



**EVALUATION OF POTENTIALLY INAPPROPRIATE MEDICATIONS AND  
POLYPHARMACY AMONG HOSPITALIZED GERIATRIC PATIENTS: A  
LITERATURE REVIEW**

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**ABSTRACT**

**Background:** The world's population is rapidly aging. The quality of drug therapy is important to improve the life expectancy of older patients. Polypharmacy is highly prevalent in older patients secondary to the increasing number of co-morbid conditions. Polypharmacy is defined as the "routine use of four or more OTC, prescription, and traditional medications at the same time by a patient", it increases the likelihood of side effects and the risk of interactions between the medications which makes the poor medication adherence. Using potentially inappropriate medications significantly affects mortality and morbidity. The standardization of policies, procedures, and protocol is critical to polypharmacy. If it is done systematically, it will reduce unnecessary drug doses, stoppage of inappropriate drug use, and choose alternative medications to reduce the avoidable medication harm. This comprehensive review is based on literature gathered from the PUB MED database, SCIENCE DIRECT from 2019-to 2021 to identify articles related to polypharmacy and potentially inappropriate medications in the elder population. The terms which are used to search articles were polypharmacy, potentially inappropriate medications, and elder population. **Conclusion:** This data shows regarding the effects of using polypharmacy and PIMs in elder populations are, more prone to the risk of developing side effects and interactions between medications which leads to poor medication adherence and poor quality of life, and the role of healthcare professionals to identify the inappropriate medications by using various methods and used to reduce the polypharmacy in the elder population.

**KEYWORDS:** Polypharmacy, Potentially inappropriate medications, older adults.

**INTRODUCTION**

The world's population is rapidly aging. The percentage of people who are aged 60 years or higher than 60years will rise from 12% to 22% (900 million to 2 Billion) between 2015 to 2050<sup>[1]</sup> this increase in the elderly population poses New challenges to health care since this age group has a greater prevalence of chronic degenerative diseases and they constantly use a high number of medications. Unfortunately, using multiple medications may cause problems such as the increased risk of inappropriate use of medications (including drug-drug interactions and duplication of therapy), medication non-adherence, and adverse effects. Physiological changes due to aging make them more susceptible to

adverse reactions than younger adults.<sup>[2]</sup> In addition, many older adults use more inappropriate medications in combination form from complex treatment regimens which causes harmful effects among older adults.<sup>[3]</sup> Polypharmacy and potentially inappropriate medication use results in poor quality of life and increased drug-related morbidity and mortality. There is a need for standardized tools to identify the contraindicated, appropriate and inappropriate medication use in polypharmacy. Recently, a set of screening tools are available to identify the appropriateness of drug use in patients with polypharmacy and provide the possible alternatives to certain medications, thus improving the positive outcomes of the treatment.

**Article highlights:**

- This article focuses on the
1. Clinical effects of using polypharmacy and potentially inappropriate medications.
  2. Interventions to reduce polypharmacy.
  3. Screening tools for detection of PIMs.

This comprehensive review is based on literature gathered from the PUB MED database, SCIENCE DIRECT from 2019-to 2021 to identify articles related to polypharmacy and potentially inappropriate medications in the elder population. The terms which are used to search articles were polypharmacy, potentially inappropriate medications, and elder population. Articles are included only if they are 1. People with age greater than 50years 2. In English 3. Observational, randomized, and cohort studies.

A total of 40 studies are examined. This literature review found that polypharmacy was the main factor associated with PIMs use in elders having a high percentage of health problems and this population is more susceptible to developing chronic conditions. Few studies are useful for reducing the polypharmacy and PIMs used in elder patients, which helps to increase the medication adherence, and quality of drug therapy and decreases the hospitalizations.

### **Clinical consequences of using polypharmacy and potentially inappropriate medications**

There are many consequences associated with polypharmacy and PIM's use. Patients are at an increased risk of receiving an inappropriate medication and having potential adverse drug reactions (ADR), which may impact a patient's adherence to the medication regimen. Polypharmacy has also been reported to increase the risk of geriatric syndromes and morbidity or mortality.

### **Polypharmacy**

Several studies have examined the relationship between polypharmacy and adverse drug events. Polypharmacy is a combination of multiple drugs including therapeutic drugs and contraindicated drugs, and inappropriate medications.<sup>[4,5]</sup> For example, a population-based study found that a prolonged administration of multiple medications was associated with a higher risk of acute renal failure.<sup>[6]</sup> Individuals with polypharmacy with prolonged duration had a higher comorbidity burden compared to those without polypharmacy, and it was found to be associated with a significantly higher risk of hospitalization and mortality<sup>[7]</sup>, and it mostly affects the illiterate persons are when compared to the highly educated people by the use OTC medication, herbal medication, and homeopathic medications.

### **Potentially inappropriate medications**

The inappropriate prescribing of medications includes (a) the use of medications for longer than recommended, (b) drug-drug interactions and duplicate prescriptions, and (c) high risk-benefit ratios of drugs.<sup>[8,9]</sup> The inappropriate prescribing of medications is prevalent among older adults, a population with multiple comorbidities, cognitive impairments, and communication deficits.<sup>[10]</sup> For example, Proton pump inhibitors (PPIs) are among the most commonly prescribed drugs for gastrointestinal diseases (e.g., dyspepsia, gastric ulcer, and gastroesophageal reflux disease (GERD), which are

highly prevalent among older adults.<sup>[10]</sup> Some studies stated that the prevalence of PIM use was notably higher in people with dementia (PWD) than in those without dementia people. The high prevalence of PIM use in PWD causes cognitive impairments, the co-morbid burden due to associated polypharmacy, age-related changes in pharmacokinetics and pharmacodynamics, and the lack of effective communication between patients and prescribers.<sup>[11]</sup> In nursing home residents Inappropriate drug use was shown to increase the risk of adverse health outcomes (hospitalizations, emergency department visits, death).<sup>[12,13]</sup> Anticholinergic and Psychotropic medications were observed as a large part of PIMs in this study. Though there are clear national and international recommendations to avoid the use of long-acting benzodiazepines in old people.<sup>[14,15]</sup> These long-acting benzodiazepines would increase the risk of the onset of dementia in benzodiazepine users.<sup>[16]</sup> The use of excessive doses of short- or intermediate-half-life benzodiazepines and the prescription of multiple benzodiazepines also produce potential adverse effects such as delirium, drowsiness, falls, and cognitive impairment but, to a lower extent compared to long-acting molecules.<sup>[17]</sup>

### **Drug-related problems**

The risk of potential drug-drug interactions increases with the increasing number of medications used.<sup>[18]</sup> Older people are more susceptible to adverse drug reactions and also consume multiple drugs than other age groups, and are thereby most exposed to potential DDIs.<sup>[19]</sup> Hence, there is a strong relationship between the number of dispensed drugs and potential DDIs.<sup>[18]</sup> The prevalence of drug-disease interactions was reported at about 15.3% in a sample of frail older veterans in the US.<sup>[20]</sup> For example, patients with hematological malignancy have identified polypharmacy as a novel risk factor in adults 50 years of age or older and the prevalence of DDIs was high. Most of these DDIs were categorized as major interactions, meaning that they could potentially result in death, hospitalization, injury, or therapeutic failure. In addition, most of the patients had the highest risk DDIs, which requires adjusting the dose to current medications, adding alternative medications, or complete discontinuation.<sup>[21]</sup> The use of multiple medications can cause adverse drug events such as falls and subsequent fractures, dementia, cognitive dysfunction, frailty, and kidney impairment have been linked to polypharmacy in several studies.<sup>[22]</sup> Adverse drug reactions are the leading cause of hospitalizations, about 90% of older people hospitalized for an ADR have been reported to have polypharmacy upon hospital admission.<sup>[23]</sup> Table 1. Shows the summary of drug-related problems and methods of reduction.

### **Screening tools for detection of potentially inappropriate medications**

Several screening tools were developed for detecting potentially inappropriate medications in elderly people in several countries. These tools play an important role to

reduce negative outcomes by optimizing the prescribing behavior including preventing adverse drug reactions. These screening tools have listed drugs that should be avoided in certain conditions.<sup>[24]</sup> The most commonly accepted screening tools are AGS Beer's criteria, STOPP/START criteria PRISCUS, French, McLeod, and Lindblad criteria. This tool represents a well-balanced and comprehensive tool that may be widely applied in the analysis of drug prescribing in the elderly (defined as 65 years or older). These screening tools can detect potentially clinically important drug-drug interactions and PIMs in the elderly and suggest alternative therapeutic solutions. As PIMs and drug interactions are often overlapping, analyzing them within the same protocol will provide a more comprehensive quality assessment of drug prescribing in the elderly and help in the detection of adverse drug reactions caused by either PIMs or drug interactions.

To avoid the potential adverse drug reactions, the benefit and risk ratio should be analyzed for each drug and also the risk of drug interactions. A list of potentially inappropriate medications was published to help adapt the drug regimen in older adults, notably Updated 2009 AGS beers criteria to assess the inappropriate medications.<sup>[25]</sup> Lorena de Agustín Sierra et al.'s study compares the PIM's prevalence with the two most important explicit criteria (STOPP and Beers), with the PRISCUS list, and also the use of psychotropic drugs was analyzed. This study shows that there is a high prevalence of PIMs during hospitalization of the elderly population. 9 out of 10 patients have at least one PIM. The prevalence rates according to STOPP and Beers criteria were similar (76.70% and 89.04%, respectively) and considerably higher than the PRISCUS list (41.91%).<sup>[26]</sup>

### Medication adherence

Medication adherence and drug safety continue to be important problems, especially for seniors.<sup>[27]</sup> The risk of suboptimal drug treatment may be due to medication non-adherence. Several studies reported that polypharmacy was associated with poor adherence to the medications.<sup>[28]</sup>

### Deprescribing

Deprescribing is a drug removal or drug reduction process.<sup>[24,25,29]</sup> Deprescribing is done by discontinuation, substitution, or discontinuation of medications with the main aim of reducing inappropriate medication use.<sup>[30]</sup> Fig 1 shows the steps involved in the deprescribing process. This process is used to improve patient outcomes and reduce the risk associated with polypharmacy in older adults by discontinuation of medication when medication has a high risk rather than a benefit.<sup>[31,32,33]</sup>, and it can also reduce medication non-adherence and adverse drug reactions. Deprescribing of medication by identifying the adverse effects can improve the quality of life and overall functions in geriatrics.

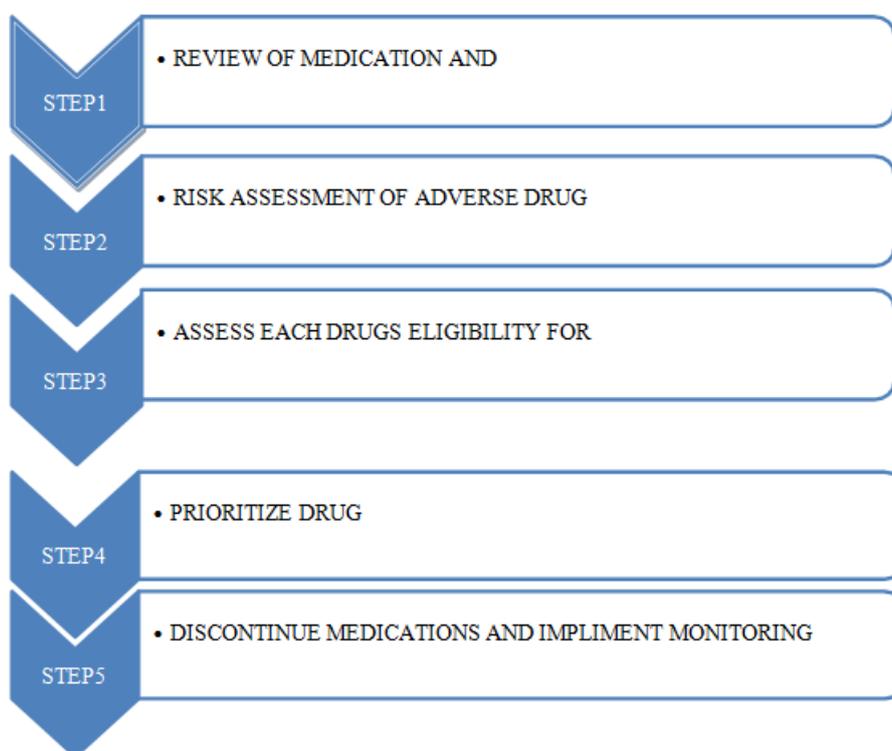
### Interventions to reduce the polypharmacy

Interventions are aimed at assessing and reducing the inappropriate prescribing and improving the appropriate and safe use of medications.<sup>[34]</sup> Medication appropriateness can be assessed by using implicit and explicit criteria. The explicit approach is criteria-based and the implicit is a judgment-based outcome measure. These approaches provide information regarding medication prescribing, which is relevant to many different drugs, clinical conditions, and the presence of co-morbidities.<sup>[35]</sup> They mainly focused on the patient rather than the drugs and it is a time-consuming process and it requires clinical pharmacists and geriatricians.<sup>[34,35,36]</sup> Milena Urfer et.al developed an interventional study by systematically integrating appropriate prescribing in each patient. They prepared a checklist by combining two conceptual frameworks with the main aim of minimizing inappropriate medications in elderly people. Generally, there is a higher risk for prescription of PIM was more likely in patients with PIM at admission, and with an increasing number of diagnoses and medications. So, by using this intervention checklist study, there is a significant reduction by 22% of the risk of being prescribed greater than the one PIM at discharge and also reduces the hospital stay.<sup>[37]</sup>

**Table 1: Summary of several studies showing drug-related problems and methods for reduction.**

S.no	Settings	Population size	Objective	Conclusion
1.	Consecutive patients were selected from heart failure outpatient departments	141	Frequency types and temporal occurrence of drug-related problems in heart failure patients.	Drug-related problems are frequently recorded from laboratory tests showing 32.7% of total drug-related problems, 29.6% of potential interactions, 13.3% of non-allergic side effects, and 9.5% of insufficient awareness about the disease. <sup>[38]</sup>
2.	Prospective case series intervention study at the op department	668	Determining the Effectiveness of medication safety reviews clinics (MMSRCs to reduce the drug-related problems among older adults prescribing multiple medications.	MSRC's model can serve as prototyping to improve prescription quality. About 96% of participants were satisfied with MSRC's services. <sup>[39]</sup>

3.	An investigation was done by 23 experts (geriatricians, clinical pharmacists.)	Survey-based study	Establishing an explicit list of potentially clinically significant drug-drug interactions in people aged greater than or equal to 65 years.	The 66 items drug-drug interaction list can be used to assist the health care professional to detect the potentially, clinically significant drug-drug interactions in older adults. <sup>[40]</sup>
4.	Quantitative study	594	Aims at the increased quality of care and reduce the cost.	Drug waste is associated with a lack of standard procedures to implement for patient safety. It is necessary to implement and develop IT to improve health information management and pharmacological presentation. <sup>[41]</sup>
5.	Cross-sectional study	215	Examine how mild cognitive impairment and high co-morbid burden are related to inappropriate prescribing of PPIs.	High prevalence of inappropriate Proton pump inhibitors with mild cognitive impairment than in normal cognitive people. <sup>[42]</sup>
6.	A multicenter observational longitudinal study	733	Investigating the effects of hyperpolypharmacy and potentially inappropriate medications on functional decline in older patients after hospital discharge.	Hyperpolypharmacy can predict functional decline at least partly independent of the use of PIMs.



## CONCLUSION

Polypharmacy is most common in the elderly. Many studies observed that effects of using polypharmacy and PIMs in elder populations are, more prone to the risk of developing side effects and interactions between medications which leads to poor medication adherence and poor quality of life. Health care professionals should be aware of the risk associated with medications and should identify the inappropriate medications by using

various methods and criteria to reduce polypharmacy in the elder population.

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