



Innovation Article

Development and feasibility testing of a digital discharge planning application for fall risk prevention

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ABSTRACT

Background: Patient falls remain a major safety concern in hospital settings, particularly during care transitions and after discharge. Conventional discharge education is often unstructured, inconsistently delivered, and difficult for patients and families to revisit after leaving the hospital. In addition, the limited availability of integrated digital tools constrains effective patient education, documentation, and monitoring, highlighting the need for innovative discharge planning solutions.

Objective: This study aimed to develop and evaluate the feasibility of a digital discharge planning application for fall risk prevention, with a focus on improving patient knowledge and nurse compliance.

Methods: This development study employed a needs-based design approach to create a mobile application integrating fall risk assessment, structured discharge education, and nurse compliance monitoring within a unified digital system. Preliminary evaluation used a pre-experimental one-group pretest–posttest design involving 30 hospitalized patients at risk of falls and 30 nurses. Patient knowledge was assessed using a 10-item questionnaire, while nurse compliance was measured using a structured checklist. Data were analyzed using the Wilcoxon signed-rank test.

Results: The developed application, named “Si-Patuh,” demonstrated good usability and practical applicability in clinical settings. Patient knowledge scores increased significantly from a median of 0 (range: 0–5) before intervention to 10 (range: 7–10) after intervention ($Z = -4.837$; $p < 0.001$; $r = 0.88$). Nurse compliance scores also improved significantly from a median of 5 (range: 0–10) to 10 (range: 9–10) ($Z = -4.563$; $p < 0.001$; $r = 0.83$). The application effectively integrated patient education and nurse adherence within a structured digital discharge planning framework.

Conclusion: The application is a feasible, innovative solution for strengthening discharge planning by improving patient knowledge and nurse compliance with fall prevention. This integrated digital approach has the potential to enhance patient safety and continuity of care in hospital settings.

INTRODUCTION

Falls remain a major patient safety concern in hospital settings and are associated with injury, prolonged hospitalization, increased healthcare costs, and reduced quality of life, particularly among older adults and patients with impaired mobility. Hospitalized patients are vulnerable

to falls due to intrinsic factors such as frailty, cognitive impairment, medication effects, and functional decline, as well as environmental hazards within care settings.^{1,2} Evidence also indicates that fall risk is dynamic and may increase during transitions of care, particularly when patients move from supervised hospital environments to self-management at home.^{3,4}

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Care transitions represent a critical period in which responsibility for safety shifts from healthcare professionals to patients and family caregivers. Inadequate discharge preparation, limited continuity of education, and insufficient caregiver involvement may contribute to adverse outcomes, including post-discharge falls.^{4,5} Older adults are especially vulnerable due to residual weakness, fear of falling, unsafe home environments, and limited support systems after hospitalization.⁶ Therefore, effective discharge planning is essential to ensure continuity of care and sustained fall prevention beyond the hospital setting.

Comprehensive discharge planning has been shown to improve patient readiness, self-care ability, satisfaction, and post-discharge outcomes.^{4,5} However, its implementation in routine clinical practice remains inconsistent. Nurses often encounter barriers, such as time constraints, excessive workload, variability in educational delivery, and limited access to educational media that patients and families can revisit after discharge.^{7,8} In addition, monitoring nurse compliance in delivering structured discharge education is rarely integrated into routine workflows.^{9,10}

Advances in digital health technologies, particularly mobile health applications, offer opportunities to enhance discharge planning through accessible, standardized, and patient-centered education. Previous studies have demonstrated that digital interventions can improve patient engagement, knowledge, and self-care behaviors after discharge.^{11,12} However, most existing solutions primarily focus on patient outcomes and do not integrate nurse compliance, documentation, and structured discharge education within a unified system.^{13,14}

Although several fall prevention technologies have been developed, many are designed for inpatient monitoring, alarm systems, or isolated risk assessments rather than transitional discharge education.^{13,15} This indicates a critical gap in developing integrated digital solutions that simultaneously support patient education and nurse adherence to discharge planning standards within routine care.^{16,17}

To address this gap, a digital discharge planning application was developed as an integrated tool for fall risk prevention. The application combines patient education, nurse compliance support, monitoring, and documentation within a single platform to strengthen nurse-patient collaboration during care transitions. Therefore, this study aimed to develop and evaluate the feasibility of this application as a discharge planning intervention for fall risk prevention in hospital settings.

METHOD

Study Design

This study employed a design-and-development approach, with preliminary feasibility testing, to develop and evaluate a digital discharge planning application for fall risk prevention. The development process was guided by the

ADDIE instructional design framework, consisting of five phases: analysis, design, development, implementation, and evaluation.²⁰

Phase 1: Needs Analysis and Literature Review

A structured needs analysis was conducted, supported by a literature review to identify key issues in fall risk prevention, discharge planning, patient education, and mobile health interventions. Relevant studies indexed in Scopus and PubMed within the past five years, along with current patient safety guidelines, were reviewed to determine content priorities, user needs, and core application functions.

Phase 2: Application Design and Development

Based on the analysis findings, a digital discharge planning application was developed for nurses, patients, and family caregivers. The application included educational content on fall risk factors, prevention strategies during hospitalization, home safety preparation, and follow-up recommendations. Additional features supported nurse adherence through structured education checklists and documentation menus. The interface was designed to be simple, accessible, and user-friendly.

Phase 3: Content Validity Assessment

Content validity was evaluated by two experts in patient safety and discharge planning. The relevance, clarity, and appropriateness of the content and interface were assessed using the content validity index (CVI), including item-level (I-CVI) and scale-level (S-CVI) indices, following Polit and Beck.¹⁸ Both the I-CVI and S-CVI were calculated. A CVI score of ≥ 0.80 was considered acceptable. All assessed components met the predefined validity criteria.

Phase 4: Usability Testing

Usability was assessed using the system usability scale (SUS).¹⁹ Testing involved five nurses and five patients, consistent with early-stage usability evaluation standards. Participants used the application and completed the SUS questionnaire. Mean SUS scores were 81 for nurses (excellent) and 77 for patients (good), indicating favorable usability.

Phase 5: Preliminary Feasibility Testing

A pre-experimental one-group pretest-posttest design was used to assess feasibility and short-term outcomes. Participants included 30 nurses and 30 hospitalized patients at risk of falls, recruited using consecutive sampling. The outcomes measured were: 1) Patient knowledge regarding fall prevention, assessed using a 10-item questionnaire (score range: 0–10); 2) Nurse compliance with discharge planning education, assessed using a 10-item structured checklist based on self-report, observation, and documentation audit. Measurements were conducted before and after the application was implemented during the discharge education process.

Data Analysis

Data were analyzed using descriptive and inferential statistics. Continuous variables were summarized as mean ± standard deviation or median (range), as appropriate. As the data were not normally distributed, differences between pre- and post-intervention scores were analyzed using the Wilcoxon signed-rank test. Statistical significance was set at $p < 0.05$.

Ethical Considerations

This study was approved by the Health Research Ethics Committee of Universitas Muhammadiyah Purwokerto (Approval No. KEPK/UMP/92/II/2026). Written informed consent was obtained from all participants. Confidentiality, anonymity, and voluntary participation were ensured.

RESULTS

Application Development Findings

The needs assessment identified several limitations in the existing discharge planning process for fall prevention. Education was primarily delivered through verbal explanations and written materials, which limited patient understanding, retention, and continuity after discharge. The electronic medical record system was mainly designed for healthcare providers and did not facilitate patient or family access to educational content.

In addition, nurse adherence to structured discharge education procedures was inconsistent, and monitoring of educational implementation was not routinely conducted. Patients and caregivers frequently reported difficulty understanding and recalling fall prevention recommendations after returning home. These findings highlighted the need for an integrated digital solution to improve accessibility, continuity, and monitoring of discharge education.

Based on these findings, a digital discharge planning application, named “Si-Patuh”, was developed. The application integrates fall risk assessment, structured discharge education, multimedia learning resources, nurse compliance monitoring, and documentation support within a single platform.

The system includes a secure login interface, a user-friendly dashboard, a structured fall-risk assessment module, standardized discharge-planning content, video-based educational materials, and a compliance-monitoring feature. These components were designed to improve the consistency, efficiency, and accessibility of discharge education while strengthening patient safety practices (Figures 1–6).

Content Validity and Usability Evaluation

Content validity assessment demonstrated that all components met the predefined criteria. I-CVI values ranged from 0.80 to 1.00, and the overall S-CVI/Ave was

0.92, indicating high content validity and suitability for implementation.

Usability testing showed favorable results among both nurses and patients. The mean SUS score was 81 for nurses, indicating excellent usability, and 77 for patients, indicating good usability. These findings suggest that the application is acceptable, practical, and user-friendly for both professional and patient users.

Feasibility and Outcome Evaluation

The feasibility trial involved 30 nurses and 30 hospitalized patients at risk of falls. All participants completed the study procedures, and no major technical barriers were reported during application use. Patient knowledge and nurse compliance improved significantly following application use (Table 1). Patient knowledge increased from a median of 0 to 10, while nurse compliance increased from 5 to 10. Both outcomes showed statistically significant differences with large effect sizes, indicating a strong intervention effect.

Table 1. Comparison of Pre- and Post-Intervention Scores Following Application Use, Median (Min–Max)

Variable	Pre-test	Post-test	Z	p-value	Effect Size (r)
Patient knowledge	0 (0–5)	10 (7–10)	-4.837	<0.001	0.88
Nurse compliance	5 (0–10)	10 (9–10)	-4.563	<0.001	0.83

DISCUSSION

The present study demonstrated that implementation of the “Si-Patuh” application was associated with significant improvements in patient knowledge regarding fall prevention and nurse compliance with discharge planning education procedures. In addition to these measurable outcomes, this study introduces an integrated digital approach that combines patient education, professional accountability, and documentation support within a single discharge planning platform. These findings support previous evidence that structured education plays a critical role in fall prevention during hospitalization and care transitions.^{2,21}

The observed improvement in patient knowledge suggests that accessible and structured educational delivery enhances understanding of fall risk factors and preventive behaviors. This finding is consistent with previous studies indicating that tailored education improves patient readiness, motivation, and self-management capacity after hospitalization.^{11,21} The ability to repeatedly access educational content may further support information retention and independent application of preventive strategies after discharge.^{14,22}

The magnitude of improvement may also reflect low baseline exposure to standardized fall prevention education. In many clinical settings, discharge information is delivered verbally within limited timeframes, which may reduce comprehension and recall. In contrast,



Figure 1. Login interface



Figure 2. Dashboard interface

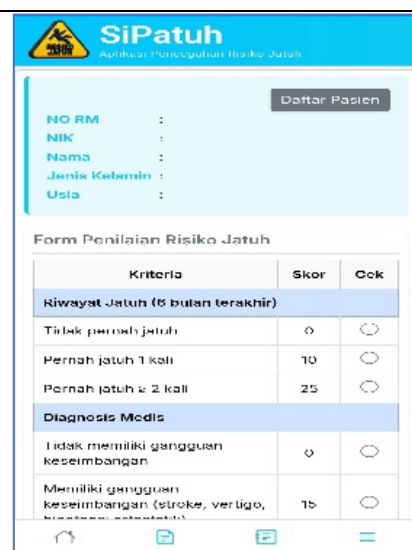


Figure 3. Fall risk assessment module



Figure 4. Discharge planning module



Figure 5. Educational video module



Figure 6. Nurse compliance monitoring feature

the application provides standardized multimedia education that can be revisited, thereby improving consistency and reinforcing learning.^{13,15}

Nurse compliance also improved substantially following implementation. This suggests that digital systems can support more consistent execution of discharge planning responsibilities by embedding structured workflows into routine practice. Previous literature has highlighted that effective patient education depends not only on individual competence but also on systems that facilitate adherence to standards, provide reminders, and promote accountability.^{9,10} The observed compliance gains may reflect the application's ability to simplify procedures, standardize educational steps, and improve monitoring.^{23,24}

An important contribution of this study lies in its dual-target design. While many digital health interventions focus primarily on patient outcomes, this application was designed to address both patient empowerment and

provider adherence simultaneously. This integrated approach is particularly relevant in discharge planning, where outcomes depend on the interaction between informed patients and consistent professional practice.^{15,16}

Several mechanisms may explain these findings. Standardized digital content likely reduced variability in educational delivery, while on-demand multimedia access improved patient engagement and recall. In addition, checklist and documentation features may have strengthened accountability and completion of discharge tasks. Similar studies have shown that digital applications can improve workflow efficiency, accessibility, and care integration.²⁵⁻²⁷

From a practical perspective, these findings indicate that mobile health applications may provide a feasible strategy for strengthening discharge planning in hospital settings. Such tools may help address barriers, including limited nursing time, inconsistency of verbal education, and lack of

accessible educational materials. If integrated into hospital systems, this approach may also contribute to broader patient safety initiatives and continuity of care.^{5,12,28}

This study has several limitations. The pre-experimental one-group pretest–posttest design limits causal inference because it lacks a control group. The single-center setting and relatively small sample size may restrict generalizability. In addition, nurse compliance assessment partly relied on self-report and documentation review, which may introduce reporting bias. Furthermore, this study evaluated knowledge and process outcomes rather than clinical outcomes such as post-discharge fall incidence.

Future studies should employ randomized or multicenter controlled designs with larger samples and longer follow-up periods. Evaluation of clinically relevant outcomes, including falls after discharge, readmissions, caregiver burden, and cost-effectiveness, would provide stronger evidence of effectiveness.

CONCLUSIONS AND RECOMMENDATION

This study demonstrates that a digital discharge planning application is a feasible and innovative approach with the potential to improve patient knowledge and nurse compliance in fall prevention. Significant improvements in both outcomes were observed following implementation. Further studies using more rigorous controlled designs and larger samples are warranted to confirm effectiveness, including evaluation of post-discharge fall incidence. Integration with hospital information systems should also be considered to enhance sustainability and broader clinical implementation.

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