and the videos made me understand the exercises right away.

Comprehensive periodic assessments facilitate timely problem identification and rehabilitation plan adjustment Orthopedic patients reported that after watching rehabilitation videos, the mini-program provides symptom assessments. Periodic evaluations during rehabilitation enable timely identification of exercise issues and adjustment of exercise regimens, demonstrating

strong operability. P6: After each exercise session, I record my feedback on the platform. When exercises feel challenging, your team promptly adjusts my regimen – this personalized approach has been crucial for my adherence. P14: The post-exercise evaluation form is exceptionally useful. It allows me to precisely communicate difficulties encountered during rehabilitation, and your team provides timely solutions.

Real-time Interaction in Communication Forum Orthopedic patients reported that the Communication Forum enables prompt responses from nurses regarding queries, offering convenient and efficient support. P13: I consistently leave inquiries in the Communication Forum, and your team always responds swiftly to resolve issues. Your dedicated approach is highly commendable.

Deficiencies and Improvement Suggestions

The check-in time for rehabilitation videos is rigidly fixed, making it easy to miss sessions. We recommend extending the check-in window and adding a make-up check-in feature. With too many check-in entries, implementing a one-click check-in function is advised. P1: The check-in time is too strict-can it be extended? P3: Too many clicks required for check-in-can we do it in one tap? P7: Excessive check-ins pose difficulties. P10: Easy to miss check-in times-can we have make-up options? P15: Check-in process is somewhat tedious, though the videos are excellent. P17: Too many check-in buttons. P20: Check-in times are easily overlooked.

Discussion

Overall Evaluation of Mini-Program Usability

During the one-week usability testing period, participants demonstrated good compliance with no study dropouts. They reported positive experiences regarding the mini-programs visual interface and functional layout. The mini-program features rich content and highly targeted rehabilitation exercises, which increased visit frequency and check-in completion rates, generating substantial positive feedback from patients regarding beneficial experiences. The study indicates that this application demonstrates good usability and can serve as a mobile health tool for comprehensive rehabilitation management in orthopedic patients.

Advantages and Benefits of the Mini-Program

Mobile health applications, as virtual digital products, maintain a certain gap from genuine human emotions and interactions [8]. The educational content in this applications knowledge base is derived from clinical guidelines, expert consensus, and well-established educational manuals. All rehabilitation exercise videos undergo review by supervising professors, ensuring personalized and targeted delivery while preventing inaccurate or irresponsible information dissemination. The mini-program facilitates comprehensive rehabilitation management across hospital and community settings, enhances patients self-efficacy, and improves their quality of life [15].The communication forum helps patients promptly resolve issues, thereby keeping them reassured and at ease. Patients actively browsing disease and health-related information in the knowledge base helps foster a positive mind-set toward rehabilitation management. The questionnaire assessment module enables nurses and patients to identify physiological, psychological, and social problems, difficulties, and needs, serving as an evidence-based foundation for interventions and outcome evaluations. Standardized comprehensive rehabilitation management provides patients with clear understanding of the recovery process, facilitating long-term management.

Limitations and Optimization Strategies of the Mini-program

Considering orthopedic patients feedback and suggestions, the application will undergo further optimization and updates. This includes extending check-in time to ensure uninterrupted service availability. Implement a backend make-up check-in feature where nurses can complete check-ins via computer terminals after bedside assessments confirm patients completion of functional exercises, thereby improving check-in completion rates. Streamline the check-in process with a one-click check-in button to facilitate patients completion of multiple rehabilitation exercise videos. For elderly users, nurses should patiently explain application functionalities and provide user-friendly interfaces. For patients without smartphones, family members phones can be used for mini-program authentication, with guidance provided for family-assisted rehabilitation exercises and knowledge acquisition [16]. Enhance backend maintenance and operation by expanding rehabilitation exercise video content, enabling patients to access more rehabilitation resources to facilitate recovery. It should be emphasized that this mini-program solely provides informational support to orthopedic patients to enhance rehabilitation management and cannot replace formal clinical treatment from medical institutions. Patients should promptly seek medical attention when experiencing emergent changes in condition or when the mini-program fails to address their issues, so as to prevent treatment delays.

Summary

Full-cycle Rehabilitation refers to a holistic intervention model encompassing comprehensive scope and entire-process rehabilitation management for patients with disease-related functional impairments [17].Orthopedic patients typically experience significant psychological stress during the perioperative period, and those with higher stress levels tend to experience relatively prolonged postoperative rehabilitation processes. The

objective of full-cycle rehabilitation is to reduce postoperative complication rates, shorten hospitalization and recovery periods, and enhance healthcare efficiency and patient satisfaction by continually refining perioperative rehabilitation nursing protocols and utilizing diverse medical resources [18].The mini-program facilitates full-cycle rehabilitation management across hospital and community settings for orthopedic patients, with all participants expressing willingness to continue using it for future rehabilitation management [19,20]. Comprehensive analysis of the mini-programs usability test results, along with patients beneficial experiences and identified shortcomings, will help developers implement future improvements and updates to better serve orthopedic patients throughout full-cycle rehabilitation [21].The research team will continue collaborating with software engineers to refine and update the application based on patient feedback, thereby promoting the integration and adoption of mobile health management programs within clinical practice.

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Author Contributions

Study Conception and Design: NL, TWH. Data Collection: XLC, QLL, ZZG, XYY, XJC. Data Analysis and Interpretation: All authors. Drafting of the Article: All authors. Critical Revision of the Article: TWH

Ethical Approval

Ethical issues are not involved in this paper.

Conflicts of Interest

All contributing authors declare no conflicts of interest.

References

1. National Health Commission. Notice on Further Advancing the Pilot Program of Internet+Nursing Services [EB/OL]. 2010-12-30 2022-08-24.
2. Lim JH, He K, Yi Z, Hou C, Zhang C, et al. (2023)Adaptive Learning based Upper-Limb Rehabilitation Training System with Collaborative Robot. Annu Int Conf IEEE Eng Med Biol Soc 2023: 1-5.
3. Guo L, Wang J, Wu Q, Li X, Zhang B, et al. (2023) Clinical Study of a Wearable Remote Rehabilitation Training System for Patients With Stroke: Randomized Controlled Pilot Trial. JMIR Healthy Uhealth 11: e40416.
4. Liu Xiufen, Chen Minyun, Li Peihao (2020) Investigation of Compliance with Postoperative Rehabilitation Training and Influencing Factors in Elderly Patients with Spinal Fractures. Electronic Journal of Modern Medicine and Health Research. 4: 105-107.
5. Zhao Shuhui, Fan Fan, Li Tong (2023) Application of Graded Rehabilitation Training Combined with Music Therapy in Postoperative Patients with Lumbar Disc Herniation. Chinese Journal of Modern Nursing. 29: 3194-3198.
6. Li Yanhua, Lu Xiaoying, Chen Jianfang (2020) Impact of Internet-Based Multidisciplinary Collaborative Continuing Nursing Model on Postoperative Patients with Lower Limb Fractures. Nursing and Rehabilitation. 19: 38-42.
7. Jiang Xinli (2023) Application effect observation of a continued rehabilitation nursing platform based on Internet Plus in elderly patients with chronic diseases. Chinese Community Doctors. 39: 89-91.
8. Chen Wei, Yue Ling, Wu Gaoxian (2022) Application of Mobile Health in military and civilian diabetes chronic disease management. Military Medical Journal of South China. 36: 930-933.
9. Waalen J (2023) Mobile Health and Preventive Medicine. Med Clin North Am 107: 1097-1108.
10. Cauley CE, Brindle M (2024) Introduction: Mobile health mini-series. Surgery. 175: 1252-1253.
11. Istepanian RSH (2022) Mobile Health (m-Health) in Retrospect: The Known Unknowns. Int J Environ Res Public Health 19: 3747.
12. Zhang Yingting, Yuan Changrong (2018) Usability Evaluation of a Smartphone Application for Breast Cancer Health Management. Military Nursing Journal. 35: 16-19.
13. Xiong Jiaming, Yu Hongyu, Su Jin, et al. (2022) Meta-synthesis of Mobile Health Care Experiences Among Elderly Patients with Chronic Diseases. Chinese Journal of Nursing. 57: 1641-1649.
14. Li Y, Wang C, Tan W, Jiang Y (2023) The transition to advanced practice nursing: A systematic review of qualitative studies. Int J Nurs Stud 144: 104525.
15. Kreitmair KV (2023) Mobile health technology and empowerment. Bioethics. 38: 481-490.
16. Golbus JR (2023) Mobile Health Technology: (Smart) Watch and Wait. JACC Case Rep 17: 101898.
17. Liu Qiang, Liu Meixi, Zhang Yumei (2020) Hospital-based Full-cycle Rehabilitation Model for Parkinsons Disease Patients. Geriatrics & Health Care. 26: 340-342.
18. Zhu Yulan, Liang Jingjuan, Lei Wei, et al. (2023) Clinical Efficacy Observation of Full-cycle Rehabilitation in Patients Undergoing Total Knee Arthroplasty. Shanghai Medical & Pharmaceutical Journal. 44: 14-18.
19. Beckmann S, Schmid-Mohler G, Muller M, Spichiger E, Nicca D, et al. (2023) Validation of the newly developed Advanced Practice Nurse Task Questionnaire: A national survey. J Adv Nurs 79: 4791-4803.
20. Hako L, Turunen H, Jokiniemi K (2023) Advanced practice nurse capabilities: A mixed methods systematic review. Scand J Caring Sci 37: 3-19.
21. Horvath S, Visekruna S, Kilpatrick K, McCallum M, Carter N (2023) Models of care with advanced practice nurses in the emergency department: A scoping review. Int J Nurs Stud148: 104608.