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Polypharmacy and Potentially Inappropriate Medication Use in Elderly Patients: A Cross-Sectional Study in Family Practice

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ABSTRACT

Background:
Polypharmacy and the use of potentially inappropriate medications (PIMs) are growing concerns in geriatric care, contributing to adverse drug events, hospitalizations, and reduced quality of life. In primary care, these issues are particularly critical due to the high burden of chronic illness among elderly patients.
Objectives:
To assess the prevalence of polypharmacy and PIMs use among elderly patients attending family practice clinics and identify associated sociodemographic and clinical factors.
Methods:
A cross-sectional study was conducted at the primary health care centers at Alahsa region , Saudi Arabia, involving 160 elderly patients aged ≥65 years. Data were collected through interviews and electronic medical record reviews. Polypharmacy was defined as the use of ≥5 medications. PIMs were identified using the 2023 AGS Beers Criteria. Descriptive statistics, bivariate analysis, and multivariate logistic regression were performed using SPSS version 26.0.
Results:
Polypharmacy was present in 64.4% of patients, while 40.6% received at least one PIMs. Benzodiazepines, nonsteroidal anti-inflammatory drugs (NSAIDs) and anticholinergics were the most common PIMs. Polypharmacy and age ≥75 years were significantly associated with PIMs use ($p < 0.05$). Polypharmacy independently predicted PIMs use (OR = 4.36, 95% CI: 2.05–9.28).
Conclusion:
Polypharmacy and PIMs use are prevalent among elderly patients in primary care. Age, multimorbidity, and low education levels contribute to these patterns. Routine medication review and targeted deprescribing interventions are essential for enhancing medication safety in older adults.

Keywords:
Polypharmacy, Potentially Inappropriate Medications, Elderly, Primary Care, Beers Criteria, Geriatrics, Saudi Arabia.

Introduction

The worldwide trend of aging populations represents a substantial obstacle for healthcare delivery systems throughout the world. The rising life expectancy produces more people who develop chronic non-communicable diseases which requires advanced therapeutic treatment plans for disease control. Polypharmacy now affects older adults in large numbers within primary and family medicine practice because they have five or more medications simultaneously [1,2]. The medical practice of treating multiple health conditions with several drugs leads to adverse outcomes through medication interactions and it causes healthcare expenses to rise and physical functioning to decrease together with an increased risk of deaths and hospital admissions [3-5].

The primary concern connected to polypharmacy exists in potentially inappropriate medications

(PIMs) that generate more risks than benefits if more secure alternatives exist [6]. The physiological vulnerability of older adults to medication effects becomes worse due to normal aging changes that affect how their body handles drugs through pharmacokinetics and pharmacodynamics processes [7]. The combination of medication-related factors makes older people highly susceptible to drug-related harm because PIMs result in non-necessary adverse drug events (ADEs) and trigger falls and cognitive problems which cause hospitalizations [8,9].

Medical practitioners are focusing more intensely on PIMs identification as well as prevention activities because they constitute vital parts of delivering safe prescription services to elderly patients. The Beers Criteria from the American Geriatrics Society together with the Screening Tool of Older Persons' Prescriptions (STOPP) criteria lead as the principal screening tools for PIMs identification specifically in European healthcare domains [10,11]. The tools function as clinical practice instruments and valuable epidemiological frameworks for evaluating improper medicine prescribing conditions. Studies across multiple healthcare environments show that PIMs usage remains high among senior citizens yet this data creates concern regarding prescription practice quality and elderly care deliverables [12,13].

General practitioners in family practice sites stand as the primary providers who care for elderly patients throughout multiple months when treating their various chronic health conditions. The consistent and comprehensive medical care provided in these settings enables observation of polypharmacy conduct and PIMs administration patterns. Research about inappropriate prescribing among elderly patients in low- and middle-income countries particular to the Middle East and North Africa region is not extensive [14]. The minimal understanding about inappropriate prescribing practices among the elderly creates major challenges for patient protection and resource allocation as well as intervention development for local health system needs.

The practice of polypharmacy together with PIMs utilization in primary care settings depends on physician prescribing patterns and patient care segmentation and healthcare expectations as well as insufficient medication reconciliation protocols and insufficient training on treating older adults [15]. Patients over 65 often require multiple medications because disease management guidelines use single-condition frameworks which results in conflicting treatments during treatment of coexisting medical conditions [16]. Patient-centered integrated care models become vital for harm reduction in polypharmacy management because cognitive impairment combined with poor health literacy and inadequate healthcare provider communication with elderly patients [17,18].

Saudi Arabia along with numerous other fast-ageing nations faces a growing incidence of chronic diseases in older adults that results in more complicated medication management [19]. Data about polypharmacy and PIMs utilization patterns within elderly family practice clinic patients remain insufficient across Saudi Arabia which hinders the creation of localized policies and guidelines. Data collected from a tertiary hospital in Riyadh showed that thirty-five percent of older patients received at least one PIMs prescription while polypharmacy directly caused inappropriate medication use [20]. These study results cannot reliably project into community-based or primary care environments.

Knowledge about the distribution and influencing factors of polypharmacy and PIMs usage within family practice practice supports effective deprescribing strategies and optimal pharmacological treatment for older adults. Real-world cross-sectional studies help establish important data about prescription practices as well as clinical practice weaknesses and possible intervention points. The research data from such studies helps medical professionals develop quality enhancement strategies including medication review protocols alongside clinical decision support systems and educational training for practicing prescribers [21,22].
This research investigates the common occurrence of polypharmacy together with PIMs use among elderly patients who receive care from family

practices. We aim to achieve the following three objectives within this study: (1) determine the proportion of elderly patients taking polypharmacy and PIMs, (2) determine which PIMs prescribed according to Beers Criteria are most prevalent, and (3) study the connection between patient characteristics and provider variables and inappropriate prescribing decisions. Our goal is to present an extensive overview of medication overload among senior citizens while generating evidence supporting safer primary care prescribing practices.

Methods

Study Design

The researchers conducted a descriptive cross-sectional study to determine how often elderly medical clinic patients received multiple medications and PIMs. The study used a cross-sectional design to evaluate medication-related issues because it provides an optimal approach for assessing specific population groups at one particular point in time. The design helps reveal prescribing tendencies and risk elements which lead to improper medication use within actual clinical practice.

Study Setting

The research took place in primary health care centers at Al-Ahsa in Eastern Province Saudi Arabia. The primary healthcare centers provide medical care to a wide range of patients including university employees and students together with local community residents. The family practice clinics deliver care according to both principles of continuity and comprehensiveness of care when treating their patients for chronic disease management and preventive care and geriatric assessment. These clinics function as fundamental community healthcare facilities which established a suitable environment to study medication patterns in elderly patients..

Sample and Sampling

A consecutive non-probability sampling technique led to the recruitment of 160 elderly patients who were above 65 years old. The research recruited participants who were 65 years or older who visited family medicine clinics for regular check-ups and needed medicine prescriptions.

Inclusion and Exclusion Criteria

Inclusion Criteria: Participants were eligible for inclusion in the study if they met the following criteria:

- **Age 65 years or older**, as polypharmacy and PIMs use are particularly relevant in this age group according to geriatric care guidelines.
- **Regular attendance at family medicine clinics** within the selected primary healthcare centers in Al-Ahsa region, Saudi Arabia, to ensure the continuity and comprehensiveness of medical records.
- **Currently prescribed at least one chronic medication**, enabling meaningful assessment of polypharmacy and PIMs.
- **Ability to communicate clearly**, either independently or with minimal assistance, to participate in face-to-face interviews regarding medication use and health conditions.
- **Provision of informed written consent** to participate in the study.

Exclusion Criteria: Patients were excluded from participation if they met any of the following conditions:

- **Severe cognitive impairment or diagnosed dementia**, which could hinder the ability to provide accurate information or give informed consent. Cognitive impairment was determined based on documented clinical diagnoses or observed communication limitations by clinic staff.
- **Incomplete or inaccessible medical records**, which would impede the accurate extraction of medication histories and clinical diagnoses.
- **Acute medical illness at the time of recruitment**, as temporary changes in prescriptions during acute episodes could confound the assessment of chronic medication use patterns.

- **Refusal to participate or withdrawal of consent**, in accordance with ethical research standards.

The calculation of sample size relied on previous research findings about PIMs utilization rates among the elderly population while using a 95% confidence level and 7.5% margin of error to estimate a potential prevalence range from 35% to 45%. With consideration of non-responses and incomplete data the researchers determined that 160 patients provided sufficient data to create reliable statistical results and perform subgroup evaluation..

Data Collection Tool

Data collection in this study was carried out using a structured data extraction form titled the "Geriatric Medication Assessment Form (GMAF-2023)", developed by the principal investigators in consultation with geriatric pharmacotherapy experts and family medicine consultants. The aim of the tool was to comprehensively assess the prevalence of polypharmacy and the use of PIMs among elderly patients in primary care settings. The form was informed by previously validated instruments used in similar geriatric medication studies and tailored to suit the clinical and demographic context of the Al-Ahsa region in Saudi Arabia.

The tool consisted of three main components: (1) Sociodemographic Data Section, which captured information such as age, sex, marital status, education level, and living arrangement; (2) Clinical and Medication Profile, which included self-reported chronic illnesses, number and names of prescribed medications, dosages, frequencies, and duration of medication use; and (3) PIMs Identification Module, which utilized the 2023 American Geriatrics Society (AGS) Beers Criteria®—a widely accepted evidence-based guideline developed by an expert panel of the AGS to detect medications considered inappropriate for use in older adults due to heightened risk of adverse effects. Each prescribed medication was matched against the Beers Criteria to determine its appropriateness.

The tool did not employ a numerical scoring system, as it functioned primarily as a classification instrument; medications were either categorized as "appropriate" or "potentially inappropriate" based on the Beers Criteria recommendations. The Beers Criteria themselves have undergone extensive validity and reliability assessments, with inter-rater reliability coefficients exceeding 0.80 in prior studies. In this study, the PIMs classification process was conducted independently by a trained clinical pharmacist and a board-certified family physician to enhance reliability. Any discrepancies were resolved through discussion and consensus to ensure consistency and minimize bias.

The entire GMAF-2023 form was translated into Modern Standard Arabic using forward-backward translation procedures as per World Health Organization guidelines. The Arabic version was reviewed by a panel of bilingual experts in geriatric pharmacology and primary care medicine to assess content and face validity. A pilot test was conducted on a subsample of 15 elderly patients to evaluate clarity, feasibility, and cultural appropriateness, with minor linguistic adjustments made accordingly. The final Arabic version demonstrated excellent internal consistency and inter-rater agreement in PIMs classification (Cohen’s kappa = 0.86), confirming its validity and reliability for use in the Arabic-speaking elderly population.

Data Collection Procedure

The study lasted three months beginning from September until November 2023. The study team identified potential participants during standard clinic appointments to invite them for research participation. The study team received informed consent before trained research assistants performed brief interviews to gather demographic details and self-reported health information from each participant.

A thorough review of medical records enabled researchers to obtain clinical diagnosis information with lists of current medications and essential laboratory results. The research defined polypharmacy through five or more concurrent medications following established definitions from the literature [2] while counting the total number of medications per patient.

A review of every prescribed medicine followed the Beers Criteria to detect PIMs which were subsequently recorded. The researchers documented the four types of inappropriate medications which included sedatives alongside anticholinergics along with nonsteroidal anti-inflammatory drugs (NSAIDs) and long-acting sulfonylureas.

Two independent reviewers checked all entries to verify both completeness and accuracy as part of the data quality assurance process. Team meetings occurred regularly to handle uncertainties and validate protocol compliance.

Data Analysis

The data input and analysis process utilized IBM SPSS Statistics for Windows Version 26.0 (IBM Corp., Armonk, NY, USA). The authors employed descriptive statistics to present information about the research participants. The statistical analysis used frequencies and percentages for categorical variables but continuous variables were presented through means along with standard deviations.
The research determined the rates of polypharmacy and PIMs utilization as its main outcome measures. Tests with Chi-square statistics evaluated connections between PIMs utilization and demographic traits like age group and gender along with clinical characteristics of patient chronic conditions and medication count usage through independent t-tests. The study established a binary logistic regression model to find independent factors that predict PIMs utilization while basing variable entry on bivariate analysis results combined with clinical significance.
All inferential tests required statistical significance at $p < 0.05$.

Ethical Considerations

Prior to data collection. The study conducted all procedures involving human participants following both institutional research committee ethical standards and Declaration of Helsinki standards.
The study participants received comprehensive information regarding the research goals together with program advantages and possible dangers. Each participant provided written consent to participate before the start of data collection. All participants' data remained confidential and personal identifiers were eliminated before analysis and data entry procedures. The research team was the sole group able to access data that received password protection for secure storage.
Participants maintained the freedom to exit the research study anytime without facing negative impacts on their medical care at the clinics. All participants received no financial benefits while joining the study because every participant joined voluntarily.

Results

Participant Characteristics
There were 160 elderly patients who took part in this research study. The Table 1 describes the sociodemographic and clinical characteristics collected from the study participants. The mean age of participants reached 72.3 years and most respondents were female at 56.9 percent and married at 68.8 percent. Data showed that older patients obtained at least primary school education while 37.5% of them had finished their basic studies. The study participants exhibited hypertension in 71.9% of patients and diabetes mellitus in 63.1% of patients.

Table 1: Sociodemographic and Clinical Characteristics (N=160)

Characteristic	n (%) or Mean ± SD
Age, mean (±SD), years	72.3 ± 6.7
Gender	

-Female	91 (56.9)
-Male	69(43.1)
Marital status	
- Married	110 (68.8)
- Widowed	38 (23.7)
- Single/Divorced	12 (7.5)
Education level	
- Illiterate	49 (30.6)
- Primary	60 (37.5)
- Secondary	33 (20.6)
- University	18 (11.3)
Common chronic diseases	
- Hypertension	115 (71.9)
- Diabetes mellitus	101 (63.1)
- Dyslipidemia	69 (43.1)
- Cardiovascular diseases	53 (33.1)

Polypharmacy among Participants

The healthcare population contained a significant number of patients with polypharmacy since they used five or more medications simultaneously which affected two-thirds (64.4%) of patients. The data regarding medication utilization shows its distribution according to patient prescription frequency in Table 2.

Table 2: Medication Count per Patient and Polypharmacy (N=160)

Number of Medications	**Patients n (%)**
1-4	57 (35.6)
5-7	68 (42.5)
8-10	27 (16.9)
≥11	8 (5.0)
Polypharmacy total	**103 (64.4)**

Prevalence and Types of PIMs

Table 3 shows how the 2023 AGS Beers Criteria identifies PIMs usage rates and different PIMs categories in participants. The research revealed PIMs use in 40.6% of the total study subjects. Benzodiazepines, NSAIDs together with anticholinergic medications emerged as the main categories of PIMs used.

Table 3: Prevalence and Categories of PIMs

Medication Class (PIMs)	Patients n (%)
Benzodiazepines	27 (16.9)
NSAIDs	22 (13.8)
Anticholinergics	11 (6.9)
Sulfonylureas (long-acting)	5 (3.1)
Muscle relaxants	3 (1.9)
Other sedatives/hypnotics	7 (4.4)
Any PIMs use	**65 (40.6)**

Factors Associated with Polypharmacy

The analysis revealed that polypharmacy was significantly associated with several demographic and clinical characteristics among the elderly participants (Table 4). Notably, older adults aged 75 years and above were more likely to experience polypharmacy compared to those aged below 75, with a statistically significant difference ($p = 0.013$). Education level was also a significant factor; patients with lower educational attainment (primary school or less) had a higher likelihood of polypharmacy compared to those with higher education levels (75.7% vs. 54.3%, $p = 0.006$). Furthermore, the presence of multiple chronic conditions was strongly associated with polypharmacy; individuals with three or more chronic diseases were significantly more likely to be on five or more medications compared to those with fewer conditions (77.7% vs. 38.6%, $p < 0.001$). Although a higher proportion of females exhibited polypharmacy than males, this difference did not reach statistical significance ($p = 0.252$).

Table 4: Factors Associated with Polypharmacy

Characteristic	Polypharmacy (n=103)	No Polypharmacy (n=57)	p-value
Age ≥75 years	59 (57.3)	21 (36.8)	0.013
Female gender	62 (60.2)	29 (50.8)	0.252
Lower education (≤ primary)	78 (75.7)	31 (54.3)	0.006
≥3 chronic diseases	80 (77.7)	22 (38.6)	<0.001

Factors Associated with PIMs Use

The findings presented in Table 5 highlight several factors significantly associated with the use of PIMs among elderly patients. Polypharmacy was the most prominent factor: 83.1% of patients who received at least one PIMs were concurrently prescribed five or more medications, compared to 51.6% of those who did not receive a PIMs, a statistically significant difference ($p < 0.001$). Age was also a relevant factor; PIMs use was significantly higher among patients aged 75 years and older (56.9%) compared to those younger than 75 (45.3%) ($p = 0.036$), indicating an age-related vulnerability to inappropriate prescribing.

Furthermore, the presence of cardiovascular diseases was associated with a significantly higher rate of PIMs usage. Among those who used PIMs, 44.6% had cardiovascular conditions, compared to 25.3% in the non-PIMs group ($p = 0.010$). However, no statistically significant association was observed between PIMs use and hypertension status ($p = 0.243$), despite hypertension being the most prevalent chronic condition in the study population.

Table 5: Factors Associated with PIMs Use

Characteristic	PIMs Use (n=65)	No PIMs Use (n=95)	p-value
Age ≥75 years	37 (56.9)	43 (45.3)	0.036
Polypharmacy	54 (83.1)	49 (51.6)	<0.001
Hypertension	50 (76.9)	65 (68.4)	0.243
Cardiovascular diseases	29 (44.6)	24 (25.3)	0.010

Predictors of PIMs Use (Multivariate Logistic Regression)

To identify independent predictors of PIMs use, a multivariate logistic regression analysis was conducted using variables that were either statistically significant in the bivariate analysis or considered clinically relevant. As shown in Table 6, polypharmacy (defined as the use of five or more medications) emerged as the strongest predictor of PIMs use. Patients exposed to polypharmacy had more than four times greater odds of receiving a PIMs compared to those prescribed fewer medications (Adjusted OR = 4.36, 95% CI: 2.05–9.28, $p < 0.001$), underscoring the profound influence of medication burden on prescribing appropriateness.

Age ≥75 years was also identified as an independent predictor. Elderly patients in this age group were almost twice as likely to be prescribed a PIMs compared to those aged 65–74 years (Adjusted OR = 1.89, 95% CI: 1.01–3.55, $p = 0.047$). This finding highlights the increased vulnerability of the oldest old to inappropriate prescribing, likely due to age-related changes in pharmacokinetics and pharmacodynamics.

While the presence of cardiovascular diseases showed an elevated odds ratio (OR = 1.67), this association did not reach statistical significance ($p = 0.152$), suggesting that its contribution may be confounded by other factors. Similarly, lower educational level (≤ primary education) was not a statistically significant predictor in the multivariate model (Adjusted OR = 1.43, 95% CI: 0.72–2.86, $p = 0.308$), although it had shown significance in the bivariate analysis.

Table 6: Multivariate Logistic Regression for Predictors of PIMs Use

Predictors	Adjusted OR (95% CI)	p-value
Polypharmacy (≥5 drugs)	4.36 (2.05–9.28)	<0.001
Age ≥75 years	1.89 (1.01–3.55)	0.047
Cardiovascular diseases	1.67 (0.83–3.35)	0.152
Lower education	1.43 (0.72–2.86)	0.308

Discussion

The study evaluated polypharmacy together with PIMs use rates for elderly patients at primary health care centers in Saudi Arabia. Research data showed polypharmacy affects most elderly patients because 64.4% of the sample received at least five medications. Studies worldwide support the idea that large numbers of elderly individuals receiving multiple medications identify polypharmacy as a major public health concern for geriatric primary healthcare services [23,24].

Present findings from this study indicate that polypharmacy affects 64.4% of patients while earlier regional research in Saudi Arabia showed rates between 40% and 55% [25,26]. The study results demonstrate a potential difference in population demographics and healthcare settings' prescribing trends as well as changes in treatment approaches for long-term conditions [27]. Worldwide polypharmacy rates show considerable diversity since developed countries face up to 70% prevalence while the results from our study lie in a comparable yet concerning range [28,29].

The research established that PIMs affected 40.6% of respondents which corresponds with findings from Middle Eastern countries as well as worldwide settings where inappropriate prescribing of medications to elderly patients is widespread [30,31]. Medical research confirms that older adults receive benzodiazepines and NSAIDs and anticholinergic meds frequently as PIMs which demonstrates continued medication challenges linked to sedatives and analgesics [32,33]. The urgent requirement for focused deprescribing interventions in primary care becomes evident due to the fact that these medications raise substantial risks for negative effects such as cognitive decline combined with increased hospitalizations and deteriorated life quality and greater fall susceptibility [34,35].

Research findings establish a direct link of polypharmacy with older patient populations (≥75 years) who have numerous health problems along with limited education attainment. Old adults tend to develop polypharmacy due to their advanced age because multiple chronic diseases lead them to require complex medication therapy [36,37]. Older patients face physiological barriers to safely handling complicated medication regimens because psychological research shows they have reduced cognitive abilities and limited powers of recall as well as less health literacy [38,39]. The aging process increases patient sensitivity to medication-related risks so healthcare providers must deliver customized educational programs combined with clinical assistance to reduce these risks.

Research findings presented earlier show that individuals with lower educational background exhibit increased vulnerability to inappropriate medication use [40] and this study confirms this relationship with polypharmacy. Education affects a person's health-related skills together with their drug intake practice and their capability to discuss medication problems with medical providers [41,42]. The psychological effects of poor health literacy drive medication comprehension problems which both results in unreliable medication behavior and elevated risk of detrimental medication outcomes [43,44]. Illuminates the need for treatment programs that improve medication literacy because they specifically benefit less-educated individuals seeking patient empowerment.

The research revealed that polypharmacy and patient age of 75 years and older function as independent factors to predict PIMs utilization in accordance with established research in this field [45,46]. The ratio of observed odds reveals

polypharmacy patients experience a fourfold greater probability of receiving PIMs which demonstrates the inseparable connection between polypharmacy and inappropriate prescribing. The complete psychological challenges stemming from polypharmacy tactics cause older adults to experience above-average anxiety from drug side effects and face confusion from intricate dosing schedules and fear medicines interacting [47,48]. Psychological factors related to medication use can be minimized through supportive counseling along with simpler medication plans and regular medication review appointments which reduces PIMs prevalence and supports medication safety enhancements [49].

The results demonstrated significant correlations between cardiovascular diseases and PIMs use during the univariate assessment although the factor lost its statistical significance in the multivariate model. Research has yielded conflicting evidence about cardiovascular diseases as individual predictors of inappropriate prescribing although other variables such as prescribing practices and clinical guidelines tend to overshadow this direct connection between the two [50,51]. Tests of psychological factors demonstrate that doctors' prescription decisions might be steered by three elements: their assessments of what patients need and want followed by their worry about negative outcomes and their requirement to meet guidelines that promote multiple medications especially among individuals with multiple health problems [52,53]. The application of training programs for healthcare providers will help reduce inappropriate prescribing when they learn geriatric pharmacology and deprescribing practices and interdisciplinary team-based approaches [54].

The results from this research carry essential significance toward enhancing both medical care practices and policy formation. The high frequency of polypharmacy along with PIMs establishes a need for introducing complete medication management services with routine medication reconciliation into primary care settings for elderly patients [55]. The medication safety improvement depends on psychological and educational interventions directed at elderly patients who have limited education and challenging medication regimens [56]. Family involvement in medical decisions through collaborative decision-making practices helps patients stick to their medications better and improves their psychological health following medication usage [57,58].

The introduction of several important points which require recognition. The study design as cross-sectional makes it impossible to determine cause-effect relationships between examined factors and polypharmacy implementation and inappropriate medications usage. The results from non-probability sampling cannot be safely extended to populations outside the studied clinical environment. The evaluation of polypharmacy reduction and inappropriate prescribing treatments among older adults needs future long-term research to understand causes and treatment effectiveness.

Conclusion

This research study delivers significant findings about polypharmacy together with inappropriate medication use practices among elderly Saudi patients under primary care. A comprehensive intervention framework for polypharmacy control and medication appropriateness improvement must adapt clinical together with psychological and educational strategies designed specifically for older adults under primary care.

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