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Research Article

Pharmacist Interventions to Reduce Inappropriate Medication Use in Older Adults

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ABSTRACT

Potentially inappropriate medications (PIMs) represent a significant problem in geriatric care due to age-related physiological changes, multiple chronic conditions, and the increasing prevalence of polypharmacy among older adults. Inappropriate prescribing has been linked to adverse drug effects, hospitalizations owing to side effects of medications, disability, diminished quality of life, and higher health care costs. Medication review, deprescribing programs, patient education, clinical decision support, and collaboration with other health care professionals have all become important ways for pharmacists to help identify, prevent, and decrease inappropriate medication use. This systematic review examines the impact of pharmacist-led interventions to promote more effective prescribing and medication safety in older people in hospitals, the community, and long-term care environments. Randomized controlled trials, observational studies, and systematic reviews have all shown that pharmacist interventions are effective in reducing PIMs, optimizing therapeutic outcomes, and improving health outcomes of patients. It also explores the barriers to the implementation of pharmacist-led interventions, such as limited integration with the healthcare system, communication issues, and limited availability of resources. Enhancing collaborative care models and expanding pharmacist involvement in geriatric medication management may further improve medication appropriateness and patient safety among older adults.

Keywords: Polypharmacy; Deprescribing; Geriatric Pharmacotherapy; Medication Safety; Potentially Inappropriate Medications; Clinical Pharmacy.

INTRODUCTION

Population ageing has emerged as a giant health care challenge for the world, and greater proportions of older people are living with diseases that demand chronic treatment using medications. With multiple chronic conditions like hypertension, diabetes mellitus, cardiovascular diseases, arthritis, and cognitive disorders, as individuals age, they may be taking multiple medications simultaneously, known as polypharmacy [7]. Medications are still necessary to manage and improve the quality of life and outcomes of patients when they have one or multiple diseases. Overprescribing and incorrect dosing of medications have become a major source of poor clinical outcomes and higher rates of health care utilization.

Physiological changes associated with age affect drug absorption, distribution, metabolism, and excretion in older adults, making them more susceptible to medication-related adverse events. The resulting changes in pharmacokinetics and pharmacodynamics increase the risk of adverse drug reactions, drug-drug interactions, medication adherence, cognitive dysfunction, falls, frailty, hospitalization, and mortality [8]. Potentially inappropriate medicines (PIMs) are those that have risks that are not warranted in the context of the benefits and where safer or more effective alternatives are available. Overprescribing, therapeutic duplication, underprescribing, prescribing medications for longer than necessary when not required, and prescription of high-risk medicines in older people are all examples of inappropriate prescribing [10].

The use of potentially inappropriate medications is still common in hospitals, long-term care communities, and assisted living facilities for older patients. Several studies have shown that inappropriate use of drugs significantly contributes to preventable adverse drug events and/or to the cost of health care [3]. To address these concerns, healthcare systems have increasingly focused on interventions that aim to optimize the use of medicines and improve prescribing quality in older people. Screening tools such as the Beers Criteria and STOPP/START are well established to detect inappropriate medications and inform safe prescribing practices [2].

The pharmacist is now a key member of the multidisciplinary healthcare work team that is engaged in medication optimization in older adults. They have advanced knowledge in pharmacotherapy, which can be used to identify Medication Related Problems, perform thorough medication reviews, suggest therapeutic adjustments, and counsel patients. In multiple health care settings, interventions led by a pharmacist have been shown to lower the rate of inappropriate medication use and enhance patient outcomes, such as in the hospital, primary care clinic, community pharmacy, and nursing home [4]. These could include medication reconciliation, deprescribing

programs, education for healthcare providers and patients, clinical decision support, and collaborative care models.

Randomized controlled trials and systematic reviews have demonstrated that interventions by pharmacists can substantially decrease the use of potentially inappropriate medications and enhance medication appropriateness among older adults. For example, the D-PRESCRIBE randomized clinical trial showed that the educational interventions that pharmacists can deliver directly to physicians and engage patients in the process were effective in decreasing inappropriate medication prescriptions [1]. Likewise, deprescribing by clinical pharmacists has been linked to decreased medication burden, enhanced therapeutic results, and less risk of adverse drug reactions [9], [14].

Pharmacist participation has also been associated with decreased medication-related issues, inpatient admission, and discharging patients into inappropriate care settings in inpatient and transitional care facilities [5], [12]. In addition, systematic reviews that assessed pharmacist-led interventions in various geriatric populations consistently demonstrated positive effects on medication safety and prescribing quality [2], [15]. Even with these advantages, existing challenges include poor integration of healthcare services, poor sharing of information between healthcare professionals, workforce challenges, and poor reimbursement mechanisms to support widespread implementation of pharmacist-led medication optimization programs.

As medication management becomes more complex in older people, there has been a need to develop evidence-based strategies to support safe, effective, and patient-centered prescribing practices. Pharmacists continue to play a key role in these roles and have opportunities for specific and collaborative interventions that can help to minimize potentially inappropriate medication use and improve geriatric care. This systematic review evaluates the effectiveness of pharmacist-led interventions in reducing inappropriate medication use in older people, and explores the potential for future research and challenges to enhance medication safety in the ageing population.

Potentially Inappropriate Medication Use in Older Adults

Potentially inappropriate medication use remains a significant challenge in geriatric healthcare, driven by multimorbidity, polypharmacy, and the complex medication needs of older adults. Age-related physiological changes increase vulnerability to adverse drug reactions, while inappropriate prescribing and inadequate medication review processes can further compromise patient safety and healthcare quality [7]. The complexity of medication management is often compounded by fragmented healthcare delivery and multiple concurrent chronic conditions.

Potentially inappropriate medications (PIMs) are defined as medications for which the potential risks outweigh the anticipated clinical benefits, particularly when safer therapeutic alternatives are available. Inappropriate prescribing may involve overprescribing, underprescribing, incorrect dosing protocols, prolonged medication use without clinical indication, drug-drug interactions, and therapeutic duplication [8]. The burden of inappropriate medication use has attracted substantial attention due to its association with increased hospitalization, risk of falls, cognitive decline, frailty, reduced quality of life, and mortality among older adults.

Concept and Definition of Potentially Inappropriate Medications

Potentially inappropriate medications refer to medications that pose higher risks than benefits in older adults because of altered pharmacokinetic and pharmacodynamic characteristics associated with ageing. Age-related reductions in renal and hepatic function may impair drug metabolism and excretion, leading to drug accumulation and toxicity. Additionally, changes in body composition, including reduced muscle mass and increased fat distribution, can alter drug distribution and therapeutic response [10].

The concept of inappropriate prescribing extends beyond the use of harmful medications alone. It also includes the omission of clinically indicated medications, inappropriate duration of therapy, unnecessary polypharmacy, and inadequate monitoring of treatment outcomes. Explicit screening tools such as the Beers Criteria and the STOPP/START criteria have been developed to identify medications that should be avoided or used cautiously in older populations [2]. These tools have become important resources for clinicians and pharmacists in evaluating prescribing appropriateness and reducing medication-related harm.

Several medication classes are frequently implicated as potentially inappropriate in older adults. These include benzodiazepines, anticholinergic drugs, nonsteroidal anti-inflammatory drugs (NSAIDs), certain antipsychotics, sedative-hypnotics, and long-acting sulfonylureas. The use of these medications has been associated with increased risks of falls, confusion, delirium, fractures, gastrointestinal bleeding, and cardiovascular complications [3].

Prevalence of Inappropriate Medication Use in Older Adults

The prevalence of potentially inappropriate medication use remains high globally across hospital, primary care, and long-term care settings. Studies have reported considerable variability in prevalence rates depending on healthcare setting, prescribing criteria used, and patient characteristics. Older adults with multiple chronic conditions and those receiving care from multiple healthcare providers are particularly vulnerable to inappropriate prescribing practices [4].

Polypharmacy is one of the strongest predictors of inappropriate medication use among older adults. The concurrent use of multiple

Table 1: Common Potentially Inappropriate Medications in Older Adults and Associated Clinical Risks

Medication Class	*Examples*	*Major Risks in Older Adults*
Benzodiazepines	Diazepam, Lorazepam	Falls, sedation, cognitive impairment
Anticholinergics	Diphenhydramine	Delirium, constipation, urinary retention
NSAIDs	Ibuprofen, Diclofenac	Gastrointestinal bleeding, renal impairment
Antipsychotics	Haloperidol	Stroke risk, mortality, sedation
Sulfonylureas	Glyburide	Hypoglycemia
Opioids	Morphine, Tramadol	Respiratory depression, falls

medications increases the risk of drug-drug interactions, prescribing cascades, therapeutic duplication, and medication non-adherence. Prescribing cascades occur when adverse drug reactions are misinterpreted as new medical conditions, leading to the prescription of additional medications that may further increase patient risk [8].

Hospitalized older adults are especially susceptible to inappropriate medication exposure due to the severity of acute illnesses, the complexity of treatment regimens, and frequent transitions of care. During hospitalization, patients often require multiple medications to manage acute and chronic conditions simultaneously, increasing the risk of prescribing errors, drug-drug interactions, therapeutic duplication, and inappropriate dosing. Furthermore, transitions between healthcare settings, such as admission, transfer between departments, and discharge, may result in communication gaps, incomplete medication reconciliation, and unintended changes to medication regimens, all of which contribute to a higher likelihood of potentially inappropriate medication use. Similarly, residents in nursing homes and long-term care facilities often receive psychotropic medications and sedatives at disproportionately high rates, increasing the risk of adverse outcomes such as falls and cognitive deterioration [6].

Socioeconomic factors, limited healthcare access, inadequate geriatric training among healthcare providers, and poor communication between healthcare professionals may also contribute to inappropriate medication use. In many healthcare systems, insufficient medication review practices and a lack of integration between pharmacists and physicians further worsen prescribing quality among older populations [2].

Polypharmacy was identified as the most significant contributor to potentially inappropriate medication (PIM) use among older adults, followed by multimorbidity and long-term care residency. Multiple prescribers, hospitalization, and cognitive impairment were also associated with increased PIM prevalence. The data presented are illustrative estimates synthesized from trends reported in contemporary literature on pharmacist interventions and medication safety in geriatric populations (2025).

Causes and Risk Factors Associated with Inappropriate Prescribing

Several interconnected factors contribute to inappropriate medication use among older adults. One major contributor is the presence of comorbidities, which often necessitate the use of multiple medications to manage coexisting chronic illnesses. Clinical guidelines for individual diseases may unintentionally promote polypharmacy when applied simultaneously without considering the overall health status of older patients [7].

Age-related physiological changes, including reduced renal and hepatic function, can alter medication responses and increase the risk of adverse drug effects among older adults [10].

Healthcare system factors also play important roles in inappropriate prescribing. Fragmented care involving multiple specialists may result in poor coordination of medication management. Inadequate communication among healthcare providers may contribute to duplication of therapy, conflicting prescriptions, and insufficient medication monitoring. Furthermore, time constraints during clinical consultations may limit opportunities for comprehensive medication review and deprescribing initiatives [3].

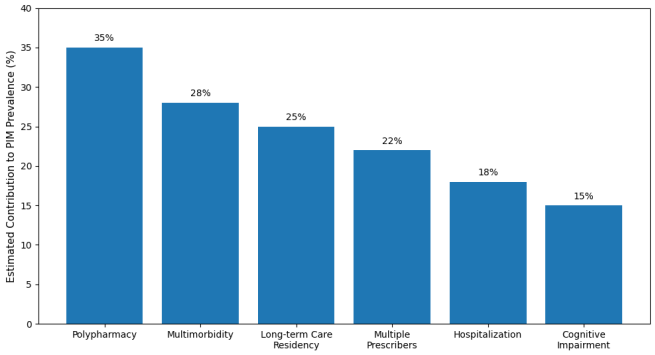


Figure 1: Prevalence and Major Risk Factors Associated with Potentially Inappropriate Medication Use in Older Adults

Patient-related factors also contribute significantly to inappropriate medication use and medication management challenges among older adults. Limited health literacy may impair an individual's ability to understand medication instructions, recognize adverse drug reactions, and adhere to prescribed treatment regimens. Self-medication practices, including the unsupervised use of over-the-counter medications, herbal products, and dietary supplements, may increase the risk of drug–drug interactions, therapeutic duplication, and adverse events. Poor medication adherence, which may result from complex treatment regimens, financial constraints, or misunderstanding of therapeutic goals, can further compromise treatment effectiveness and clinical outcomes.

In addition, cognitive impairment, including mild cognitive decline and dementia, may reduce an older adult's ability to manage medications safely, increasing the likelihood of missed doses, incorrect administration, or accidental overdose. Sensory deficits such as impaired vision and hearing can make it difficult to read medication labels, follow instructions, or communicate effectively with healthcare providers. Social isolation, limited caregiver support, and functional impairments may further exacerbate these challenges, ultimately increasing the risk of medication errors, inappropriate medication use, and adverse health outcomes among older adults.

Clinical Consequences of Potentially Inappropriate Medication Use

Potentially inappropriate medication use is strongly associated with adverse clinical outcomes among older adults. Adverse drug reactions represent one of the most significant complications and are major causes of emergency department visits and hospital admissions in geriatric populations. Older adults receiving inappropriate medications are at increased risk of dizziness, hypotension, sedation, delirium, and falls [15].

Falls and fractures are major events associated with inappropriate prescribing among patients receiving sedatives, benzodiazepines, and antipsychotic medications. These events may lead to loss of independence, disability, prolonged hospitalization, and increased mortality. Additionally, the risk of increased cognitive impairment due to anticholinergic medications may also exacerbate dementia and decrease functional capacity [9].

Medication non-adherence can arise from inappropriate medication use, due to complex regimens, increased pill burden, and treatment-related side effects. Poor adherence can lead to disease progression, therapeutic failure, and avoidable healthcare utilization. Moreover, polypharmacy and inappropriate prescribing lead to substantially increased healthcare costs due to recurrent hospitalizations, extended treatment duration, and management of medication-related complications [2].

The psychological burden associated with medication-related complications should also be considered when looking at overall patient health outcomes. Fear of adverse effects, confusion regarding medication regimens, and reduced confidence in treatment may negatively affect patient satisfaction and overall quality of life.

Role of Screening Tools in Identifying Potentially Inappropriate Medications

Screening tools are important in identifying and reducing inappropriate medication use in older adults. Explicit criteria-based tools such as the American Geriatrics Society Beers Criteria and the STOPP/START criteria are among the most widely used instruments to assess medication appropriateness in older patients [10].

The Beers Criteria provides a list of medications that should be avoided or used cautiously in older adults due to increased risk of harm. These criteria categorize medications based on drug-disease interactions, renal function considerations, and risk of adverse effects. The STOP/START criteria complement the Beers Criteria by identifying both potentially inappropriate medications and important treatments that may have been overlooked [2].

In clinical pharmacy practice, these tools have improved medication review and deprescribing efforts. Pharmacists often use them during medication reconciliation and therapeutic review to support safer prescribing and reduce preventable medication-related harm [1].

Despite their value, screening tools have limitations. They do not fully account for patient-specific data, individual preferences, or treatment-related complexities. For this reason, clinical judgment and interdisciplinary collaboration remain essential components of appropriate prescribing in geriatric care.

Use of potentially inappropriate medications remains a major challenge for the safety and quality of care among older adults. The combined effects of polypharmacy, multimorbidity, age-related changes, and fragmented healthcare systems all contribute to increasing the risk of inappropriate prescribing and adverse medication outcomes. A thorough understanding of the causes, prevalence, and consequences of inappropriate medication use is therefore essential for the development of effective interventions to improve geriatric pharmacotherapy. Screening tools and multidisciplinary approaches, particularly pharmacist-led medication reviews, remain important strategies for minimizing medication-related harm and improving therapeutic outcomes in older populations.

Types of Pharmacist Interventions in Reducing Inappropriate Medication Use

Pharmacists play an increasingly important role in addressing the challenges associated with polypharmacy and potentially inappropriate medication use among older adults. As the complexity of medication regimens continues to rise in geriatric populations, there is a growing need for interventions that promote safer prescribing practices and optimize therapeutic outcomes. Owing to their expertise in pharmacotherapy and medication management, pharmacists are well-positioned to identify medication-related problems and support appropriate treatment decisions.

A wide range of pharmacist-led interventions have been implemented across hospitals, primary care settings, nursing homes, and community pharmacies. These interventions often involve collaboration with physicians, nurses, patients, and caregivers to improve medication use and reduce the risk of adverse drug events. Evidence suggests that pharmacist involvement can enhance prescribing quality, reduce inappropriate medication use, and contribute to better clinical outcomes among older adults [4]. Such findings highlight the value of integrating pharmacists into multidisciplinary strategies aimed at improving medication safety in geriatric care [2].

Drug Utilization Review (DUR) and Medication Therapy Management

Drug Utilization Review (DUR) is a structured and systematic process used to evaluate prescribing patterns, medication use, and therapeutic outcomes to ensure that medications are prescribed, dispensed, and used appropriately. In older adults, pharmacist-led drug utilization reviews help identify potentially inappropriate medications, therapeutic duplications, drug–drug interactions, dosing errors, and unnecessary therapies. By assessing the appropriateness, safety, effectiveness, and cost-effectiveness of medication regimens, DUR contributes to improved prescribing quality, enhanced patient safety, and optimized therapeutic outcomes.

Older adults frequently receive medications from multiple healthcare providers, increasing the risk of fragmented care and prescribing errors. DURs conducted by pharmacists can help identify medications without clinical indications and recommend safer alternatives where appropriate [10]. These reviews are particularly important in patients with comorbidities and complex treatment regimens, as excessive medication use can increase the likelihood of adverse drug events and hospitalization.

Studies have shown the effectiveness of pharmacist-led medication reviews in improving prescribing quality among older adults. [4] reported that pharmacist interventions in primary care settings significantly improved medication appropriateness and reduced potentially inappropriate prescribing. Similarly, [11] observed that pharmacist involvement in medication review processes within tertiary hospitals reduced medication-related problems and optimized therapeutic regimens in elderly patients.

Medication therapy management also places an emphasis on patient education and individualized care planning. Pharmacists help patients understand their medications, including their purpose, dosing schedules, side effects, and adherence strategies. These interventions can strengthen patient understanding and support shared decision-making, which is particularly important in geriatric pharmacotherapy, where maintaining quality of life and functional independence is often a primary goal.

Table 2: Major Pharmacist-Led Interventions Used to Reduce Inappropriate Medications in Older Adults

Intervention type	*Main activities*	*Clinical benefits*	*Common healthcare setting*
Medication Review	Identification of PIMs, therapeutic duplication, and drug interactions	Improved medication appropriateness and reduced adverse events	Hospitals, primary care
Deprescribing	Discontinuation or dose reduction of unnecessary medications	Reduced polypharmacy and medication burden	Community and long-term care
Educational Interventions	Patient and physician education on safe prescribing	Improved prescribing awareness and adherence	Primary care and outpatient clinics
Medication Reconciliation	Verification of medications during care transitions	Reduced medication discrepancies and errors	Hospitals and discharge settings
Clinical Decision Support	Electronic alerts and prescribing recommendations	Enhanced prescribing accuracy	Integrated healthcare systems
Collaborative Care Models	Interdisciplinary medication management	Improved patient outcomes and coordinated care	Multidisciplinary healthcare facilities

Deprescribing Interventions

Deprescribing has emerged as an important pharmacist-led intervention for reducing polypharmacy in older adults. Deprescribing refers to the systematic process of identifying and discontinuing medications where potential harms outweigh clinical benefits, particularly in patients with limited life expectancy, frailty, or high medication burden [9]. The primary aim of deprescribing is to reduce polypharmacy while maintaining or improving patient outcomes and quality of life.

Pharmacists are central to de-prescribing initiatives because of their ability to evaluate medication necessity, therapeutic effectiveness, and potential adverse effects. During deprescribing interventions, pharmacists assess each medication based on current clinical indications, patient goals, comorbidities, and potential drug interactions. Medications considered inappropriate are gradually tapered down or discontinued in collaboration with physicians and patients.

Evidence suggests that pharmacist-led deprescribing interventions significantly reduce the prevalence of potentially inappropriate medications. Martin et al. [1], through the D-PRESCRIBE randomized clinical trial, demonstrated that pharmacist educational interventions successfully reduced the use of inappropriate sedative-hypnotics, anticholinergics, and nonsteroidal anti-inflammatory drugs among older adults. Similarly, Kimura et al. [14] reported that pharmacist-led deprescribing initiatives improved medication appropriateness and reduced medication-related risks in geriatric patients.

Deprescribing interventions also contribute to reductions in risk of falls, cognitive impairment, sedation, and hospital readmissions associated with inappropriate medication use. Pharmacists often conduct regular follow-up assessments after medication discontinuation to monitor withdrawal effects, symptom recurrence, and therapeutic outcomes. This continuous monitoring helps ensure patient safety throughout the deprescribing process.

Figure 2: Conceptual Framework of Pharmacist-Led Deprescribing Process in Older Adults

Educational and Behavioral Interventions

Educational interventions represent another important pharmacist-led approach to improving prescribing practices and reducing inappropriate medication use among older adults. These interventions target healthcare professionals, patients, and caregivers through evidence-based education regarding medication safety, appropriate prescribing, deprescribing principles, and geriatric medication management.

Pharmacist-led educational programs directed at physicians have shown significant effectiveness in reducing potentially inappropriate prescriptions. Martin et al. demonstrated that educational brochures and direct pharmacist communication with physicians encouraged safer prescribing decisions and increased discontinuation of inappropriate medications [1]. Educational outreach interventions also improve physician awareness of screening tools such as the Beers Criteria and STOPP/START criteria.

Patient-focused educational interventions are equally important in reducing medication misuse and improving adherence. Older adults may continue unnecessary medications because of misconceptions regarding medication necessity or fear of symptom recurrence following discontinuation. Pharmacists provide counseling regarding medication risks, expected therapeutic outcomes, and deprescribing benefits, thereby improving patient acceptance of medication optimization strategies [9].

Behavioral interventions often involve motivational interviewing, shared decision-making approaches, and individualized care planning. These interventions encourage active patient participation in treatment decisions and improve medication adherence. In addition, caregiver education is essential for older adults with cognitive impairment or limited self-management capacity. Pharmacists frequently collaborate with family caregivers to ensure proper medication, administration, and monitoring.

Educational interventions also contribute to improved interprofessional collaboration. Through case discussions, academic detailing, and multidisciplinary meetings, pharmacists support healthcare teams in identifying high-risk medications and developing safer treatment plans for older adults.

Medication Reconciliation and Transitional Care Interventions

Medication reconciliation is a structured process used to ensure the accuracy and continuity of medication records during transitions of care, such as hospital admission, transfer, and discharge. Older adults are particularly vulnerable to medication discrepancies during these transitions because of multiple comorbidities and complex medication regimens [5].

Pharmacist-led medication reconciliation interventions are essential for preventing prescribing errors and reducing inappropriate medication use. During the medication reconciliation process, pharmacists compare patients' existing medication regimens with newly prescribed therapies to identify omissions, therapeutic duplications, dosage discrepancies, and potentially harmful drug interactions. Any discrepancies identified are discussed with prescribing physicians and corrected before patient discharge or continuation of treatment, thereby enhancing medication safety and continuity of care.

Studies have demonstrated the effectiveness of pharmacist involvement in transitional care. [5] found that pharmacist-driven medication management interventions in inpatient settings significantly reduced inappropriate medication use and improved medication safety among hospitalized older adults. Similarly, [12] reported that multifaceted pharmacist interventions during discharge reduced potentially inappropriate prescribing and improved continuity of care.

Transitional care interventions also include discharge counseling, post-discharge follow-up calls, medication adherence assessments, and communication with primary care providers. These measures help prevent medication-related complications and hospital readmissions following discharge.

Clinical Decision Support and Collaborative Care Interventions

Advancements in healthcare technology have contributed to the integration of clinical decision support systems (CDSS) into pharmacist-led interventions aimed at reducing inappropriate medication use. These support tools utilize computerized alerts, prescribing algorithms, and evidence-based guidelines to assist healthcare professionals in identifying high-risk medications and potential prescribing errors.

Pharmacists frequently utilize electronic prescribing systems integrated with screening criteria such as the Beers Criteria and STOPP/START tools to identify potentially inappropriate medications in older adults [2]. These systems improve prescribing accuracy by generating alerts regarding contraindications, excessive dosages, therapeutic duplication, and drug interactions.

Pharmacists play an integral role in collaborative care interventions by working closely with physicians, nurses, and other healthcare professionals within multidisciplinary teams to optimize medication management and promote safer prescribing practices. Through participation in clinical rounds, medication review meetings, and patient care planning, pharmacists contribute specialized pharmacotherapeutic expertise that supports evidence-based decision-making and improves patient outcomes. The success of these collaborative care models depends on effective communication, clearly defined professional responsibilities, and strong institutional support for pharmacist integration within healthcare systems. As healthcare organizations increasingly emphasize patient safety and coordinated care, the involvement of pharmacists in multidisciplinary interventions continues to expand, further strengthening the quality and effectiveness of geriatric medication management.

Studies have shown that collaborative pharmacist interventions improve medication appropriateness and reduce adverse drug events in geriatric populations [6]. [13]. further demonstrated that pharmacist-led collaborative interventions among older patients with heart failure improved medication optimization and reduced inappropriate medication use.

Despite substantial evidence supporting pharmacist involvement in medication optimization, challenges related to healthcare integration, communication barriers, and resource limitations remain important considerations. Strengthening multidisciplinary collaboration and expanding pharmacist participation in clinical decision-making may further improve the management of potentially inappropriate medications among older adults and enhance overall geriatric healthcare delivery.

Evidence on the Effectiveness of Pharmacist-Led Interventions

The increasing burden of potentially inappropriate medication (PIM) use among older adults has intensified the need for evidence-based interventions aimed at improving medication safety and optimizing

therapeutic outcomes. Pharmacist-led interventions have emerged as one of the most effective strategies for addressing inappropriate prescribing practices in geriatric populations. These interventions are designed to identify medication-related problems, reduce unnecessary drug use, improve prescribing quality, and minimize adverse drug events.

Evidence from randomized controlled trials, prospective observational studies, and systematic reviews has consistently demonstrated that pharmacist involvement contributes significantly to safer medication use across multiple healthcare settings [4], [2]. Findings from these studies indicate that pharmacists play a critical role in identifying prescribing risks and implementing strategies that enhance medication appropriateness among older adults.

The effectiveness of pharmacist-led interventions is reflected not only in reductions in the prevalence of potentially inappropriate medications but also in improvements in clinical outcomes, healthcare utilization, and patient quality of life. These benefits highlight the value of integrating pharmacists into multidisciplinary healthcare teams to support safe and effective medication management in geriatric populations.

Evidence from Randomized Controlled Studies on Pharmacist-led Interventions

Randomized controlled trials (RCTs) provide some of the strongest evidence supporting pharmacist-led interventions in reducing inappropriate medication use among older adults. Studies have shown that pharmacist participation in medication review and deprescribing significantly improves medication appropriateness and decreases exposure to high-risk medications.

One of the most influential studies in this area was the D-PRESCRIBE randomized clinical trial conducted by Martin et al. [1]. The study evaluated a pharmacist-led educational intervention targeted at reducing inappropriate prescriptions among older adults living in the community. Pharmacists provided evidence-based educational materials to both physicians and patients regarding medications considered potentially inappropriate, including sedative-hypnotics, antihyperglycemics, and nonsteroidal anti-inflammatory drugs. The intervention demonstrated a substantial reduction in inappropriate medication use compared with usual care, which consisted of standard clinical management without the pharmacist-led educational and deprescribing intervention, highlighting the effectiveness of direct pharmacist involvement in prescribing optimization.

Similarly, [6] conducted a pragmatic randomized controlled trial among elderly inpatients and reported significant reductions in targeted potentially inappropriate medications following pharmacist-led medication review and collaborative deprescribing interventions. The study further demonstrated improvements in prescribing appropriateness during hospitalization and at discharge, suggesting that pharmacist interventions may provide sustained benefits beyond the inpatient setting.

Another important inpatient study [5] examined pharmacist-driven medication management interventions among hospitalized older adults. The findings revealed reductions in medication-related problems, improved medication reconciliation accuracy, and enhanced identification of potentially harmful prescriptions. These interventions also contributed to safer transitions of care, an area recognized as particularly vulnerable to medication errors in all populations.

The effectiveness of pharmacist-led deprescribing interventions has also been demonstrated in observational and prospective studies. [14] reported that pharmacist involvement in deprescribing initiatives resulted in significant discontinuation of inappropriate medications without compromising clinical stability. Their findings support the growing role of pharmacists in individualized medication optimization and risk reduction among older patients.

The evidence generated from these randomized and prospective studies strongly supports pharmacist-led interventions as effective approaches for reducing inappropriate prescribing and enhancing medication safety among older adults.

Evidence from Systematic Reviews and Meta-Analyses

Systematic reviews and meta-analyses have further strengthened the evidence supporting pharmacist interventions in geriatric medication management. These reviews synthesize findings from multiple studies and provide comprehensive evaluations of intervention effectiveness across different healthcare settings.

Kaur et al. [7] conducted one of the first systematic reviews examining interventions aimed at reducing inappropriate prescribing among older adults. The review concluded that pharmacist-led medication reviews and multidisciplinary collaboration significantly improved prescribing quality and reduced inappropriate medication use. The authors emphasized the importance of integrating

Table 3: Summary of Major Pharmacist-Led Intervention Studies in Older Adults

Study	*Study design*	*Intervention type*	*Healthcare setting*	*Major findings*
Martin et al. [1]	Randomized Clinical Trial	Educational deprescribing intervention	Community care	Significant reduction in inappropriate prescriptions
Cossette et al. [6]	Pragmatic RCT	Medication review and deprescribing	Hospital setting	Improved prescribing appropriateness and reduced PIMs
Alosaimy et al. [5]	Prospective intervention study	Pharmacist-driven medication management	Inpatient care	Reduced medication-related problems and safer discharge practices
Kimura et al. [14]	Prospective observational study	Deprescribing intervention	Clinical care setting	Successful discontinuation of inappropriate medications
Cortejoso et al. [11]	Prospective study	Pharmacist medication review	Tertiary hospital	Reduced medication errors and optimized therapy

pharmacists into geriatric care teams to improve medication safety outcomes.

Tjia et al. [8] evaluated interventions targeting unnecessary medication use among frail seniors. Their review demonstrated that pharmacist involvement in medication review processes effectively reduced polypharmacy and inappropriate prescribing, particularly in nursing home and long-term care settings. The study highlighted that those interventions combining educational approaches with clinical medication review produced the most consistent outcomes.

Riordan et al. [4] conducted a systematic review focused on pharmacist-led interventions in primary care. The review found that pharmacist participation significantly improved medication appropriateness and reduced medication-related risks among older adults. Importantly, the study noted that collaborative interventions involving pharmacists and physicians were more effective than isolated pharmacist-led interventions conducted without active interdisciplinary collaboration or physician involvement.

Similarly,[10] reviewed randomized controlled trials addressing inappropriate prescribing in community-dwelling older adults and found consistent evidence supporting pharmacist-led medication reviews, educational outreach, and deprescribing initiatives. The authors reported that pharmacist interventions reduced the prevalence of potentially inappropriate medications while improving medication adherence and therapeutic outcomes.

More recent evidence from [2] demonstrated that multifaceted interventions involving pharmacists, clinical decision support tools, and interdisciplinary collaboration achieved substantial reductions in PIM use. Their systematic review indicated that pharmacist-led interventions were particularly effective when integrated into routine clinical workflows and supported by structured prescribing guidelines.

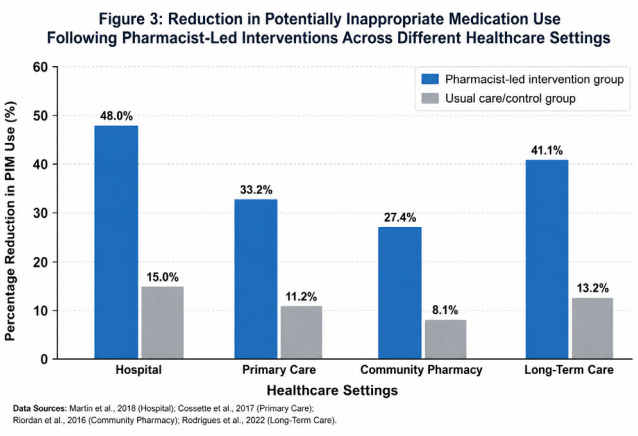
This graph visually demonstrates the comparative effectiveness of pharmacist interventions across multiple healthcare environments and provides strong statistical support for the discussion presented in this section.

Impact on Clinical Outcomes and Patient Safety

Beyond reducing inappropriate prescriptions, pharmacist-led interventions have demonstrated substantial benefits in improving clinical outcomes and patient safety among older adults. Medication-related complications remain one of the leading causes of preventable morbidity in geriatric populations, making patient safety a major outcome measure in intervention studies.

Gray et al. [15], in a systematic review and meta-analysis evaluating interventions aimed at reducing adverse drug reactions in older adults, reported that pharmacist involvement significantly lowered medication-related adverse events and hospitalization rates. The review demonstrated that medication review and deprescribing strategies reduced exposure to high-risk medications associated with falls, confusion, sedation, and cardiovascular complications.

Ammerman et al. [9] examined deprescribing interventions led by clinical pharmacists and found notable improvements in medication burden reduction and patient-centered care. Their findings indicated that pharmacist recommendations frequently resulted in discontinuation of unnecessary medications, leading to improved therapeutic efficiency and reduced risk of adverse effects.



Furthermore, pharmacist interventions have been shown to improve medication adherence and patient understanding of therapy. Educational counseling provided by pharmacists enables seniors to better understand medication indications, dosage schedules, and possible adverse effects. Improved medication literacy contributes to safer medication use and greater patient engagement in therapeutic decision-making [1].

The role of pharmacists in transitional care has also gained significant attention. [12] demonstrated that pharmacist-led multifaceted interventions during hospital discharge reduced inappropriate prescribing and improved continuity of care among discharged older adults. Such interventions are particularly important because medication discrepancies frequently occur during transitions between healthcare settings.

Effectiveness Across Different Healthcare Settings

Pharmacist-led interventions have shown effectiveness across diverse healthcare environments, including hospitals, primary care clinics, long-term care facilities, and community pharmacies. However, the magnitude and sustainability of intervention outcomes often vary depending on the healthcare setting and level of interdisciplinary collaboration.

In hospital settings, pharmacist interventions primarily focus on medication reconciliation, identification of drug interactions, dosage optimization, and deprescribing. [11] reported that pharmacist involvement in tertiary hospitals significantly reduced medication errors and improved prescribing appropriateness among older inpatients. Hospital-based interventions are particularly valuable because older hospitalized patients often experience complex medication regimens and acute clinical instability.

In primary care settings, pharmacist-led interventions emphasize long-term medication optimization and chronic disease management. [4] found that primary care pharmacist interventions effectively reduced inappropriate prescribing and improved therapeutic monitoring. Community pharmacists also contribute substantially through medication counseling, prescription review, and collaboration with prescribers.

Long-term care facilities represent another important setting for pharmacists due to the high prevalence of frailty, cognitive impairment, and polypharmacy among residents. [8] noted that regular pharmacist medication reviews in nursing homes contributed

to reductions in sedative use, anticholinergic burden, and unnecessary medication exposure.

Specialized interventions targeting disease-specific populations have also demonstrated positive outcomes. [13] evaluated pharmacist-led interventions among patients with heart failure and reported improvements in medication appropriateness, adherence, and reduction of potentially harmful medications. These findings suggest that pharmacist involvement may be particularly beneficial in older adults with complex chronic conditions requiring intensive pharmacotherapy management.

Factors Influencing the Success of Pharmacist-Led Interventions

The effectiveness of pharmacist interventions is influenced by several organizational, professional, and patient-related factors. Collaborative healthcare models that support active communication between pharmacists, physicians, nurses, and patients tend to produce more favorable outcomes. Studies consistently demonstrate that multidisciplinary approaches achieve greater reductions in inappropriate prescribing compared to isolated interventions [2].

Access to clinical information and electronic prescribing systems also enhances pharmacist effectiveness by enabling accurate medication review and identification of prescribing risks. Clinical decision support tools integrated with pharmacist review processes have been associated with improved intervention acceptance and prescribing quality [12].

Patient engagement represents another critical factor affecting intervention success. Seniors who participate in shared decision-making and receive individualized counseling are more likely to accept deprescribing recommendations and adhere to optimized medication regimens [9]. Educational interventions targeting both patients and prescribers, therefore, remain essential components of successful pharmacist-led programs.

Despite the substantial body of evidence supporting pharmacist-led interventions in reducing potentially inappropriate medication use among older adults, several barriers continue to limit their widespread implementation and long-term sustainability. Challenges such as limited pharmacist staffing, inadequate reimbursement policies for clinical pharmacy services, and insufficient training in geriatric pharmacotherapy can restrict the scope and effectiveness of these interventions across healthcare settings. In many institutions, heavy workloads and resource constraints reduce the time available for comprehensive medication reviews, deprescribing activities, and patient-centered counseling. Furthermore, the absence of consistent financial support for pharmacist-led clinical services may discourage healthcare organizations from expanding medication optimization programs. Addressing these barriers is essential for maximizing the benefits of pharmacist involvement in medication management. Strengthening workforce capacity, expanding access to specialized geriatric pharmacotherapy training, and implementing supportive reimbursement frameworks may enhance the sustainability and effectiveness of pharmacist-led interventions. Additionally, greater integration of pharmacists within multidisciplinary healthcare teams, supported by clinical decision support systems and collaborative care models, can improve intervention acceptance and facilitate more comprehensive medication optimization. Continued investment in these areas is likely to strengthen the role of pharmacists in promoting safer prescribing practices, reducing medication-related harm, and improving health outcomes among older adults.

Challenges Affecting Pharmacist Interventions

The increasing involvement of pharmacists in reducing inappropriate medication use among older adults has contributed significantly to improvements in medication safety, prescribing quality, and patient outcomes. Despite the demonstrated effectiveness of pharmacist-led interventions, several barriers continue to limit their implementation and long-term sustainability across healthcare settings. These challenges are multifactorial and involve healthcare system limitations, patient-related factors, professional barriers, technological constraints, and policy-related issues. Addressing these challenges is essential for optimizing the role of pharmacists in geriatric medication management and ensuring the successful reduction of potentially inappropriate medications (PIMs) among older populations.

Healthcare System and Organizational Barriers

Healthcare system limitations remain one of the most significant barriers affecting pharmacist interventions in older adults. In many institutions, pharmacists are still underutilized in direct patient care and are restricted to traditional dispensing roles rather than clinical decision-making responsibilities [4]. This limited integration reduces opportunities for pharmacists to actively participate in medication review processes, multidisciplinary ward rounds, and deprescribing initiatives.

Inadequate staffing and workforce shortages further affect the implementation of pharmacist-led interventions. Many hospitals and community healthcare facilities experience insufficient pharmacist-to-patient ratios, limiting the time available for comprehensive medication assessments and individualized patient counseling [2]. Older adults often require detailed medication reviews because of multiple chronic conditions and complex therapeutic regimens, making pharmacist workload a critical concern.

Financial and institutional constraints also influence intervention effectiveness. In several healthcare systems, reimbursement structures for clinical pharmacy services remain inadequate or poorly defined, discouraging healthcare institutions from expanding pharmacist-led programs [3]. The absence of sustainable funding models may reduce the availability of medication therapy management services, especially in primary care and long-term care facilities.

Fragmented healthcare systems can also hinder effective medication management in older adults. Because care is often provided by multiple healthcare professionals across different settings, communication gaps and incomplete medication records may increase the risk of prescribing-related problems. Strengthening care coordination and information sharing is therefore important for supporting effective pharmacist interventions [8].

Patient-Related Challenges

Patient-related factors also contribute significantly to the difficulties encountered during pharmacist interventions among older adults. One of the major challenges is medication adherence. Older adults

Table 4: Major Healthcare System Challenges Affecting Pharmacist-Led Interventions in Older Adults

Challenge category	*Description*	*Impact on pharmacist interventions*	*Clinical consequences*
Limited Clinical Integration	Pharmacists excluded from multidisciplinary care teams	Reduced participation in prescribing decisions	Increased inappropriate prescribing
Workforce Shortages	Inadequate pharmacist-to-patient ratio	Limited time for medication review	Missed medication-related problems
Poor Reimbursement Policies	Lack of financial support for clinical pharmacy services	Reduced the sustainability of interventions	Lower availability of deprescribing services
Fragmented Healthcare Systems	Lack of coordinated patient records and communication	Difficulty tracking medication history	Increased drug duplication and interactions
Resource Constraints	Insufficient clinical support tools and infrastructure	Reduced intervention efficiency	Delayed medication optimization

Source: Adapted from Riordan et al. (2016), Santos et al. (2019), and Rodrigues et al. (2022).

often experience cognitive decline, visual impairment, hearing loss, and reduced manual dexterity, all of which can interfere with proper medication administration and adherence to therapeutic recommendations [15].

Many older adults develop psychological dependence on long-term medications and may perceive discontinuation as a reduction in care quality or disease management. Fear of the return of symptoms and anxiety regarding medication changes may reduce patient acceptance of pharmacist recommendations [9]. In some cases, caregivers and family members may also oppose medication discontinuation due to concerns about patient stability.

Another important challenge involves socioeconomic factors that can significantly influence medication optimization among older adults. Financial constraints may limit patients' ability to purchase prescribed medications, attend follow-up appointments, or access supportive healthcare services. Transportation difficulties, particularly among older adults with mobility limitations or those living in rural and underserved areas, may further reduce access to pharmacies, healthcare facilities, and routine medication reviews. Inadequate health insurance coverage and disparities in healthcare access can also contribute to interruptions in treatment and reduced continuity of pharmaceutical care. These socioeconomic barriers may increase the risk of medication non-adherence, delayed interventions, and poorer health outcomes among older populations [3].

Health literacy limitations further complicate medication optimization efforts. Some older adults may have an inadequate understanding of medication indications, dosing schedules, adverse effects, and treatment goals, limiting their ability to actively participate in shared decision-making processes [10]. Communication barriers, including language differences, low educational attainment, and limited access to health information, may additionally hinder effective pharmacist–patient interactions. Poor health literacy can contribute to medication errors, inappropriate medication use, and reduced adherence to therapeutic recommendations.

Resistance to deprescribing represents another significant challenge in pharmacist-led medication optimization. Many older adults develop psychological dependence on long-term medications and may perceive medication discontinuation as a reduction in care quality or disease management. Fear of symptom recurrence, disease progression, or adverse consequences following medication withdrawal may reduce patient acceptance of pharmacist recommendations [9]. In some cases, caregivers and family members may also oppose deprescribing initiatives because of concerns regarding patient stability and treatment effectiveness. Such resistance may limit the successful implementation of medication optimization strategies despite evidence supporting the benefits of deprescribing in reducing medication burden and adverse drug events.

Professional and Interdisciplinary Barriers

Effective pharmacist interventions require strong collaboration among physicians, nurses, and other healthcare professionals. However, interprofessional barriers continue to limit collaborative practice in many healthcare settings. Some physicians may be reluctant to accept pharmacist recommendations because of concerns regarding professional autonomy or differing therapeutic opinions [4]. This resistance may reduce the implementation of pharmacist-identified medication changes and deprescribing recommendations.

Variability in pharmacist training and clinical competence in geriatric pharmacotherapy also affects intervention quality. Although clinical pharmacy practice has expanded considerably, some pharmacists may lack specialized training in comprehensive geriatric assessment, deprescribing principles, and age-related pharmacological changes [7]. Variations in pharmacists' training and professional experience may contribute to differences in the effectiveness of interventions across healthcare settings.

Communication gaps among healthcare providers further contribute to medication-related errors and incomplete care coordination. Poor documentation, delayed transfer of patient information, and inconsistent communication channels may prevent pharmacists from obtaining accurate medication histories and monitoring treatment outcomes effectively [11].

The graph visually demonstrates the relationship between various barriers and their cumulative effect on the effectiveness of pharmacist-led interventions in reducing inappropriate medication use among older adults.

Technological and Information-Related Challenges

Technological limitations continue to affect medication management processes in geriatric care. Although electronic prescribing systems and clinical decision support tools have improved medication safety in many institutions, the implementation of these technologies

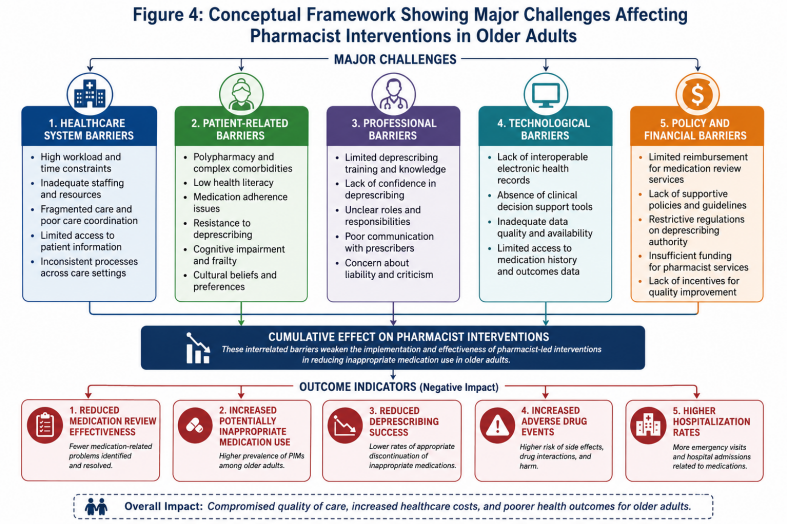


Figure 4: Conceptual Framework Showing Major Challenges Affecting Pharmacist Interventions in Older Adults

remains inconsistent across healthcare settings [12]. Some healthcare facilities use electronic medical record (EMR) systems that do not communicate effectively with one another, resulting in delayed information exchange, incomplete access to patient records, and potential gaps in care coordination. These interoperability challenges may increase the risk of medication discrepancies, incomplete medication histories, and prescribing errors.

Even in institutions with electronic health records, interoperability problems between healthcare systems may limit access to complete patient medication histories. Pharmacists may encounter difficulties obtaining accurate information regarding previous prescriptions, allergies, laboratory values, and medication changes from different healthcare providers [2]. These information gaps can reduce the effectiveness of medication review and deprescribing interventions.

Alert fatigue associated with clinical decision support systems also presents a challenge. Excessive electronic alerts may lead healthcare professionals to override or ignore important medication warnings, thereby reducing the effectiveness of safety monitoring systems [14]. Additionally, inadequate training in the use of digital health technologies may further limit the successful integration of technological tools into pharmacist-led interventions.

Policy and Regulatory Challenges

Policy and regulatory limitations significantly influence the scope and effectiveness of pharmacist interventions in seniors. In many countries, pharmacists have limited prescribing authority and restricted access to patient medical records, reducing their ability to independently implement medication optimization strategies [13]. Regulatory restrictions may also limit pharmacist participation in collaborative practice agreements and multidisciplinary healthcare planning.

The absence of standardized national guidelines for deprescribing and medication review programs may create inconsistencies in clinical practice. Healthcare institutions may adopt varying approaches to identifying and managing potentially inappropriate medications, resulting in unequal patient outcomes across settings [15].

Furthermore, some healthcare policies continue to prioritize acute disease management over preventive medication optimization services due to immediate clinical demands, resource constraints, staffing shortages, and reimbursement models that often favor the treatment of acute conditions rather than long-term preventive care. As a result, pharmacist-led interventions may receive insufficient institutional support despite evidence demonstrating their positive impact on medication safety and healthcare cost reduction [1].

Pharmacist-led interventions play a critical role in reducing inappropriate medication use and improving medication safety among older adults. However, multiple barriers continue to limit the effectiveness and sustainability of these interventions across healthcare systems. Challenges related to healthcare infrastructure, patient factors, interdisciplinary collaboration, technology, and regulatory policies collectively influence the successful implementation of pharmacist-led medication optimization programs. Addressing these barriers through stronger healthcare integration, enhanced professional training, supportive policies, and improved communication systems may strengthen the role of pharmacists in geriatric care and contribute to safer prescribing practices among older populations.

Strategies to Improve Pharmacist-Led Medication Optimization

Medication optimization among older adults has become a critical priority in geriatric healthcare due to the growing prevalence of multimorbidity, polypharmacy, and potentially inappropriate medication use. Age-related physiological changes, coupled with complex therapeutic regimens, increase the risk of adverse drug events, medication-related complications, and poor clinical outcomes in this population. As medication experts, pharmacists are uniquely positioned to address these challenges through interventions aimed at improving prescribing quality, enhancing medication safety, and promoting patient-centered care. Despite the demonstrated benefits of pharmacist-led interventions, several barriers continue to limit their effectiveness and widespread implementation. Consequently,

Table 5: Major Strategies for Improving Pharmacist-Led Medication Optimization in Older Adults

Strategy	*Description*	*Expected clinical outcome*	*Supporting evidence*
Interprofessional collaboration	Inclusion of pharmacists in multidisciplinary care teams	Reduced prescribing errors and improved medication appropriateness	Riordan et al. (2016)
Medication review programs	Comprehensive evaluation of medication regimens	Reduction in potentially inappropriate medications	Martin et al. (2018)
Deprescribing initiatives	Structured discontinuation of unnecessary medications	Reduced polypharmacy and adverse drug reactions	Ammerman et al. (2019)
Clinical decision support systems	Use of electronic prescribing alerts and screening tools	Improved prescribing accuracy and medication safety	Akkawi et al. (2020)
Continuing professional education	Ongoing geriatric pharmacotherapy training for pharmacists	Enhanced clinical competency and intervention effectiveness	Rodrigues et al. (2022)
Patient-centered education	Engagement of patients and caregivers in medication decisions	Improved adherence and therapeutic outcomes	Kimura et al. (2022)

there is a need for evidence-based strategies that strengthen pharmacist involvement in medication management, facilitate interdisciplinary collaboration, and support the delivery of safe and effective pharmacotherapy for older adults. This section discusses key approaches for improving pharmacist-led medication optimization and maximizing its impact on geriatric healthcare outcomes.

Strengthening Interprofessional Collaborative Care Models

Collaborative healthcare models involving pharmacists, physicians, nurses, and other healthcare professionals have become increasingly important in optimizing medication regimens among older adults. Effective interprofessional collaboration enables comprehensive assessment of medication regimens, facilitates communication regarding therapeutic goals, and promotes shared clinical decision-making. Studies have shown that pharmacist participation in multidisciplinary healthcare teams significantly improves prescribing appropriateness and reduces potentially inappropriate medication use in geriatric patients [4].

In collaborative care settings, pharmacists contribute specialized pharmacotherapeutic expertise that complements physician-led disease management. Their involvement in ward rounds, case conferences, medication reconciliation, and discharge planning has been associated with reductions in medication errors and hospital readmissions [11]. Collaborative deprescribing initiatives also improve patient safety by identifying medications that may no longer provide clinical benefit or may expose older adults to unnecessary risks [9].

Healthcare institutions can strengthen collaborative practice by clearly defining the role of pharmacists within clinical teams and ensuring they are actively involved in day-to-day patient care decisions rather than working in isolation. When pharmacists are fully integrated into multidisciplinary teams, communication between physicians, nurses, and other healthcare professionals becomes more coordinated, reducing medication discrepancies and improving continuity of care. A key part of this integration is the expansion of pharmacists' involvement in Drug Utilization Reviews (DURs), where they systematically evaluate prescribing patterns, assess medication appropriateness, and identify potential issues such as therapeutic duplication, drug–drug interactions, and unnecessary long-term therapies. Through DURs, pharmacists are able to provide timely, evidence-based recommendations that support safer prescribing and more individualized treatment plans for older adults. Establishing multidisciplinary geriatric assessment units alongside pharmacist-led medication review clinics can further enhance this process by creating structured environments where medication optimization, deprescribing decisions, and ongoing monitoring are carried out collaboratively. These approaches not only improve continuity of care but also strengthen medication safety outcomes and ensure that prescribing decisions remain patient-centered and clinically appropriate.

Expansion of Comprehensive Medication Review Programs

Comprehensive medication review (CMR) programs remain one of the most effective pharmacist-led strategies for reducing inappropriate medication use among older adults. These reviews involve systematic evaluation of all prescribed, over-the-counter, and complementary medications (vitamins/herbal products and other supplements) to identify drug-related problems, therapeutic duplications, inappropriate dosing, adverse drug interactions, and unnecessary therapies [3].

Pharmacists conducting medication reviews assess medication indications, effectiveness, safety, and patient adherence while considering age-related changes and comorbidities. Research has shown that regular pharmacist-led medication reviews contribute to substantial reductions in potentially inappropriate prescribing and medication-related complications [6]. Furthermore, medication review interventions have demonstrated positive outcomes in both hospital and community settings, particularly among frail older adults and patients with chronic illnesses.

The implementation of structured medication review protocols within primary healthcare systems can improve continuity of care and facilitate early detection of medication-related risks. Periodic medication review should be incorporated into routine geriatric care, especially during transitions between healthcare settings such as hospital admission, discharge, and long-term care placement.

Integration of Deprescribing Practices into Routine Geriatric Care

Deprescribing should be integrated into routine geriatric care as a structured component of medication optimization programs. Pharmacists can operationalize deprescribing through established workflows embedded within medication reconciliation, multidisciplinary medication review, and clinical decision-making pathways. This process is strengthened by standardized institutional protocols and the use of clinical decision support systems within electronic health records to flag high-risk or potentially unnecessary medications. In collaboration with physicians and other healthcare professionals, pharmacists can systematically identify inappropriate therapies and implement controlled dose reduction or discontinuation while ensuring continuous monitoring of patient outcomes and medication safety.

Pharmacists are central to the safe reduction of unnecessary or potentially harmful medications in older adults. Their involvement extends beyond identifying candidates for medication discontinuation to providing individualized assessments, evaluating therapeutic risks and benefits, counseling patients, and monitoring clinical outcomes following medication withdrawal. Evidence suggests that these activities contribute to lower rates of inappropriate prescribing, reduced medication burden, and improvements in both safety and functional health outcomes among older populations [14]. Further support comes from the D-PRESCRIBE trial, which demonstrated that targeted pharmacist-led educational efforts can successfully promote the discontinuation of inappropriate medications by engaging both prescribers and patients in the decision-making process [1].

The effectiveness of deprescribing initiatives depends largely on patient engagement and trust. Older adults may be hesitant to discontinue long-standing therapies because of concerns about symptom recurrence or disease progression. Consequently, clear communication, shared decision-making, and individualized education are essential for addressing these concerns and facilitating informed choices. Increasing awareness of the potential benefits and risks of medication withdrawal among healthcare professionals, patients, and caregivers can further support the successful integration of deprescribing into routine geriatric care.

This demonstrates the sequential process involved in pharmacist-led medication optimization and illustrates how collaborative interventions contribute to improved medication safety and therapeutic outcomes in older adults.

Utilization of Clinical Decision Support Systems and Digital Technologies

Technological innovations have increasingly supported pharmacist-led medication optimization using clinical decision support systems (CDSS), electronic health records, and prescribing surveillance tools. These systems assist pharmacists and prescribers in identifying potentially inappropriate medications, drug interactions, duplicate therapies, and dosage errors in older patients [12].

The effective integration of electronic prescribing systems and evidence-based screening tools, such as the Beers Criteria and STOPP/START criteria, requires their incorporation into routine pharmacist-led medication review processes and clinical workflows. These tools should be embedded within electronic health record platforms to provide real-time alerts during prescribing, dispensing, and medication reconciliation activities. Pharmacists can utilize these alerts to identify potentially inappropriate medications, assess medication-related risks, and collaborate with prescribers to optimize therapeutic regimens. Successful integration also depends on adequate staff training, interoperability between health information systems, and institutional support for multidisciplinary medication management. Studies have demonstrated that incorporating digital decision-support tools into routine pharmacist interventions enhances medication appropriateness and reduces preventable medication-related adverse events among older adults [2].

In addition, telepharmacy and remote medication review services have expanded access to pharmaceutical care, particularly for older adults residing in rural, remote, or underserved communities where access to pharmacists may be limited. Telepharmacy utilizes information and communication technologies to deliver a wide range of pharmacy services, including medication review, prescription verification, patient counseling, therapeutic drug monitoring, and medication reconciliation without requiring the physical presence of a pharmacist. These services help address geographical barriers, improve continuity of pharmaceutical care, and support timely medication management for older adults with complex therapeutic

needs. Evidence suggests that telepharmacy can enhance access to clinical pharmacy services, promote medication adherence, and facilitate safer medication use while maintaining levels of patient care comparable to traditional face-to-face pharmacy services [16]. Furthermore, digital health technologies may strengthen continuity of care by improving communication among healthcare providers, enabling real-time monitoring of medication-related outcomes, and supporting collaborative medication optimization across healthcare settings.

Continuing Professional Education and Specialized Geriatric Training

The growing complexity of geriatric pharmacotherapy highlights the need for continuous professional development among pharmacists involved in medication optimization programs. Specialized training in geriatric medicine, deprescribing principles, pharmacokinetics in ageing, and comprehensive medication review enhances pharmacists' ability to identify and manage medication-related problems effectively [7].

Continuing professional education programs can include workshops, clinical simulations, certification courses, and interdisciplinary training initiatives focused on geriatric patient care. Research suggests that pharmacists with advanced geriatric training demonstrate improved clinical competency and increased confidence in making evidence-based therapeutic recommendations [2].

Healthcare organizations and academic institutions should promote competency-based geriatric pharmacy education and support pharmacist participation in lifelong learning initiatives. Continuing professional development opportunities can strengthen pharmacists' expertise in medication optimization, deprescribing, and the management of complex geriatric syndromes. Examples of recognized educational and certification programs include the geriatric pharmacy training resources provided by the American Geriatrics Society (AGS), the Canadian Society of Hospital Pharmacists (CSHP) Geriatric Pharmacy Residency and professional development programs, the American Society of Consultant Pharmacists (ASCP) Geriatric Pharmacotherapy Boot Camp, and the Board of Pharmacy Specialties (BPS) Board-Certified Geriatric Pharmacist (BCGP) credential. Participation in such programs enhances clinical competency, supports evidence-based decision-making, and promotes the consistent application of best practices in geriatric pharmacotherapy. Standardized training frameworks and specialty certification pathways may further improve the quality, consistency, and effectiveness of pharmacist-led interventions across diverse healthcare settings.

Enhancing Patient and Caregiver Engagement in Medication Management

Patient-centered care remains fundamental to successful medication optimization in older adults. Active involvement of patients and caregivers in medication-related decisions improves adherence, medication literacy, and acceptance of deprescribing interventions. Pharmacists play an important role in educating patients regarding medication indications, adverse effects, proper administration, and potential medication-related risks [14].

Educational counseling sessions and individualized medication action plans can empower older adults to participate actively in their treatment decisions. Involving caregivers is particularly important for patients with multiple comorbidities requiring complex medication regimens. Studies have shown that patient engagement strategies contribute to improved medication adherence and reductions in inappropriate medication use [13].

Healthcare systems should prioritize communication approaches that support health literacy and shared decision-making. The development of patient-friendly educational materials and culturally sensitive counseling strategies may further strengthen pharmacist-led medication optimization programs.

Strengthening healthcare policies that support pharmacist integration into clinical care teams, expanding access to geriatric pharmacy services, and promoting continuous professional development may further enhance medication safety and quality of care for ageing populations. As medication-related challenges among older adults continue to increase, pharmacist-led optimization strategies remain essential for advancing safe, effective, and patient-centered geriatric healthcare.

CONCLUSION

Potentially inappropriate medication use remains a significant challenge in the care of older adults, largely due to the growing prevalence of multimorbidity, polypharmacy, and age-related physiological changes that increase vulnerability to medication-related harm. Inappropriate prescribing contributes to adverse drug events, hospitalizations, functional decline, increased healthcare costs, and reduced quality of life, making medication optimization a critical component of geriatric healthcare [8], [3].

Evidence reviewed in this study demonstrates that pharmacists play a pivotal role in improving medication safety and prescribing quality among older adults. Through activities such as comprehensive medication reviews, deprescribing initiatives, medication reconciliation, patient education, and collaboration with other healthcare professionals, pharmacists help reduce potentially inappropriate medication use and support better therapeutic outcomes across hospital, community, and long-term care settings [1], [4], [6]. These interventions have consistently been associated with lower medication burden, fewer adverse drug events, and improved patient-centered care.

Despite these benefits, challenges related to healthcare integration, resource limitations, communication barriers, and variability in geriatric pharmacotherapy training continue to affect the implementation of pharmacist-led interventions. Strengthening interdisciplinary collaboration, expanding the clinical role of pharmacists, and investing in supportive policies, education, and digital health technologies will be essential for maximizing the impact of medication optimization programs. As healthcare systems respond to the needs of ageing populations, pharmacist-led interventions will remain a key strategy for promoting safer prescribing practices and improving the overall quality of geriatric care.

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