

Nurse-Led Medication Management for Older People in Home Care: A Systematic Review of Evolving Nurse Responsibilities in Technology-assisted Care

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Abstract

Technology-assisted care is transforming the home care landscape for older people requiring medication management. With evolving roles and responsibilities, nurse-led interventions are shaping the future of nursing practice in home care. This review aimed to identify and describe nurse-led roles in medication management in home care for older people within the context of technology-assisted care. A systematic review employing an integrative approach was conducted on the PubMed (covering MEDLINE), Scopus, CINAHL, ProQuest, and Embase, targeting studies published in English over the past decade, from 2014 to 2024. The initial database search identified 1629 studies, which were subsequently narrowed down to 20 studies selected for data analysis and narrative research synthesis. The review findings were classified into 3 categories: “fundamental principles,” “nurses and their role identities,” and “enhanced care quality and medication safety.” Given the effectiveness of nurses as leaders in technology-assisted home care for enhancing medication management safety, it is essential to implement policies that support and improve their involvement in multidisciplinary healthcare teams. Additionally, continuous education and training focused on technology-assisted care competencies are necessary to ensure nurses are well-prepared to enhance patient safety in home care.

Keywords

home care, medication management, nurse-led, older people, patient safety, technology-assisted care

Introduction

Physical and psychological frailty among older people as a global health problem¹ makes home care vital for maintaining their functional abilities and independence. Home-based interventions including rehabilitation and remote delivery of healthcare services have been shown effective.² However, the unpredictable nature of the home care environment can pose safety risks for older people,^{3–5} necessitating the identification and mitigation of potential harms.⁶ For instance, medication management during transitions to home care is challenging due to medication discrepancies (38%),⁷ polypharmacy (43%), drug–drug interactions (54%),⁸ and nonadherence (60%).⁹ These factors make the post-discharge period critical for preventing errors.¹⁰ Medication management in home care involves the anticipation of medication issues, risks reduction, and resilience improvement by the multidisciplinary healthcare team.¹¹ Nurses in home care manage chronic conditions, reduce hospitalization rates, improve care outcomes, and build crucial relationships with

patients and families. Their role in coordinating care and ensuring patient safety is vital for addressing the complex needs of older people.^{12,13} The complexity of older people’s needs in home care and the importance of continuous care underscore nurses’ roles¹⁴ to maintain the standards of patient safety.¹⁵ Nurse-led interventions have been shown to enhance medication adherence,¹⁶ older people’s ability to self-manage medication at home, and address adherence issues.¹⁷

Technology-assisted care, digital health, as the use of technology for personalized monitoring and care offers innovative solutions for preventing and managing chronic

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conditions.¹⁸ It holds great potential for managing chronic diseases and enhancing patient safety for older people receiving home care.¹⁹ Continuous and onsite monitoring by remote healthcare specialists in a timely manner, and continuity of care^{20,21} and communication with older people and their families²² are the advantages of technology-assisted care. It improves medication review at home,²³ reduces medication discrepancies and adverse drug events²⁴ and time spent on medication administration by nurses (33%),²⁵ and improves medication adherence.²⁶ Technology-assisted care using the nurse-led approach increases older people's awareness of their symptoms, encourages self-efficacy and self-control,²⁷ and improves self-care medication practices.²⁸

The effects of technology-assisted care on health indicators have been studied in acute care settings, with less focus on its use by nurses in home care.²⁹ Additionally, there is limited knowledge about the role of nurses as leaders in technology-assisted home care. Therefore, this review aimed to identify and describe nurse-led roles in medication management in home care for older people within the context of technology-assisted care. Accordingly, the review question was: "What are nurse-led roles in medication management for older people receiving home care within the technology-assisted care context, and how they influence patient safety?"

Methods

Design

This systematic review using an integrative approach combined quantitative and qualitative data to offer a comprehensive synthesis of existing knowledge, providing valuable insights for policymakers and managers to enhance practice.³⁰ It followed a five-step process: identifying the research problem, conducting a literature search, appraising data quality, analyzing and synthesizing data, and presenting findings.³⁰ It adhered to the PRISMA guideline for development and reporting (Supplemental File 1).

Protocol and Registration

A multinational team of researchers from Norway, Finland, and Spain, experts in patient safety, medication management, and systematic review methodology, collaborated to develop the review protocol. To ensure transparency, integrity, and reduce publication bias, the protocol consisting of objectives, methods, and analysis plan was registered under PROSPERO ID: CRD42023481881, which is accessible via the following link: [https://www.crd.york.ac.uk/PROSPERO/display_record.php?RecordID=481881]. The objectives and approach of the review were formulated using the PICO framework as follows:

P (Population): Home care nurses, including registered nurses, nurse practitioners, or licensed practical nurses, providing care to older people in their homes, often with the

involvement of informal/family caregivers. **I (Interest):** Nurse-led digital medication management, where nurses play a central role in utilizing digital solutions like electronic health records (EHRs), mobile applications, or telehealth tools to enhance patient care, streamline processes, and improve healthcare outcomes by overseeing and coordinating medication use in home care. **C (Context):** Home care, defined as healthcare services provided in older people's homes, supervised by community healthcare. **O (Outcome):** Medication safety, aimed at minimizing risks and optimizing patient care outcomes during prescribing, dispensing, administering, and monitoring medications' effects and side effects, ensuring overall patient safety.

Literature Search

This review was prompted by the lack of previous reviews integrating nurse-led initiatives and technology-assisted care for medication management in older people's home care. A comprehensive literature search was conducted across databases, including PubMed (covering MEDLINE), Scopus, CINAHL, ProQuest, and Embase, targeting studies published from January 1, 2014, to April 30, 2024, to ensure a focus on the most recent research. A pilot search on the Google Scholar was conducted to identify relevant keywords, leveraging personal research experiences. Search strings were created by translating Medical Subject Headings (MeSH) and thesaurus terms into database-compatible terms. Boolean logic and truncation were applied, using AND/OR operators. A librarian was consulted to ensure the search's accuracy. Various versions of key terms related to nurse-led care, medication management, technology-assisted care, older people, and home care were used (Supplemental File 2). Cross-references from article bibliographies and current review papers were also examined to enhance search coverage. Gray literature, including profiles on nurses' roles in home care medication management, was retrieved through a Google search.

Selecting Relevant Studies

All original research studies using qualitative, quantitative, or mixed-methods designs were considered, with selection criteria emphasizing: medication management in home care; involvement of older people as the primary age group; application of digital solutions; publication in peer-reviewed scientific journals in English. Exclusions included: commentaries, letters, case reports, case studies, conference proceedings, and books; medication management led by healthcare professionals other than nurses; studies published before 2014.

The search results were uploaded to the Rayyan platform for screening. Two review authors (MV and RT) independently screened and selected studies according to the eligibility criteria, first reviewing titles and abstracts, then full

texts. They reached consensus on article selection through discussions and shared findings. Tables summarizing study details were created, and the selection process was systematically documented. The authors discussed their perspectives to resolve disparities and decide on next steps. In cases of disagreement, input from the other review author (MLC) was sought to reach a final consensus.

Quality Appraisal

This review involved a thorough assessment of the credibility, relevance, and findings of the selected studies. The JBI Critical Appraisal Tools,³¹ tailored to the specific research methodologies (randomized clinical trials, cohort, quasi-experimental, and qualitative studies), were utilized. To assess the risk of bias, the RoB 2, ROBINS-E, and ROBINS-I tools³² were used for randomized clinical trials, cohort studies, and quasi-experimental studies, respectively. The robvis tool was employed to visualize the risk of bias assessment. The studies were evaluated independently to provide detailed explanations of their methodological quality. A joint decision was made on studies' inclusion or exclusion, considering their importance, methodological rigor, and potential bias, ensuring a well-informed and rigorous selection process.

Research Synthesis

Substantial variations in research methodologies, objectives, data collection tools, and measurement outcomes across experimental studies, including clinical trials, quasi-experimental, cohort, and the inclusion of qualitative studies, made a meta-analysis unfeasible. Therefore, the review results were presented descriptively and narratively, encompassing both statistical and non-statistical details to provide a comprehensive overview. To synthesize data, an extraction table was used to organize, summarize, and compare studies' results systematically. The data was arranged in a table format for easy comparison and categorization of characteristics relevant to the review focus. Collaborative teamwork allowed for thematic comparisons and analyses, resulting in meaningful categories that synthesized the findings.

Ethical Considerations

This review study did not require ethical approval as it did not involve human samples. However, efforts were made to properly acknowledge sources and adhere to citation practices respecting intellectual property rights.

Results

Search Outcome and Study Selection

The initial database search yielded 1629 studies (Supplemental file 3). After removing duplicates and

excluding studies based on titles and abstracts, 78 remained. A detailed full-text review narrowed this to 20 articles. The primary reasons for exclusion were that the studies were not nurse-led initiatives or focused on acute and ambulatory healthcare settings like hospitals. After evaluations using appropriate checklists all 20 articles were included for research synthesis. Figure 1 shows the PRISMA-based search process.

Methodological Quality Appraisal

The non-randomized controlled trials³³ and randomized clinical trials³⁴⁻⁴⁴ showed a causal relationship between variables with low bias risks, though some issues were noted in participant selection,³³ randomization,^{34,38,41,42} and missing data.⁴⁴ The cohort study⁴⁵ had clear definitions and adequate follow-up but faced challenges with measurement consistency and selection bias. Quasi-experimental⁴⁶⁻⁴⁹ studies were transparent and consistent but had concerns about group similarities.⁵⁰ Qualitative studies^{51,52} demonstrated appropriate design and credibility. Overall, all studies were deemed sufficient in quality and included in the research synthesis (Supplemental File 4).

General Characteristics of Included Studies

They were published in English, covering the last decade from 2014 to 2024. They originated from the USA,^{34,36,38,40,42,43,45,46,50} Canada,^{47,49} Sweden,⁴⁴ Japan,⁴¹ France,³⁵ Turkey,³⁷ Iran,³⁹ China,⁴⁸ and Finland.^{48,51,52} Regarding their research design, they were predominantly quantitative including 12 clinical trials³³⁻⁴⁴, 5 quasi-experimental studies⁴⁶⁻⁵⁰, 1 cohort study.⁴⁵ Additionally, there were 2 qualitative studies both employing inductive content analysis.^{51,52} Table 1 provides an overview of the selected studies and their general characteristics.

Nurse-Led Initiatives for Medication Management in Technology-assisted Home Care

The review findings were classified to categories of 'fundamental principles', 'nurses and their role identities', and 'enhanced care quality and medication safety' highlighting nurses' roles in medication management and their impact on improving patient safety in older people's home care (Table 2).

Fundamental principles. Technology-assisted care, encompassing a range of diverse approaches facilitated communication and patient contact, as well as helped implement strategies for medication management in home care.

The most common method was telephone.^{35,37,39,44,49,50} Also, in some studies a multimethod approach was used consisting of telephone and interactive video⁴⁰; tablet computer and video education⁴¹; tablet computers, electronic messaging, and electronic health records³⁸; cloud clinic,

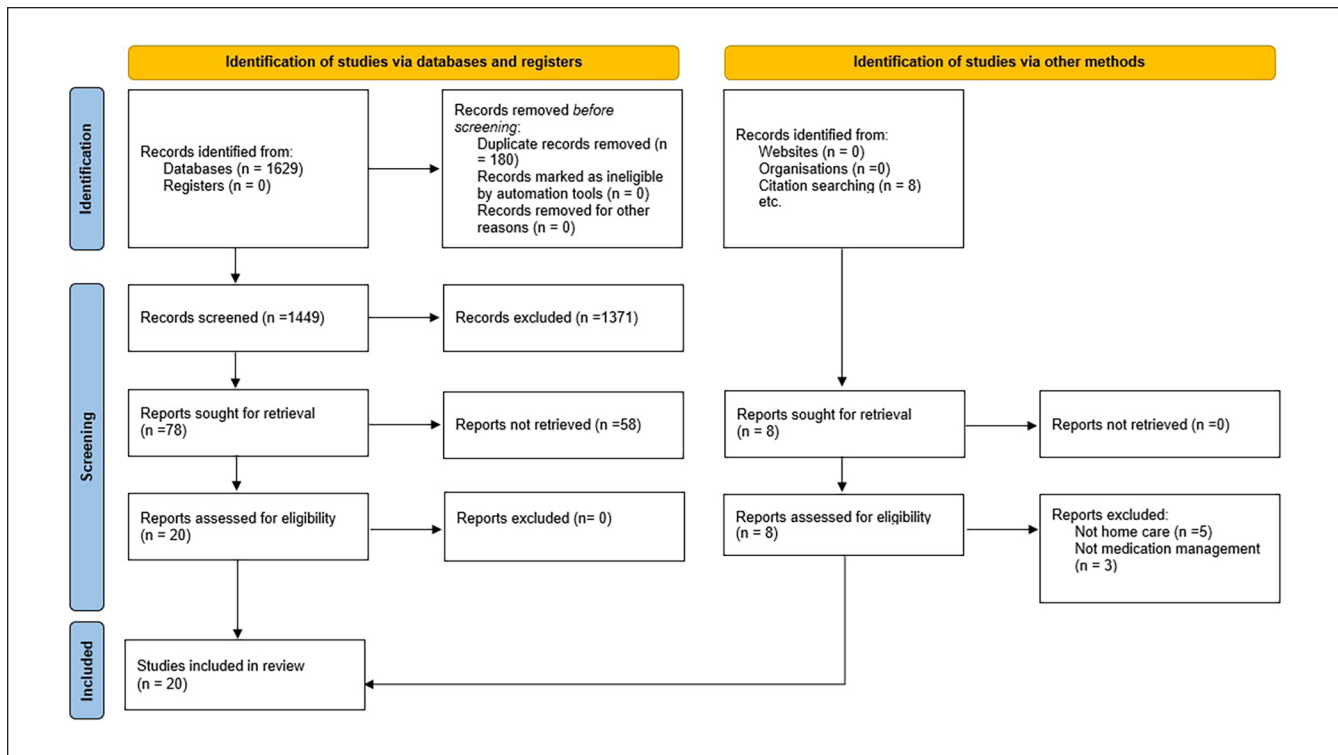


Figure 1. The search results according to the PRISMA.

app and telephone follow up⁴⁸; electronic health record and telephone⁴³; telerehabilitation, telephone or fax communication³⁶; electronics E-care system for remote monitoring and telephone.³⁴ Other methods were smartphone-based telemonitoring app⁴⁷; telemonitoring system for collecting daily physiologic data and symptoms⁴⁶; robots and machines for medication management in terms of a pill organizer machine⁴²; medications dispensing robot.^{33,51,52}

The foundation of nurse-led medication management initiatives in technology-assisted home care was a team-based approach, emphasizing the importance of teamwork and communication among healthcare professionals. Multidisciplinary collaboration, with nurses as central players, was crucial in fostering shared decision-making. Examples for the collaboration were: multidisciplinary healthcare teams with the variety of participants such as physicians, clinic nurses, physiotherapists, dieticians, and family caregivers to collaborate in transitional care program³⁷; collaboration by the pharmacist and nurse for loading medications into the machine and conducting a thorough pharmacy screening to identify potential drug interactions and inappropriate medication use⁴²; dispensing medications in single-dose bags by the pharmacist to be dispensed by the nurse into dosette^{33,51,52}; continuous care coordination by the nurse, primary care physicians, community medical directors, geriatricians, and pharmacist⁵⁰; provision of support and confirmation of the nurse decision by the neurologist and discharge physicians⁴⁵; medication practice and care by the multi-professional team

consisting of a cardiologist, clinical pharmacist, registered nurse, and nutritionist³⁹; continued care by the clinical physician based on the initial assessment, and chart audit and referral made by the nurse^{35,38,49}; addressing needs and concerns by the special clinical team⁴⁷; education, assessment, monitoring, and therapeutic activities by the nurse and then referral to the physician⁴⁶; nurse assessment and collaboration by the clinician and planning for referral⁴³; nurse and physical therapist-physician consisting of general internist and a palliative care physician/medical oncologist³⁶; obtaining consultation by the nurse from the specialist physician.^{34,44}

Nurses and their role identities. The nurses' expertise in older people home care were found essential for ensuring safe medication practice as they served as the point of reference for identifying and addressing risks and gaps in medication management. They also served as the central link between older people and the multidisciplinary healthcare team, facilitating coordination and communication among all parties.

Although the included studies did not specify the nurses' educational levels and expertise, they noted that nurses typically received additional education and training to manage medication in older people's home care. For instance, the nurses were introduced as psychiatric advanced practice nurse,⁴⁰ coordinator nurse,³⁷ advanced practice nurse,⁴² public health nurse, practical nurse, and registered nurse,^{33,44,51,52} geriatric nurse as discharge coordinator and transitional care

Table 1. The General Characteristics of the Selected Studies in This Review.

Author/country	Research methodology	Sample/setting	Type of technology-assisted care	Nurse qualification	Nurse's role in medication management
Blum and Gottlieb ³⁴ /USA	Randomized trial	204 Elderlies/own home	Telemonitoring Philips Electronics E-care System for remote monitoring, telephone	Heart failure nurse practitioner	Medication review
Delaney et al ⁴⁶ /USA	Pilot study/quasi-experimental	50 Patients in the intervention (n = 26) and control group (n = 24), 49 years to above 90 years with most patients (71 %) between the ages of 70 and 90/own home	Physiological telemonitoring system	Nurse trained in heart failure	Medication review
Marek et al ⁴² /USA	Randomized, controlled, three-arm longitudinal study	Older adults from elderly care home health care (n = 414)/own home	Medication-dispensing machine	APNs and RNs coordinated care for drug screening to identify interactions	Medication dispensing
Feldman et al ³⁸ /USA	Three-arm cluster randomized trial	845 Patients as elderlies/own home	Email	Home care field nurse	Medication assessment, monitoring, education and self-management support
Grubbs et al ⁴⁰ /USA	Randomized control trial	Veterans (n = 132) with posttraumatic stress disorder recruited from 5 large- (5000-10,000 patients) and 6 medium-sized/own home, community-based outpatient clinics	Telemedicine: inter-active video	Psychiatric advanced practice nurse	Medication review
Ögren et al ⁴¹ /Sweden	Randomized controlled trial	660 Older people in the intervention and control group/own home	Telephone follow up	Practical nurse	Medication titration
Parsell et al ⁴³ /USA	3-Group cluster randomized clinical trial	794 Participants/own home	EHR, telephone	Nurse educator	Medication therapy management
Chevillat et al ³⁶ /USA	3-Arm randomized clinical trial	516 Elderlies/own home	Telerehabilitation, telephone or fax communication	Nurse pain care manager	Pharmacological pain management
Gordon et al ⁴⁷ /Canada	A pragmatic, multimethod feasibility study	26 Participants/own home	Smartphone-based telemonitoring app	Clinical nurse	Medication review
Kazawa et al ⁴¹ /Japan	Post-hoc analysis of randomized controlled trial	40 Company employees: intervention group (n = 21), control group (n = 19)/own home	Telenursing, video	Corresponding nurse	Medication review
Bouletour et al ³⁵ /France	A randomized, multicentre, controlled trial	183 Patients elderlies: 92 and 91 patients to intervention and control groups/own home	Telephone follow-up	Trained nurse	Adherence to medication, management of potential drug toxicities
Stacey et al ⁴⁹ /Canada	Quality improvement	113 Audio-recorded calls for patients aged 64 years/own home	Telephone	Oncology nurse	Medication review, relevant to symptoms
Coskun and Duygulu ³⁷ /Turkey	Randomized control trial	66 Elderly patients in the intervention (n = 33) and control (n = 33) groups/own home	Telephone follow up at sixth month of discharge	Clinical nurse and coordinator nurse	Medication review
Ghobadi et al ³⁹ /Iran	Clinical trial	94 HF patients with comorbidities: intervention (n = 47) and control (n = 47)/own home	Telephone follow-ups	Experienced nurse in heart failure	Medication instructions
Huang et al ⁴⁸ /China	Quasi-experimental, non-equivalent, two-group, comparison group design	339 Patients in the intervention and 333 patients in the control group/own home	Cloud clinic, app and telephone follow up for online insulin injection activities	Clinical nurse	Insulin therapy
Jun-O'Connell et al ⁴⁵ /USA	Cohort	447 Consecutive stroke patients/own home	Telephone	Stroke nurse navigator	Medication review
Kajander-Unkuri et al ³³ /Finland	A pragmatic non-randomized controlled clinical trial	Intervention groups and control groups (n = 64 and 46 elderly people)/own home	Robot for medication management	Public health nurses, practical nurses, and registered nurses	Loading medications inside the robot enabling older home care clients to carry out medication management
Sison et al ⁵⁰ /USA	Quality improvement initiative	35 Veterans as elderlies/own home	Telephone-based intervention	RN with geriatric experience in inpatient, outpatient, and home care settings, discharge coordinator and transitional care case manager	Medication reconciliation
Turjamaa et al ⁵² /Finland	Qualitative interview study	38 Older home care clients/own home	Robot for medication management	Practical nurse	Dispensing medications
Turjamaa et al ⁵¹ /Finland	Qualitative focus group interview study	62 Home care professionals/own home	Robot for medication management	Practical nurse	Dispensing medications

Note. APN, advanced practice nurse; RN, registered nurse; EHR, electronic health record; HF, heart failure.

Table 2. The Summary of the Selected Studies' Results.

Author	Outcome of the intervention for medication management	Nurse's role within the multidisciplinary team	Patient safety indicator	Implications for patient safety
Blum and Gottlieb ³⁴	No difference in 30-day readmissions ($P = .627$) or mortality ($P = .575$) between the groups. Improvements between the groups ($P > .05$), no differences in Medicare payments for inpatient or emergency department visits, and length of stay, percentage of patients readmitted within 30 days was initially lower with telemonitoring during the first year, but this effect did not persist over time	Nurse practitioner and consultation with a cardiologist	Quality of life, readmission, costs	Maintaining communication, offering encouragement, and addressing any inquiries with the probable impact on unnecessary readmissions and referral to the hospital
Delaney et al ⁴⁶	Improved understanding of medication (M/S/D: 3.83, 0.491, $P < .001$); non-significant trend toward improved quality of life and fewer hospital readmissions (9 vs 6 patients)	Nurse-directed multicomponent home care intervention and cardiac program manager and referral to the physician	Medications—prescription and over the counter drugs, readmission	Education, assessment, remote-monitoring, and therapeutic activities based on the self-care model to develop own daily routine and regularly take medications
Marek et al ⁴²	Pill organizer intervention cost \$151 monthly, resulting in savings of \$296 monthly or \$3552 annually. Medication-dispensing machine intervention cost \$251 monthly, with Medicare costs \$409 higher monthly compared to the pill organizer group	Care coordination by advanced practice nurses and RNs involving physicians, pharmacists, social workers, and other service providers; medication screening by pharmacist and advanced practice nurses	Pill organizers helped in organizing and remembering medication schedules, while medication dispensing machines were preloaded with medications in reusable plastic cups	Evaluations and care plan encouraging patients and their families for medication self-management behaviors, frequent communication between the medication management team and the patient
Feldman et al ³⁸	No significant differences at the 12-month mark in BP control rates (control: 25% vs intervention: 22%), systolic BP (143.8 mmHg vs 143.9 mmHg), and medication intensification rates (47% vs 54%); compliance score ranged from 1.15 to 11.7 indicating a significantly higher level of medication adherence	Home care nurse, and health educator along with the primary care physician	Medication intensification as taking new medications, and patient-reported hypertension self-management	Hypertension medication assessment, monitoring, education, and self-management support, the nurse collaborated with home care nurses to enhance patients' comprehension of their hypertension risk factors and medication routines, encouraging them to convey their concerns to their personal physicians
Grubbs et al ⁴⁰	Collaborative care: 72% at least one medication management session in year, 30% via interactive video, 3.7 encounters per year	Two to third of medication management encounters with the nurse and the rest with the prescriber physician	Medication management encounters	Providing high rates of medication management encounters, including remote sessions via interactive video without onsite mental health services
Ögren et al ⁴⁴	A higher percentage of the intervention group compared with the control achieved the treatment goal for BP (systolic: 79.4% vs 55.3%, $P < .001$; diastolic: 90.3% vs 77.9%, $P < .001$) and for LDL-C (69.3% vs 48.9%, $P < .001$)	Practical nurse along with a consultant physician	Compliance with the treatment and reaching the target LDL-C and BP based on individual-adjusted medications	Improved medication titration and the proportion of patients that reached the treatment target at follow up, creating the opportunity to discuss their treatment and potential side effects with the nurse, likely increasing medication adherence. The intervention's positive outcomes are attributed to reduced therapeutic inertia and improved adherence
Persell et al ⁴³	In the electronic health record plus education group, systolic BP was lower compared to the EHR-alone group (-5.6 mmHg; 95% CI: -8.8 to -2.4 mm Hg), at 12 months, greater medication reconciliation for hypertension medications (OR: 2.0 [95% CI: 1.3-3.3; $P = .003$]) and all long-term medications (OR for both comparisons, 2.5; 95% CI: 1.2-5.2; $P = .02$) were in the electronic health record plus education group, understanding of medication instructions and dosing was higher in the electronic health record plus education group compared to the usual care group for hypertension medications (OR: 2.3; 95% CI: 1.1-4.8) and all medications combined (OR: 1.7; 95% CI: 1.0-2.8), reconciliation of all medications was higher in the electronic health record plus education group compared to the usual care group (OR: 6.0; 95% CI: 1.1-32.2; $P = .04$)	Nurse educator and communicating the review results to the clinician and planning for referral	Identifying possible medication errors such as duplicates or internal discrepancies, and pinpoint areas requiring monitoring and subsequent follow-up, medication comprehension assessments, medication usage patterns, reconciling with electronic health records, consolidating dosing regimens, and creating medication tables for complex regimens, assessing adherence, improper usage patterns, and reasons for nonadherence	Improving patients' understanding of their chronic conditions, addressing misconceptions and the importance of medications, medication education and review, proactive follow up by the nurse, combining EHR with nurse-led self-management education causes greater reductions in BP demonstrating the importance of understanding of medication instructions and dosing

(continued)

Table 2. (continued)

Author	Outcome of the intervention for medication management	Nurse's role within the multidisciplinary team	Patient safety indicator	Implications for patient safety
Chevile et al ³⁶	Reduction in pain interference (-0.4; 95% CI: -0.79- to -0.10; $P=0.01$) and average intensity (-0.5; 95% CI: -0.84- to -0.11; $P=0.06$), higher odds of home discharge (OR, 3.8; 95% CI, 1.1-12.4; $P=0.03$)	Nurse-coordinated pharmacological pain management by a nurse pain care manager in collaboration with a general therapist-physician team as physical internist and a palliative care physician/medical oncologist	Tracking pain and treatment recommendations	Improving function and better pain control via collaborative tele-rehabilitation within a multidisciplinary team
Gordon et al ⁴⁷	56%, 55%, 72% of heart failure, hypertension, and diabetes mellitus, maintained adherence to physiological readings, respectively	Nurse-led care and connecting the patient to the clinical team to address symptoms, cross-condition needs, and concerns	Adherence to self-monitoring and medication use	Improving patient-clinician communication and connecting to the personal clinician, visualizing live data, and assuring patients that the team was taking care of their health, receiving immediate feedback, proactive calling by the nurse
Kazawa et al 2020 ⁴¹	Comparing medication intake and improvement in main clinical indicators, the distance method was equally effective as the direct face-to-face method (95% CI: -3.50 (-8.92 to 1.92))	Education by the corresponding nurse for self-monitoring medications and management	Self-management behaviors	Self-management as to take or inject medications daily and taking the necessary action in case of missing the dose self-management behaviors
Bouletfour et al ³⁵	Medium medication adherence (81.3%), reduction in the number of patients experiencing grade 3 adverse events during the follow-up period (18.5% vs 33%; OR: 0.45 [95% CI: 0.23, 0.9]; $P=0.03$). Toxicities were mild to moderate (grade 1 and grade 2), with asthenia and pain being the most common. Improvement in mucositis, rash, and anorexia with no effect on diarrhea and nausea symptoms	Monitoring and follow up by the nurse and further referral to the physician	Identifying toxicities and expected adverse effects	Early identification and improvement in grade 3 toxicities' management to enhance adherence to medications
Stacey et al ⁴⁹	Symptoms resolved (38%), worsened (25%), remained unchanged (3%), or had unknown status (33%). Eight patients (13%) visited the emergency department	Documentation of cancer-related symptoms receiving therapies and medications by the nurse using a chart audit for referral to the oncologist	Review of medications relevant to the symptom, patient agreement/commitment to continue or initiate medications	More possibility to work within nursing scope of practice and less inclusion for the immediate referral of patient-reported symptoms to oncologists, lack familiarity or comfort with nurse role's scope without the remote support tool
Coskun and Duygulu ³⁷	Higher level of functional autonomy and quality of life of patients at ninth week ($P<0.05$), less repeated hospitalization ($n=2$) or emergency service referral ($n=1$) at the 6-month follow-up ($P<0.05$) for medication adjustments	Nurse led transitional care model team: physician, clinic nurses, coordinator nurse, physiotherapist, dietician, caregiver/family member	Functional autonomy, quality of life levels, and repeated admission/re-hospitalization rates to the clinic	Coordinated care planning by the multidisciplinary team and consultancy at post-discharge care
Ghobadi et al ³⁹	Mean changes in total scores of symptom burden and medication adherence at various time points ($P<0.001$) indicating an increase in medication adherence and reduction symptoms' burden	Multidisciplinary management program supervised by the nurse consisting of cardiologist, clinical pharmacist, and nutritionist	Self-management and self-monitoring and multi-drug management	Liaison role between patients and the multi-professional management team, managing new and multiple symptoms in comorbidities, and directing the patient to overcome obstacles to adherence to numerous medications
Huang et al ⁴⁸	At 3 and 6 months after the intervention, significant differences in compliance rates for fasting BP (sixth month rate difference: 0.077, 95% CI: 0.007-0.14, $P<0.05$) and HbA1c (%) (sixth month rate difference: 0.106, 95% CI: 0.324-0.180, $P<0.01$) between the intervention and control groups, "my opinion on Insulin" scale was in the group was (intervention: 80.18 ± 6.68 vs control: 71.15 ± 8.17; mean difference: 9.03, 95% CI: 7.900-10.160, $P<0.01$), daily insulin dosages sixth month: Intervention M1SD: 16.10 ± 3.12 and control: 18.25 ± 3.32 (mean difference: 2.14, $P<0.01$)	Nurse-led video education regarding insulin injection activities	Reduction of the patient's daily insulin dose and improvement of the patients' compliance using insulin therapy	Implementing a safe, standardized, and consistent approach to patients with diabetes mellitus undergoing initial basal insulin therapy during post-discharge follow-up

(continued)

Table 2. (continued)

Author	Outcome of the intervention for medication management	Nurse's role within the multidisciplinary team	Patient safety indicator	Implications for patient safety
Jun-O'Connell et al ⁴⁵	A greater utilization of mechanical thrombectomy (35.6% vs 24.7%, $P = .016$), lower usage of pre-admission oral anticoagulants (1.3% vs 5.6%, $P = .025$), and a lower frequency of previous stroke/transient ischemic attack (14.4% vs 27.5%, $P = .001$), lower 30-day unplanned readmission rates (log-rank $P = .029$), with reduced risks of such readmissions (adjusted HR 0.48, 95% CI 0.23–0.99, $P = .046$)	Medication review and discharge plan verification follow up by the nurse along with support and confirmation by the neurologist and discharge physicians	Medication usage and side effects and complications, readmission	Standardized follow-up transition plan, verification of medications for post-discharge use, and an early identification of complications
Kajander-Unkuri et al ³³	Number of home visits significantly reduced by 89.4% at the 1-month follow-up (from 878 to 93 visits) and by 92.5% at the 2-month follow-up (from 878 to 66 visits, $P < .001$)	Dispensing medications for home care use by the pharmacist, and manual dispersion of medications to the dosette by the nurse	Dispensing right medications at right times, monitoring medication use at home	Reduced time spent on medication management leads to less time available for tasks such as ordering medications, monitoring their effects, and providing medication education
Sison et al ⁵⁰	Nine medication discrepancies in 8 patients (22.9%), with an average of 1.1 discrepancies per patient; 5 discrepancies (56%) due to incomplete medication reconciliation at discharge, and 5 (56%) had potential for serious harm, a higher percentage of patients received a post-discharge call within 7 days (82.9% vs 61.9%; $P = .03$). Of 35 veterans participating in the program, the nurse identified 9 medication discrepancies in 8 patients (22.9%; average of 1.1 discrepancies per patient)	Nurse as discharge coordinator and transitional care case manager to perform detailed medication reconciliation, follow-up with primary care physician, geriatricians, and pharmacist	Medication reconciliation	Serving as a central contact for the patient's post-discharge care involving consistent communication with various stakeholders regarding the patient's requirements, medication supply, and offering guidance and education to the patient and caregiver, identifying medication discrepancies, and appropriate intervention to prevent harm
Turjamaa et al ⁵²	Positive experiences with medication technology but caused daily life challenges; implementation required practice with a nurse; participants felt excluded from the development process	Pharmacists dispensed medications for home care, while nurses manually prepared medication doses in dosette	Accurate dispensing of medications at the correct times and allowed for monitoring of medication usage at home, maintaining an electronic record of medication use	Ensuring a safe medication process, scheduling daily routines, fostering independence from home care professionals' schedules, minimizing the impact on professionals' busy work, no need for memorizing medications, but the challenge of medication use on a trip
Turjamaa et al ⁵¹	Home care professionals required competence including familiarity with digital solutions, addressing preconceived attitudes, and assessing the robot's suitability for older individuals while advising on its usage	Pharmacists dispensed medications for home care, while nurses prepared doses in dosette	Experiences of the implementation, use and competence needs of a robot	Enabling home care professionals to schedule and conduct visits more flexibly, the robot was accessible 24/7, offering individual training opportunities, written and illustrated information sheets enhanced understanding of robot usage, need for improving proficiency and competence in the digital health, access to experts should be ensured during holidays to safeguard the medication process

Note. RN, registered nurse; BP, blood pressure; LDL-C, low-density lipoprotein cholesterol; EHR, electronic health record; CI, confidence interval; OR, odds ratio; HbA1c, hemoglobin A1C; HR, hazard ratio.

case manager,⁵⁰ stroke nurse,⁴⁵ experienced nurse in heart failure, nurse trained in heart failure, and heart failure nurse practitioner,^{34,39,46} trained nurse in toxicities and side effects of medications,³⁵ oncology nurse,⁴⁹ clinical nurse,⁴⁷ corresponding nurse,⁴¹ home care field nurse,³⁸ clinical nurse,⁴⁸ nurse educator,⁴³ and nurse pain care manager.³⁶

The nurses' role was mainly to educate older people and empower them and their families to actively participate in medication management initiatives. In line with their roles in continuous monitoring and evaluation, nurses assessed medications, identified areas for improvement, and adapted strategies to prevent harm. They encouraged the older people to attend medication management sessions⁴⁰ and engaged them and supported their families' involvement through continuous communication.³⁷ The older people were empowered to report physiological readings online and use an automated phone call system for reporting missed readings, that was adjustable to their needs and requests. This direct connectivity facilitated patient-nurse communication and cooperation.^{38,47} Also, older people were monitored for functionality and pain through automated systems every other week during the first month, and then monthly using interactive voice recognition phone calls or web-based surveys.³⁶

While medication management was monitored online, the older people were responsible for taking their medications independently and remembering doses to ensure the safe use of medication robots.^{33,51,52} Regular visits to fill medication organizers or machines, with the frequency adjusted as needed, were carried out.⁴²

Older people could manage symptoms at home based on guidance from nurses.^{39,49} Nurses remotely monitored symptoms based on reports, flagged abnormal readings, adjusted medications accordingly, and discussed treatment, side effects, and strategies to improve medication adherence.^{34,44}

Education through video tutorials and guidebooks focused on self-monitoring and symptom management aimed at encouraging behavioral changes and proper medication use,⁴¹ as well as self-injection of medications post-discharge.⁴⁸ Nurses' roles included training, counseling, medication reconciliation, follow-up, and planned contacts and check-ups. They reinforced medication use, managed refills and renewals, and addressed misconceptions on a weekly and monthly basis after discharge.^{37,39,43,45,46}

Enhanced care quality and medication safety. Nurse-led medication management in technology-assisted care improved quality of care and medication safety for older people across various domains. Post-discharge follow-ups revealed higher autonomy scores, improved functionality, fewer symptoms, and a better quality of life among older people.^{36,37} Improved home discharge and reduced readmissions and emergency visits were also observed.^{34,36,37,45,49} Additionally, the improved medication reconciliation resulted in reduced use of coagulation medications, adjustments in medications, and titration for better symptom control, leading to less frequent

occurrences of ischemia and stroke.^{38,43-45,48} Approximately one-fourth of older people had medication discrepancies identified, prompting early interventions.⁵⁰

Further improvements included increased medication adherence, reduced physical and psychological symptom burden, and observed behavioral changes over time.^{35,39,41,47,48} Also, streamlined daily routines, fostered independence from caregiver schedules, and lessened the burden on healthcare professionals were observed.⁵¹ Moreover, there was an enhanced understanding of medication instructions and dosing.^{43,46,48} Cost-effectiveness for Medicare beneficiaries was demonstrated.⁴²

For medication management using robots, healthcare professionals' responsibilities transitioned to tasks such as ordering medications, monitoring their effects, and providing medication education. It optimized time use and ensured efficient medication management. Also, electronic records were maintained ensuring round-the-clock availability and monitoring for timely interventions.^{33,51,52}

Discussion

This review aimed to identify and describe nurse-led roles in medication management in home care for older people within the context of technology-assisted care. It also identified the advantages of technology-assisted care in home care for older people and its impact on medication safety (Figure 2).

Nurse-led technology-assisted care enhanced communication between older people and the healthcare team for medication management, employing home-based technologies. Telehealth, including telemonitoring, teleconsultation, teleassistance, tele-homecare, telerehabilitation, and mobile health, supports post-discharge care by enhancing quality of life, reducing re-hospitalizations, shortening hospital stays, lowering healthcare costs, and improving health indicators and symptoms.⁵³⁻⁵⁵ They enable monitoring and education by the multidisciplinary team and are central to modern healthcare delivery.⁵⁶ Home health technologies, often used for tracking daily activities and managing conditions such as cognitive decline and heart issues in older people, significantly enhance their care.⁵⁷ By offering smart home care, they support daily tasks and social interactions, thereby extending older individuals' ability to live independently at home.⁵⁸ Technology-assisted care can enhance caregivers' perceived competence⁵⁹ especially in medication management by improving medication adherence at home.^{60,61} However, addressing challenges such as patient and provider acceptance, low digital literacy, limited device access, individual customization, and healthcare system support for sustainable long-term use is essential.⁶²⁻⁶⁴

In this review, nurse-led medication management in technology-assisted care was established on the foundation of teamwork, highlighting the importance of collaboration and communication among the multidisciplinary healthcare team. Home-based medication management

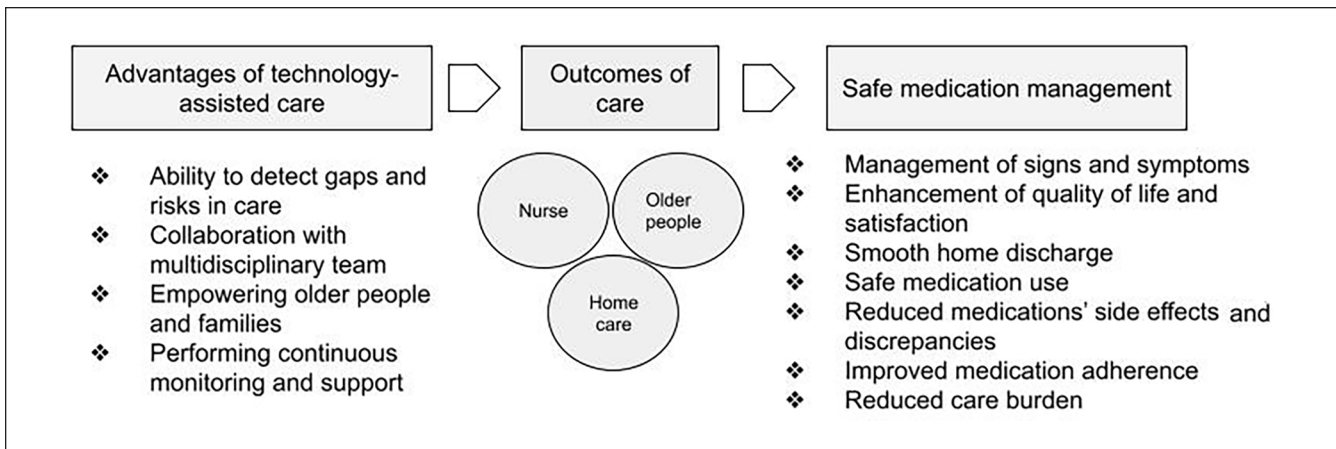


Figure 2. Advantages and impacts of technology-assisted home care on medication management.

emphasizes care burden on family caregivers with risk factors such as inadequate interprofessional communication and unstandardized medication reconciliation.^{65,66} Therefore, an interdisciplinary approach to primary care is widely advocated, emphasizing the need for organized care and resources tailored to support family caregivers. This approach aims to provide individualized, integrated care by leveraging contributions from all healthcare providers to optimize long-term care.^{12,67} Key roles within interdisciplinary teams, such as patient education, coping, symptom management, follow-up, and care planning are crucial.⁶⁸ Collaboration is vital for implementing information and communication technology in care, positively influencing healthcare providers' adoption.⁶⁹ Interprofessional collaboration can reduce hospital stays and readmissions, decrease medication errors, improve dose adjustments and medication deprescription, and enhance satisfaction and adherence.^{70,71}

In this review, nurse-led initiatives highlighted the importance of nurses' expertise in older people's care for ensuring safe medication practices. These interventions include both long-term and short-term management efforts to improve the quality of older people care.⁷² Nursing diagnoses have been shown to serve as valuable predictors for hospital stay length and care outcomes such as mortality and quality of life.⁷³ Nurse-led initiatives have been shown effective in reversing frailty, improving physical functioning, nutritional status, quality of life, social support perceptions, mental health, and reducing depression.⁷⁴ Nurses, when assuming leadership roles, can integrate their unique knowledge and practice to address potential barriers and conflicts within teams.⁷⁵ Implementation of nurse-led interventions is influenced by policies, organizational culture, management support, and attitudes toward the nurse's role.^{76,77}

The review findings indicated that nurses played a crucial role in educating and empowering older people and their families to actively participate in their care and safety,

especially regarding self-medication and symptom management. Effective home-based transitional care programs should include education, training, and self-management components.⁷⁸ Patient-led educational approaches can reduce stress and financial burdens while improving care quality and knowledge.⁷⁹ Nursing support for family caregivers should offer psychological and educational assistance using information and communication technology.^{80,81} Attention should focus on the needs of both caregivers and older people, emphasizing self-management, decision-making, advance care planning, and shared responsibilities.^{82,83} Adherence to self-medication at home is associated with higher satisfaction, cost savings, and reduced healthcare referrals and readmissions.^{84,85}

Nurse-led medication management in technology-assisted care in this review enhanced quality of care and medication safety across multiple dimensions. These improvements included better symptom management, reduced medication use, early detection of effects and side effects, and increased medication adherence. This led to enhanced quality of life, fewer readmissions, and reduced healthcare and emergency referrals. International literature shows that nurse-led interventions are more effective than standard care in alleviating symptoms and improving quality of life for older people.⁸⁶ Web-based interventions led by nurses have emerged as promising complements to routine clinical care.⁸⁷ Nurse telephone follow-up serves as a convenient method to ensure continuity of care leading to improved care adjustment, self-efficacy, higher satisfaction, and fewer complications.⁸⁸ Nurse-led interventions utilizing real-time communication through digital technologies enhance self-management in terms of medication adherence through patient-centered interventions and shared decision-making, overcoming space and time limitations.^{28,89} During the COVID-19 pandemic, nurse-led telehealth interventions for community-dwelling outpatients delivered effective, efficient, and high-quality patient care.⁹⁰

Limitations

To the best of our knowledge, this is the first systematic review to integrate current international knowledge on the evolving leadership roles of nurses in medication management in home care for older people within the context of technology-assisted care. Only 20 articles specifically examined this phenomenon. This review excluded material pre-dating 2014, potentially overlooking early concerns or challenges regarding technology-assisted home care in nursing practice. The limited existing knowledge impedes a comprehensive understanding and improvement of safety protocols specific to nurses' leadership roles in medication safety via technology-assisted care. Focusing on English-language studies may have introduced language bias, potentially excluding relevant research in other languages. Selection bias was mitigated by including both qualitative and quantitative studies, though the varied quality and diverse study designs could have influenced the findings. Future research is essential to bridge the knowledge gap and detail nurses' competencies in interdisciplinary teams for medication management in home care and its impact on care outcomes. Modeling research is needed to create clinical guidelines that support nurse-led medication safety initiatives in technology-assisted home care.

Conclusion

Nurse-led initiatives in technology-assisted home care can greatly enhance older people's care, especially in medication management. It enables nurses to monitor patients more effectively, improve symptom management, and medication adherence. Standardized training programs are required for nurses to improve their knowledge and expertise regarding technology-assisted care to maintain high standards in nursing and improve patient safety. Also, policymakers and home care managers should support technology-assisted nursing care through funding, guidelines, and equitable access to digital health solutions.

A multidisciplinary team-based approach including nurses, physicians, pharmacists, and caregivers for optimizing resources and improving medication outcomes should be developed. In addition, nurses should prioritize educating older people and involving them and their family caregivers in care decisions to enhance their responsibility and awareness regarding medication management in home care.

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All authors (MV, MLC, RT) made a substantial contribution to the concept or design of the work; or acquisition, analysis or interpretation of data, drafted the article or revised it critically for important intellectual content, and approved the version to be published.

Data Availability Statement

The data that support the findings of this review are available upon a reasonable request from the corresponding author.

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Supplemental Material

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