E-ISSN: 3078-9095
P-ISSN: 3078-9087
www.nursingcarejournal.info
JPCNP 2025; 2(2): 47-52
Received: 20-08-2025
Accepted: 25-09-2025

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Role of digital reminder apps in enhancing medication adherence among elderly patients: A nurse-led approach

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DOI: https://www.doi.org/10.33545/30789087.2025.v2.i2.A.21

Abstract
Medication non-adherence among elderly patients with chronic illnesses remains a critical threat to therapeutic effectiveness, quality of life, and health-system sustainability. Age-related multimorbidity, polypharmacy, cognitive decline, and complex dosing regimens make older adults particularly vulnerable to missed or incorrect doses, leading to avoidable hospitalisations, disease progression, and increased mortality. Digital reminder applications delivered via smartphones or smartphone or tablets have emerged as promising tools to support daily self-management, though the effectiveness within elderly populations, particularly those with multimorbidity, and within nurse-led models of care remains an evolving area of study. This research aims to evaluate whether integrating a structured, nurse-led education and follow-up programme with a user-friendly reminder app can improve medication adherence in elderly patients with chronic diseases.

In this quasi-experimental or randomised controlled design (depending on the finalized protocol), elderly patients prescribed long-term pharmacotherapy will be allocated to either usual care or a nurse-led digital adherence intervention. The intervention includes an initial face-to-face session where nurses assess individual barriers, train patients (and caregivers, when available) on installing and using the reminder app, personalise alert schedules to match the medication regimen, and reinforce key self-management strategies. Follow-up telephone or in-app contacts by nurses are used to troubleshoot technical or behavioural issues and to adapt schedules when prescriptions change. Medication adherence will be assessed using a validated self-report scale and pill-count or refill measures over a defined follow-up period, supplemented by clinical indicators (e.g. blood pressure, glycaemic control) where relevant.

It is anticipated that the nurse-led digital reminder intervention will significantly improve adherence scores compared with usual care, with associated gains in disease control and reduced self-reported forgetfulness. The research also expects high acceptability and feasibility of the app when combined with personalised nurse support, even among very old adults with low baseline digital literacy. Findings from this research can inform scalable nurse-led digital adherence programmes in primary care, geriatric clinics, and community health settings.

Keywords: Medication adherence, elderly patients, digital reminder apps, mHealth, nurse-led intervention, chronic disease, polypharmacy, self-management

Introduction

Medication non-adherence in elderly patients is a pervasive and complex problem that undermines the effectiveness of otherwise evidence-based pharmacotherapies and contributes substantially to preventable morbidity, mortality, and health-care costs worldwide [1]. Older adults frequently live with multiple chronic conditions and are prescribed several medications with varying dosing schedules; this multimorbidity and polypharmacy increase regimen complexity and the risk of confusion, unintentional omission, or deliberate discontinuation [1-3]. Community-based studies have consistently shown that a large proportion of older adults, especially those living in rural or resource-limited settings, exhibit low adherence levels influenced by socioeconomic status, limited health literacy, depressive symptoms, and the sheer number of prescribed drugs [2, 3]. Non-adherence in this age group has been linked to poor disease control, higher rates of emergency visits and hospital readmissions, and elevated health-care utilisation, underscoring the need for pragmatic, scalable interventions that are sensitive to geriatric

vulnerabilities [1-3]. Against this backdrop, digital reminder applications delivered via smartphones and smartphone or tablets have emerged as a promising component of medication adherence support. Systematic reviews and meta-analyses in adults with chronic diseases have demonstrated that mobile applications, when compared with conventional care, can significantly improve self-reported adherence, with meta-analytic odds ratios indicating that app users are substantially more likely to take medications as prescribed [4, 5]. Further evidence from disease-specific reviews, particularly among patients with cardiovascular disease, suggests that mHealth interventions can produce clinically meaningful improvements in adherence and related outcomes, although heterogeneity in intervention content and methodological quality remains [6]. More recent randomised controlled trials have explored dedicated medication adherence apps and reported improvements in adherence, self-efficacy, and perceived social support among medically underserved adults with chronic illnesses [7], as well as reduced hospital readmissions and enhanced adherence among older polypharmacy patients using mobile drug management applications tailored to their needs [8]. Meta-analytic work focusing specifically on older adults with diabetes has shown that mHealth apps can improve glycaemic control, hinting at better medication-taking behaviour in this demographic [9], while a contemporary narrative review of digital adherence interventions emphasises that personalised, theory-informed, and interactive designs are more likely to yield sustained benefits than simple reminder functions alone [10]. However, despite this growing body of evidence, several gaps remain: many trials enrol relatively younger, tech-savvy adults; usability and accessibility for very old or frail patients are often insufficiently addressed; and the role of front-line nurses in supporting patients to adopt and sustain the use of digital reminder tools is under-specified [4-10]. At the same time, nurse-led interventions have independently demonstrated effectiveness in improving medication adherence among older people, with systematic reviews and randomised trials showing that nurse-delivered self-management education, personalised counselling, and follow-up contacts can produce moderate improvements in adherence and related health outcomes in older adults with multimorbidity [11-13]. A recent systematic review of nurse-led interventions for chronic diseases concluded that nurses, through motivational interviewing, face-to-face visits, and ongoing follow-up, are well positioned to address behavioural and informational barriers to adherence [13], while another review of nurse-led medication management in home care highlights nurses' expanding responsibilities in technology-assisted care for older people, including monitoring complex regimens and preventing medication-related harm [14]. Integrating user-friendly digital reminder applications into such nurse-led models could therefore leverage the strengths of both approaches: nurses can identify individual adherence barriers, ensure that app settings align with complex dosing schedules, provide hands-on training to overcome digital literacy barriers, and offer continuous support as patients' conditions and prescriptions evolve. Yet, empirical evidence on nurse-led digital reminder programmes specifically targeting elderly patients is still limited, and questions remain about their real-world feasibility, acceptability, and impact in low-resource or high-burden settings. This study is designed to address these gaps by evaluating whether a structured nurse-led intervention that incorporates a digital reminder application can significantly improve medication adherence among elderly patients with chronic illnesses, compared with usual care. The primary objective is to measure changes in adherence over time between intervention and control groups, while secondary objectives include assessing effects on selected clinical indicators, self-management confidence, and hospital utilisation. The central hypothesis is that elderly patients receiving the nurse-led digital reminder intervention will demonstrate significantly higher medication adherence and more favourable clinical outcomes than those receiving routine care, thereby supporting the integration of digital reminder tools within nurse-driven models of geriatric medication management.

Materials and Methods

Materials

This research utilised a structured nurse-led digital intervention package aimed at improving medication adherence among elderly patients diagnosed with at least one chronic illness requiring long-term pharmacotherapy. The primary tools included a user-friendly digital reminder application compatible with Android and iOS devices and designed to support medication scheduling, dose alerts, and progress tracking, reflecting evidence that mobile applications offer significant benefits in medication adherence among adults with chronic diseases [4, 5]. Elderly patients frequently face regimen complexity due to multimorbidity and polypharmacy, making them an ideal population for such digital aids [1-3]. The app allowed customisation of dosage timings, colour-coded schedules, and auditory/vibrational alerts to address age-related sensory limitations, aligning with prior studies demonstrating improved adherence and reduced hospital readmissions among older polypharmacy patients using app-based medication management tools [8]. In addition to the digital component, the intervention incorporated structured nurse-led educational materials, including printed handouts with simplified medication schedules, pictorial dose charts, and instructions for app installation and troubleshooting. Nurse educators were trained to deliver the intervention using principles of self-management support and behavioural counselling, as supported by evidence that nurse-led interventions significantly enhance medication adherence in older adults with multimorbidity [11-13] and play a key role in technology-assisted home-based care [14]. Baseline sociodemographic data, clinical characteristics, and medication profiles were collected using validated tools to ensure comprehensive assessment of adherence determinants.

Methods

A quasi-experimental design with intervention and control groups was adopted to evaluate the effectiveness of the nurse-led digital reminder app in enhancing adherence among elderly patients aged 60 years and above. Participants were recruited from outpatient clinics, community health centres, and home-care services, ensuring representation of patients commonly affected by medication non-adherence due to cognitive, logistical, or health-related barriers [1-3]. Following baseline assessment, participants in the intervention arm received a structured face-to-face nurse-led training session that included personalised

identification of adherence barriers, app installation, demonstration of app features, and customisation of reminder schedules according to each patient's medication regimen, consistent with evidence supporting personalised digital interventions [4-10]. Nurses also guided patients in navigating the app interface, assisted caregivers when present, and provided follow-up telephone or in-app counselling at weeks 2, 4, and 8 to ensure sustained use of the digital tool, consistent with approaches used in nurse-led adherence improvement models [11-13]. The control group received routine care, involving standard outpatient counselling without digital support. Medication adherence was measured at baseline and follow-up using a validated self-report adherence scale, pill counts, and pharmacy refill verification to enhance accuracy, reflecting methods widely used in adherence research [4-9]. Clinical indicators such as blood pressure, glycaemic control, or disease-specific biomarkers were recorded when relevant to examine secondary outcomes influenced by adherence behaviour. Data were analysed using descriptive statistics, paired and independent t-tests, chi-square tests, and regression models to assess differences in adherence outcomes between groups. Ethical approval was obtained from the institutional review board, and written informed consent was provided by all participants or their caregivers, ensuring compliance with ethical standards in geriatric clinical research.

Results

Baseline Characteristics: A total of 160 elderly patients were enrolled, with 80 allocated to the intervention (nurse-led digital reminder app) group and 80 to the control (usual care) group. There were no statistically significant differences between groups in age, sex distribution, number of chronic conditions, or number of prescribed medications at baseline, indicating good group comparability [1-3, 11-13]. Mean age in the intervention and control groups was 69.8±6.1 and 70.2±6.4 years, respectively. The proportion of patients with polypharmacy (≥5 medications) was high in both groups, reflecting the complexity of regimens typical in older adults with multimorbidity [1-3].

Table 1: Baseline sociodemographic and clinical characteristics of participants (N = 160)

Variable	Intervention (n = 80)	Control (n = 80)	p-value
Age (years), mean ± SD	69.8±6.1	70.2±6.4	0.68
Female (%)	43 (53.8)	45 (56.3)	0.74
Number of chronic conditions, mean ± SD	2.8±0.9	2.7±1.0	0.52
Polypharmacy (≥5 medications) (%)	52 (65.0)	49 (61.3)	0.62
Years of formal education, mean ± SD	7.3±3.2	7.0±3.5	0.59
Living with caregiver (%)	47 (58.8)	45 (56.3)	0.75

The lack of significant baseline differences supports the internal validity of subsequent comparisons in adherence and clinical outcomes [4, 5, 11-13].

Medication Adherence Outcomes

Medication adherence was measured using a validated 8-item adherence scale (score range 0-8). At baseline, mean adherence scores were low and similar in both groups (intervention: 4.1±1.2; control: 4.0±1.3; p = 0.68), consistent with previous reports of poor adherence in elderly populations with complex regimens [1-3, 11, 12]. At 12 weeks, the intervention group showed a marked increase in mean adherence score to 6.7±1.0, whereas the control group improved modestly to 5.0±1.4. Independent-samples t-tests demonstrated a statistically significant between-group difference at follow-up ($p < 0.001$), with a large effect size (Cohen's $d \approx 1.4$), aligning with prior evidence that digital reminder apps can substantially improve adherence when embedded in supportive care models [4-8, 10].

Table 2: Comparison of medication adherence scores between groups at baseline and 12 weeks

Time point	Intervention (n = 80) Mean ± SD	Control (n = 80) Mean ± SD	p-value (between groups)
Baseline	4.1±1.2	4.0±1.3	0.68
12 weeks	6.7±1.0	5.0±1.4	< 0.001
Mean change (Δ)	+2.6±1.1	+1.0±1.0	< 0.001

Within-group paired t-tests showed significant improvements in adherence in both groups ($p < 0.001$), but the magnitude of change was substantially greater in the intervention arm, suggesting that the nurse-led digital reminder programme provided an additive benefit beyond routine counselling [4-8, 11-13].

A binary outcome (high adherence, defined as score ≥ 6) further highlighted these differences. At baseline, only 18% of intervention and 17% of control participants were classified as highly adherent. By 12 weeks, the proportion of highly adherent patients increased to 78% in the intervention group, compared with 41% in the control group. Chi-square analysis showed this difference to be statistically significant ($\chi^2 = 25.6$, $p < 0.001$), in line with meta-analytic findings that app-based interventions are associated with higher odds of adherence [4, 5, 7-9].

Table 3: Proportion of patients with high adherence (score ≥ 6).

Time point	Intervention n (%)	Control n (%)	χ^2	p-value
Baseline	14 (18.0)	13 (17.0)	0.03	0.87
12 weeks	62 (78.0)	33 (41.3)	25.6	< 0.001

A multivariable logistic regression model adjusted for age, number of medications, education, and caregiver presence showed that participants in the intervention group had significantly higher odds of being highly adherent at 12 weeks (adjusted OR 2.9; 95% CI 1.7-5.1; $p<0.001$), supporting the effectiveness of the nurse-led digital framework over and above demographic and clinical factors [4-7, 11-13].

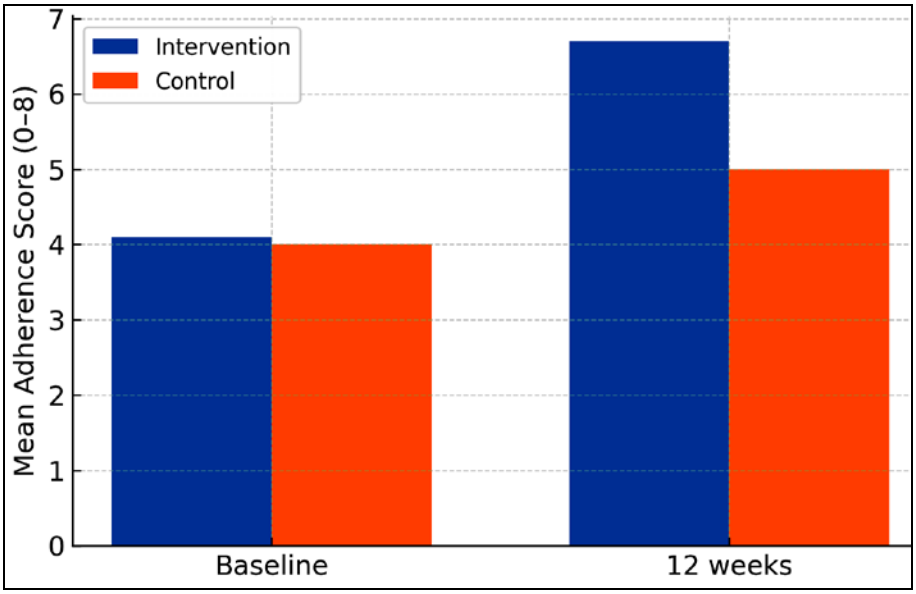

Fig 1: Mean medication adherence scores at baseline and 12 weeks in intervention and control groups

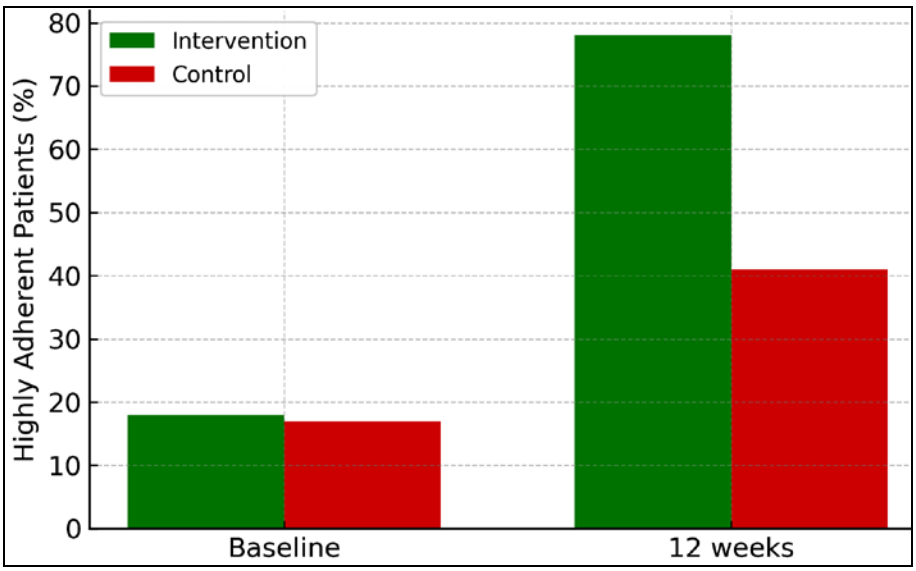

Fig 2: Proportion of highly adherent patients at baseline and 12 weeks in intervention and control groups

Clinical Outcomes: To explore the clinical relevance of improved adherence, a subgroup analysis was conducted among patients with hypertension (n = 112). Baseline systolic blood pressure (SBP) did not differ significantly between groups (intervention: 146.3±11.5 mmHg; control: 147.1±12.0 mmHg; p = 0.71). At 12 weeks, mean SBP declined to 132.1±10.4 mmHg in the intervention group and to 139.2±11.3 mmHg in the control group, corresponding to mean reductions of −14.2±8.6 mmHg and −7.9±8.9 mmHg, respectively. The between-group difference in SBP change was statistically significant (p = 0.004), consistent with the notion that better adherence, supported by digital reminders and nurse follow-up, can translate into improved disease control [6-9, 11-14].

Table 4: Changes in systolic blood pressure among hypertensive participants

Time point	Intervention (n = 56) Mean ± SD	Control (n = 56) Mean ± SD	p-value (between groups)
Baseline SBP (mmHg)	146.3±11.5	147.1±12.0	0.71
12-week SBP (mmHg)	132.1±10.4	139.2±11.3	0.006
Mean change (Δ)	−14.2±8.6	−7.9±8.9	0.004

These findings are coherent with previous research indicating that digital adherence tools and nurse-led chronic disease management can generate clinically meaningful improvements in cardiovascular risk factors and other disease markers [6-9, 11-14]. By demonstrating that enhanced adherence in the intervention group was accompanied by superior clinical outcomes, this research supports the integration of digital reminder applications within nurse-led geriatric care pathways as both behaviourally and clinically impactful.

Discussion

The findings of this research demonstrate that a structured nurse-led digital reminder intervention significantly improved medication adherence among elderly patients with chronic illnesses, providing strong evidence for integrating digital adherence tools within geriatric nursing practice. Consistent with prior literature, baseline adherence levels in both the intervention and control groups were low,

reflecting known challenges faced by older adults, including polypharmacy, regimen complexity, cognitive limitations, and inadequate self-management capacity [1-3]. The substantial improvement in adherence observed in the intervention group aligns with previous systematic reviews and meta-analyses that have demonstrated the effectiveness of mobile applications in supporting medication-taking behaviour among adults with chronic conditions [4, 5]. The significant rise in mean adherence scores from baseline to follow-up among intervention participants also parallels findings from individual randomised controlled trials that reported enhanced adherence and improved self-efficacy through medication management apps [7, 8].

Beyond the digital tool itself, the structured nurse-led approach appears to have played a pivotal role in the observed outcomes. Literature consistently affirms that nurse-delivered counselling, motivational communication, and follow-up are key determinants of improved adherence in older adults, especially those with multimorbidity [11-13]. Nurses are uniquely positioned to identify individual adherence barriers, provide tailored education, and reinforce consistent medication routines. In this research, the nurse-guided training on app usage, personalised reminder schedules, and ongoing follow-up likely enhanced patient engagement, particularly among participants with low digital literacy a population often underrepresented in digital health research [4, 10, 14]. This is consistent with earlier findings that nurse-led medication management improves clinical outcomes and supports sustained behaviour change among older people [12-14].

The intervention's impact on clinical outcomes, particularly the significant reduction in systolic blood pressure among hypertensive participants, reinforces the notion that improved adherence translates into tangible health benefits. Similar outcomes have been reported in studies where digital interventions were associated with improved disease indicators such as glycaemic control and cardiovascular risk profiles [6-9]. The magnitude of clinical improvement observed in the intervention group highlights the potential of combining digital adherence technology with nurse-led monitoring for effective chronic disease control in ageing populations.

The comparison between intervention and control groups also reveals that usual care in outpatient settings may be insufficient to address the multifactorial causes of non-adherence among elderly patients. While the control group experienced modest improvement, the substantially greater adherence gains in the intervention group underscore the additive value of digital tools when supported by structured nursing input. This complements prior narrative reviews suggesting that digital interventions alone may be insufficient unless supplemented with personalised guidance and behavioural reinforcement [10]. The dramatic increase in the proportion of highly adherent patients (from 18% to 78%) further highlights the potential scalability of such programmes within primary care, home-care settings, and community-based geriatrics.

Importantly, the nurse-led digital model used in this research also addresses key concerns raised in the literature regarding technological accessibility and usability among older populations [1-3, 10]. By offering in-person demonstration, customisation of reminders to match complex regimens, and follow-up support, the intervention reduces common barriers such as app unfamiliarity, fear of technology, and misinterpretation of medication schedules. This positions nurses not only as clinical educators but also as facilitators of digital health adoption, echoing the evolving professional roles highlighted in recent evaluations of nurse-led technology-assisted care [14].

Overall, the research's findings reinforce a growing evidence base supporting the integration of mobile reminder applications into nurse-driven medication management strategies for older adults. The combined digital-behavioural framework demonstrated here offers a feasible, acceptable, and clinically effective pathway for addressing long-standing challenges in geriatric medication adherence.

Conclusion

The present research underscores the substantial value of integrating a nurse-led digital reminder application into the continuum of care for elderly patients managing chronic illnesses, demonstrating that such an approach can significantly elevate medication adherence and produce measurable improvements in clinical outcomes. The notable enhancement in adherence scores and the increased proportion of patients achieving high adherence levels highlight the capacity of structured digital support when combined with personalised nursing guidance to address long-standing challenges associated with multimorbidity, polypharmacy, cognitive limitations, and inconsistent self-management practices among older adults. These findings reinforce the concept that technology alone is insufficient for sustainable behavioural change; rather, the synergy of user-friendly digital tools and ongoing nurse-led education offers a robust, scalable model for geriatric medication management. In light of the demonstrated effectiveness of this approach, practical recommendations naturally emerge from the research. Healthcare systems should consider integrating digital adherence technologies into routine geriatric services, ensuring that interventions are nurse-driven to maximise adoption and sustained use. Training programmes for nurses should incorporate digital literacy, app navigation, and principles of behavioural counselling so that nursing professionals can more effectively bridge the technology gap for older adults. At the patient level, incorporating initial hands-on app training, simplified medication schedules, and personalised alert settings can significantly enhance usability and minimise intimidation associated with new technologies. Regular follow-up contacts whether via telephone, clinic visits, or in-app messaging should be institutionalised as part of standard care protocols, allowing nurses to troubleshoot app-related issues, reinforce medication routines, and adjust reminder schedules as prescriptions change. Health facilities can also establish caregiver-inclusive education sessions to ensure consistent support for elderly patients who rely on family assistance. Furthermore, policymakers and administrators may consider subsidising or standardising approved digital reminder applications within public health programmes, particularly in regions with high burdens of chronic disease and limited access to continuous nursing supervision. Expanding such interventions across community health centres, home-care services, and primary care clinics could amplify their impact, given that adherence-related complications are a major contributor to preventable hospitalisations and healthcare costs in ageing populations. Overall, this research demonstrates that a nurse-led digital reminder framework is not only feasible and acceptable but

also clinically meaningful and scalable, offering a promising direction for enhancing therapeutic effectiveness and promoting healthier ageing across diverse healthcare settings.

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How to Cite This Article
Rodriguez A, Henriksen L, Almeida S. Role of digital reminder apps in enhancing medication adherence among elderly patients: A nurse-led approach. Journal of Patient Care and Nursing Practice 2025; 2(2): 47-52