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REVIEW ARTICLE

Medication Optimization in Geriatric Polypharmacy: Reducing Risks and Enhancing Patient Outcomes

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Abstract

Polypharmacy is a major concern among the elderly population, with approximately 40–50% of older adults taking five or more medications. Age-related physiological changes, including reduced renal and hepatic function, altered drug metabolism, and increased sensitivity to medications, make geriatric patients more vulnerable to adverse drug reactions (ADRs), drug–drug interactions, and medication non-adherence. Inappropriate medication use can lead to increased morbidity, prolonged hospitalization, reduced quality of life, and a greater healthcare burden. Therefore, optimizing medication therapy is essential to ensure safe and effective treatment in elderly patients. This review explores evidence-based strategies for optimizing medication use in geriatric patients experiencing polypharmacy, focusing on pharmacist-led medication reviews, medication reconciliation, application of prescribing assessment tools such as the Beers Criteria and STOPP/START criteria, appropriate renal and hepatic dose adjustments, deprescribing, regimen simplification, and adherence-enhancing interventions. Evidence suggests that inappropriate polypharmacy is associated with an increased risk of ADRs, hospitalization, and poor health outcomes. Pharmacist-led interventions, regular medication reviews, and structured deprescribing approaches help identify potentially inappropriate medications and reduce medication-related complications. Furthermore, patient-centred decision-making, medication education, simplified dosing schedules, and caregiver involvement contribute to improved medication adherence and therapeutic outcomes. Overall, effective medication optimization in geriatric patients requires a structured, multidisciplinary approach involving physicians, clinical pharmacists, nurses, patients, and caregivers. Implementing standardized medication optimization strategies in routine geriatric care may reduce inappropriate prescribing, improve medication safety, enhance adherence, and promote a better quality of life among older adults.

Key words: Adverse drug reactions, Beers criteria, deprescribing, geriatrics, medication reconciliation, patient adherence, polypharmacy, screening tool of older persons' prescriptions/screening tool to alert to right treatment criteria

INTRODUCTION

Polypharmacy, defined as the concurrent use of multiple medications, is frequently required in geriatric patients to manage complex and coexisting chronic conditions. Its prevalence among older adults is increasing, with studies indicating that approximately 30–40% of community-dwelling elderly individuals and over 90% of nursing home residents take five or more medications regularly. Polypharmacy is associated with both benefits and challenges. While it is essential for managing multiple chronic health conditions, patients with diabetes, hypertension, and cardiovascular disease may require a combination of metformin, insulin, angiotensin-converting enzyme inhibitors, statins, and aspirin to control blood sugar, blood pressure, and cardiovascular risk. Similarly, individuals with

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chronic obstructive pulmonary disease and heart failure may benefit from bronchodilators, diuretics, and osteoporosis medications to maintain respiratory function and prevent fractures. In neurodegenerative disorders like Alzheimer's disease, the use of cholinesterase inhibitors, antidepressants, and sleep aids can enhance cognitive function and mental well-being. In addition, patients with chronic kidney disease and anemia may require antihypertensives and erythropoiesis-stimulating agents to manage disease progression.[1] Despite its benefits, polypharmacy presents significant challenges, particularly when not managed carefully, such as concurrent use of multiple medications which increases the risk of drug–drug interactions, adverse drug reactions (ADRs), and medication errors. For example, combining anticoagulants with non-steroidal anti-inflammatory drugs (NSAIDs) can heighten the risk of severe bleeding, while the use of multiple antihypertensives may lead to excessive drops in blood pressure, causing dizziness and falls. In addition, the "prescribing cascade" often occurs when the side effects of one drug are misinterpreted as new symptoms, leading to the prescription of additional medications that may not be necessary.[2] To mitigate the risks associated with polypharmacy, a systematic approach to medication optimization is crucial. Medication optimization refers to the process of ensuring that medications are prescribed appropriately, used effectively, and regularly reviewed to achieve the best possible health outcomes while minimizing risks.[3] This process involves several key strategies, including regular medication reviews, deprescribing unnecessary drugs, patient-centered prescribing, and the integration of clinical decision support systems (CDSS) to improve medication safety. Regular medication reviews where healthcare providers assess a patient's entire drug regimen to ensure that each medication is necessary, effective, and safe. This review helps in identifying inappropriate prescribing, potential drug interactions, and adverse drug reactions, which are common in individuals taking multiple medications.[4] CDSS tools use artificial intelligence and evidence-based algorithms to assist healthcare providers in making informed prescribing decisions, such as recommending dose adjustments, flagging potential drug–drug interactions, and suggesting safer alternatives. These digital tools enhance patient safety and support evidence-based prescribing, reducing the likelihood of preventable medication-related complications. Medication optimization not only enhances the safety and efficacy of pharmacological treatment but also contributes to broader health benefits, including reduced hospitalizations, lower healthcare costs, and improved patient outcomes. Studies have shown that implementing medication optimization strategies in older adults results in fewer medication-related hospital admissions, improved functional status, and enhanced quality of life.[5] By addressing the risks associated with polypharmacy through structured medication management [Table 1], healthcare providers can ensure that patients receive the right medications at the right dose for the right duration, ultimately leading to safer and more effective treatment outcomes.

Table 1: Common chronic diseases and associated medications in older adults

Condition	Common medications
Hypertension	Angiotensin-converting enzyme inhibitors, Beta-blockers
Diabetes mellitus	Metformin, Insulin, Sulfonylureas
Cardiovascular disease	Statins, Antiplatelets, Beta-blockers
Osteoarthritis	Non-steroidal anti-inflammatory drugs, Acetaminophen, Opioids
Dementia	Cholinesterase inhibitors, Antipsychotics

FACTORS CONTRIBUTING TO POLYPHARMACY IN GERIATRICS

Polypharmacy in older adults is influenced by multiple factors, including age-related physiological changes, multimorbidity, fragmented healthcare systems, patient-related behaviors, and socioeconomic influences. Understanding these factors is crucial for mitigating the risks associated with excessive medication use.

Age-related physiological changes and pharmacokinetics

Aging results in significant physiological changes that impact how drugs are absorbed, distributed, metabolized, and excreted, which affects both pharmacokinetics and pharmacodynamics. For example, gastrointestinal changes such as reduced gastric acid secretion and slower gastric emptying can influence drug solubility and absorption rates. In addition, decreased total body water and increased fat content alter drug distribution, leading to a prolonged half-life for lipophilic drugs like benzodiazepines. This increases the risk of sedation and falls. Hepatic metabolism is also affected by aging, due to a reduction in liver size and blood flow. This impairment can hinder the metabolism of drugs such as propranolol and verapamil. Furthermore, the decline in renal function, which is common in older adults, results in decreased drug clearance. As a result, dose adjustments may be necessary for renally excreted drugs, including aminoglycosides and digoxin.[6] These changes increase the risk of drug accumulation and toxicity, highlighting the need for careful medication management.

Chronic disease burden and multimorbidity

Multimorbidity, which is the coexistence of two or more chronic conditions, is especially common among older adults and often results in polypharmacy, the use of multiple medications. Common conditions that contribute to this include hypertension, diabetes, osteoarthritis, and cardiovascular diseases, all of which frequently require various medications for proper management.[7] Studies indicate that as many as

65% of older adults live with multiple chronic conditions, which leads to the necessity of complex treatment plans. As the number of prescribed medications increases, so does the risk of drug interactions and adverse effects.

Fragmented healthcare system and multiple prescribers

Older adults often visit multiple specialists, leading to prescription discrepancies, duplication, and drug interactions due to the lack of coordination between healthcare providers. A study found that up to 40% of elderly patients receive prescriptions from more than one physician, increasing the likelihood of inappropriate prescribing.[8]

Electronic health records (EHRs) and medication reconciliation programs are essential to reduce discrepancies, but their implementation remains suboptimal in many healthcare settings. In addition, communication gaps between primary care providers and specialists contribute to conflicting medication regimens, further escalating polypharmacy risks.

Patient-related factors (self-medication, over-the-counter [OTC], and herbal supplements)

Self-medication, the use of OTC medications, herbal supplements, and unregulated remedies, is prevalent among older adults and contributes significantly to polypharmacy. A study in India reported that over 50% of elderly patients self-medicate, often unaware of potential drug interactions and contraindications.[9]

Lack of awareness about these risks, combined with the misconception that herbal products are always safe, exacerbates polypharmacy-related complications. Educating patients and implementing pharmacist-led interventions can help mitigate these risks.

Socioeconomic and cultural influences

Socioeconomic factors, including education level, financial constraints, and access to healthcare, influence medication use patterns. Older adults with lower socioeconomic status may struggle with medication adherence due to cost, leading to inappropriate self-adjustment of doses or discontinuation. Conversely, individuals from higher-income groups may have greater access to multiple healthcare providers, increasing the likelihood of polypharmacy.[10]

Cultural beliefs also play a role, as traditional medicine practices and herbal therapies are widely used in some populations, often alongside prescription drugs, leading to unintended interactions. Studies indicate that 20–30% of older adults in Asian countries use traditional medicine alongside prescribed treatments, emphasizing the need for culturally tailored medication counseling [Table 2].[11]

CLINICAL IMPLICATIONS OF POLYPHARMACY

Increased risk of ADRs

Polypharmacy significantly raises the risk of ADRs, particularly in older adults due to age-related changes in drug metabolism and elimination as kidney and liver functions decline; drug clearance slows, leading to drug accumulation and heightened toxicity. Studies show that older adults are twice as likely to experience ADRs compared to younger populations, with hospitalizations often linked to medications such as anticoagulants, sedatives, and NSAIDs. Common ADRs include gastrointestinal bleeding from NSAIDs, excessive sedation from benzodiazepines, and hypoglycemia from diabetes medications. Inappropriate prescribing and failure to monitor drug therapy contribute to preventable ADRs, emphasizing the need for medication optimization strategies [Table 3].[12]

Drug–drug and drug-disease interactions

The use of multiple medications increases the risk of drug–drug interactions, where one drug alters the effects of another, leading to reduced efficacy or toxicity. For instance, combining anticoagulants like warfarin with NSAIDs significantly raises the risk of severe bleeding, while the use of diuretics alongside antihypertensive agents may lead to excessive drops in blood pressure and electrolyte imbalances.[13] Drug-disease interactions are equally concerning, as certain medications may exacerbate pre-existing health conditions.

Table 2: Socioeconomic and cultural influences on polypharmacy

Factor	Influence on polypharmacy
Financial constraints	Skipping doses, discontinuing medications
Higher income levels	Increased access to specialists, multiple prescriptions
Cultural practices	Herbal medicine use, alternative therapies
Education level	Medication adherence, understanding drug interactions

Table 3: Common self-medicated substances and risks

Category	Examples	Potential risks
Over-the-counter pain relievers	Non-steroidal anti-inflammatory drugs (Ibuprofen)	GI bleeding, kidney damage
Supplements	Calcium, Vitamin D	Hypercalcemia, drug interactions
Herbal remedies	Ginseng, Ginkgo Biloba	Increased bleeding risk, liver toxicity

Impact on cognitive function and falls

Polypharmacy is associated with cognitive impairment and an increased risk of falls, particularly in older adults who take multiple central nervous system depressants. Medications such as benzodiazepines, opioids, and antipsychotics can cause drowsiness, confusion, and memory problems, which may lead to delirium or exacerbate dementia. Falls are a major consequence of polypharmacy, with studies indicating that older adults taking five or more medications have a significantly higher risk of falling compared to those on fewer medications.[14] Orthostatic hypotension, a sudden drop in blood pressure upon standing, is commonly induced by antihypertensive drugs and increases fall risk. Falls can lead to fractures, hospitalization, and loss of independence, making medication reconciliation and careful prescribing essential in polypharmacy management.

Medication non-adherence and compliance challenges

Managing multiple medications can lead to medication non-adherence, which is a major barrier to effective treatment. Older adults may struggle with complex drug regimens, requiring multiple doses at different times, increasing the likelihood of missed or incorrect doses. Financial burden, forgetfulness, side effects, and skepticism about medication necessity further contribute to intentional or unintentional non-adherence. Non-adherence can result in poor disease control, increased hospitalizations, and reduced quality of life. Strategies such as medication simplification, pill organizers, and pharmacist-led interventions can significantly improve adherence and optimize therapy outcomes.[15]

PRINCIPLES OF MEDICATION OPTIMIZATION IN GERIATRICS

Deprescribing

Deprescribing is the systematic process of tapering, discontinuing, or replacing medications that may no longer be beneficial or could be causing harm. It plays a crucial role in minimizing polypharmacy and reducing medication-related complications in geriatric patients.[16]

A major tool used in deprescribing is the Beers criteria, which provides guidelines on medications that should be avoided or used with caution in older adults. Similarly, the screening tool of older persons' prescriptions/screening tool to alert to right treatment (STOPP/START) helps identify potentially inappropriate medications (PIMs) and recommend beneficial medications that may have been omitted from treatment.[17] Clinical pharmacists and geriatricians play a key role in implementing deprescribing strategies by conducting medication reconciliation, reviewing prescriptions, and educating patients about the risks and benefits of deprescribing.

Risk-benefit analysis in medication use

A thorough risk-benefit analysis is essential when prescribing or continuing medications in older adults. This involves evaluating whether a medication's benefits outweigh its potential risks, particularly in frail elderly individuals with limited life expectancy. Certain medications that are essential for disease management in younger populations may pose significant risks in older adults due to altered pharmacokinetics and pharmacodynamics.[18]

Individualized treatment goals and shared decision-making (SDM)

Given the diversity of health conditions and functional status among older adults, individualized treatment goals are crucial for optimizing medication therapy. Rather than adhering to rigid disease-based treatment guidelines, healthcare providers should focus on patient-specific priorities, such as symptom control, functional independence, and quality of life.[19] SDM is an integral part of individualized medication optimization, ensuring that patients and caregivers are actively involved in treatment choices. This approach improves medication adherence and patient satisfaction while aligning therapy with personal health goals.[20] Tools like patient decision aids and comprehensive geriatric assessments support collaborative discussions between healthcare providers, patients, and families.

Use of age-friendly and simplified drug regimens

The use of age-friendly and simplified medication regimens is essential to enhance adherence, minimize pill burden, and reduce the risk of medication errors in older adults. Polypharmacy increases the complexity of medication administration, leading to confusion, unintentional overdose, and missed doses.[19] Pharmacists play a vital role in ensuring medication safety by implementing medication therapy management programs, which focus on reviewing prescriptions, optimizing dosages, and educating patients on medication adherence. In addition, electronic prescribing and CDSS help reduce prescription errors and promote safer medication use.[21]

CLINICAL TOOLS AND FRAMEWORKS FOR MEDICATION OPTIMIZATION

Beers criteria and its application

The Beers criteria, developed by the American Geriatrics Society, are one of the most widely used tools for identifying PIMs in older adults. They provide a list of drugs that should generally be avoided or used with caution due to their high risk of ADRs. The Beers criteria are updated regularly to reflect new evidence regarding medication safety in older adults.

STOPP/START criteria for inappropriate prescribing

The STOPP and START criteria were developed to identify inappropriate prescribing and missed beneficial medications in older adults. These tools are widely used in Europe and have been validated for improving medication safety in geriatrics. STOPP criteria (PIM): STOPP helps identify and discontinue high-risk medications that can cause harm. START criteria (Omitted Beneficial Medications): START ensures that patients receive necessary medications to manage chronic conditions effectively. STOPP/START criteria improve medication safety by balancing deprescribing unnecessary drugs while ensuring essential treatments are not omitted.

Medication appropriateness index (MAI)

The MAI is a tool used to assess the overall appropriateness of a medication regimen based on 10 key criteria, including indication, effectiveness, dosage, and drug interactions. Each medication is scored, and higher scores indicate a greater risk of inappropriate prescribing. The MAI helps guide medication adjustments, particularly in complex geriatric cases where multiple prescribers are involved. It has been shown to reduce polypharmacy and improve patient outcomes.[22]

STOPP

STOPP is specifically designed to detect and discontinue high-risk medications in older adults by assessing drug–drug interactions, duplicate therapy, and medications contributing to falls or cognitive decline. Unlike Beers criteria, STOPP considers the patient's overall clinical status and comorbidities when evaluating inappropriate prescribing. STOPP is particularly useful in hospital settings and long-term care facilities to optimize prescribing in older adults.[23]

PIMs assessment

PIMs are drugs that pose more risks than benefits in older adults due to their side effects, interactions, or lack of efficacy in geriatrics. PIM assessment is essential to prevent medication-related complications, particularly in frail elderly patients. A systematic review of PIMs using tools such as Beers criteria, STOPP/START, and MAI helps reduce polypharmacy and improve medication safety.

PRACTICAL STRATEGIES FOR MEDICATION OPTIMIZATION

Comprehensive medication review (CMR)

A CMR is a structured evaluation of a patient's medications, conducted by a healthcare professional, usually a pharmacist. The primary aim is to identify and resolve medication-related problems, assess drug interactions, and ensure that each medication is necessary and effective.[24] Studies have shown that CMR reduces ADRs, hospital readmissions, and healthcare costs.

Medication reconciliation and regular follow-ups

Medication reconciliation is a process that ensures an accurate and up-to-date medication list is maintained during healthcare transitions, such as hospital admission or discharge. This reduces errors due to discrepancies in medication regimens.[25] Regular follow-ups by healthcare professionals help monitor adherence, side effects, and treatment effectiveness, leading to improved medication safety [Table 4].

Role of clinical pharmacists in polypharmacy management

Clinical pharmacists play a vital role in reducing inappropriate prescribing and optimizing medication regimens in older adults. Their interventions have been associated with improved medication adherence, reduced hospital admissions, and better patient outcomes.[26]

Pharmacist-led medication optimization programs have demonstrated significant reductions in polypharmacy-related complications in older adults [Table 5].

Strategies to improve medication adherence

Poor medication adherence is a common issue in older adults, leading to disease progression, hospitalizations, and increased healthcare costs. Several strategies can be implemented to enhance adherence. Research has shown that educational interventions combined with behavioral support significantly improve medication adherence.[27]

CHALLENGES AND BARRIERS TO MEDICATION OPTIMIZATION

Resistance to deprescribing from patients and providers

One of the major barriers to medication optimization is resistance to deprescribing from both patients and healthcare providers. Many older adults believe that medications are essential for maintaining health, leading to reluctance in stopping long-term prescriptions, even when the drugs are unnecessary or potentially harmful. Patients often fear that deprescribing may worsen their condition, cause withdrawal symptoms, or reduce their quality of life. In addition, lack of awareness about medication risks and a strong attachment to previously prescribed drugs contribute to low acceptance of deprescribing recommendations.[28] Healthcare providers

Table 4: Overview of commonly used medication optimization tools

Tool	Purpose	Key features	Limitations
Beers criteria	Identifies high-risk medications for older adults	Lists medications to avoid or use with caution	Does not consider drug-disease interactions
STOPP/START criteria	Identifies inappropriate medications (STOPP) and missing beneficial drugs (START)	Comprehensive and considers clinical conditions	Requires clinical judgment and frequent updates
MAI	Evaluates overall medication appropriateness	Scoring system for indication, dose, effectiveness, and safety	Time-consuming to apply to multiple medications
STOPP (expanded version)	Identifies high-risk medications, drug–drug interactions, and duplications	More detailed than Beers Criteria	Needs frequent revisions based on new evidence
PIMs assessment	Identifies medications that pose more harm than benefit in older adults	Helps in deprescribing efforts	Requires integration with patient-specific data

STOPP: Screening tool of older persons' prescriptions, START: Screening tool to alert to right treatment, MAI: Medication appropriateness index, PIMs: Potentially inappropriate medications

Table 5: Clinical pharmacist-led interventions

Intervention	Impact
Conducting comprehensive medication reviews	Identifies and prevents adverse drug reactions and drug interactions
Providing medication counseling	Enhances patient understanding and adherence
Implementing deprescribing strategies	Eliminates unnecessary or harmful medications
Assisting with dose adjustments	Prevents toxicity in renal/hepatic impairment
Educating healthcare teams	Promotes evidence-based prescribing

may also hesitate to deprescribe due to concerns about liability, patient dissatisfaction, or uncertainty regarding the consequences of stopping a medication. Some physicians feel pressured to continue prescriptions initiated by other providers, especially in fragmented healthcare systems where multiple specialists manage a patient's care. A study found that over 40% of physicians expressed discomfort in deprescribing medications that another doctor had originally prescribed, highlighting the complexity of SDM in medication management.[29] Addressing this challenge requires effective patient-provider communication, SDM, and the use of evidence-based deprescribing guidelines. Educating both patients and clinicians about the benefits of deprescribing, alternative treatment strategies, and monitoring strategies can improve acceptance and facilitate medication optimization.[30]

Limited time and resources in clinical settings

Time constraints and limited healthcare resources pose significant challenges to medication optimization. In busy clinical environments, physicians and pharmacists may struggle to conduct thorough medication reviews, deprescribing assessments, and patient education due to heavy workloads and time pressures. Studies indicate that primary care physicians spend an average of only 15–20 min per patient visit, making it difficult to address complex polypharmacy-related issues comprehensively.[31] In addition, healthcare facilities often lack dedicated resources, such as clinical pharmacists or geriatric specialists, who are essential in medication optimization programs. Many hospitals and outpatient clinics do not have structured deprescribing protocols, making it challenging for providers to implement medication reduction strategies systematically. EHRs and clinical decision support tools could help streamline medication reviews, but their underutilization and technical limitations further hinder optimization efforts.[32]

Inadequate communication among healthcare providers

Poor communication among healthcare providers is a critical barrier to medication optimization, particularly in multidisciplinary and fragmented healthcare settings. Older adults with multiple chronic conditions often see several specialists, leading to disconnected medication management and conflicting prescriptions. Lack of coordination between primary care physicians, specialists, pharmacists, and nurses increases the risk of drug–drug interactions, duplicate prescriptions, and inconsistent deprescribing efforts.[29] Studies have shown that incomplete medication reconciliation during care transitions (e.g., hospital discharge to primary care) is a major contributor to medication errors and ADRs. A review found that over 60% of hospital discharge summaries lacked accurate medication information, leading to mismanagement of prescriptions in outpatient settings.[33]

CONCLUSION

Medication optimization in geriatric polypharmacy is essential for ensuring safe and effective treatment while minimizing risks. Although polypharmacy is often necessary for managing

multiple chronic conditions, inappropriate prescribing can lead to ADRs, drug interactions, and decreased quality of life. A structured approach involving CMRs, deprescribing, patient-centered care, and multidisciplinary collaboration is key to reducing medication-related complications. By implementing evidence-based strategies and enhancing communication among healthcare providers, medication optimization can improve clinical outcomes, promote patient safety, and enhance the overall well-being of older adults.

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