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# Medication Overload Evaluating Drug Interaction Patterns in Older Adults

**[1]Dr. Qurrat-ul-ain Bukhari, [2]Dr.Shireen Nazir, [3]Mansoor Musa, [4]Qamar Abbas, [5]Isma Abbas, [6]Faiza Maqsood**

[1]Altamash Institute of Dental Medicine.
[2]Assistant professor Altamash institute of dental medicine.
[3]Agha Khan Hospital Karachi.
[4]PIMS Islamabad
[5]UHS Lahore
[6]Liaquat Hospital Karachi.

**Background:**
Medication overload and polypharmacy are increasingly common in older adults, particularly those with chronic conditions such as hypertension, diabetes, and urological disorders. Drug–drug interactions (DDIs) are often underreported but contribute significantly to hospitalizations, adverse drug reactions (ADRs), and treatment failure in this population (1–3). Despite widespread clinical guidelines, inappropriate prescriptions and poorly monitored regimens continue to pose risks (4,5).

**Objective:**
This study aims to evaluate patterns of medication overload and clinically significant drug–drug interactions among older adults, using both hospital-based data and a community survey. It also seeks to assess contributing risk factors and propose improved strategies for medication safety.

**Methods:**
A mixed-methods study was conducted using secondary data from published studies, a retrospective review of 115 elderly patient records from a tertiary hospital in Lahore, and a small survey of 50 community-dwelling adults aged ≥65. Key variables included number of medications, DDI risk (based on Micromedex® and Beers Criteria), and clinical outcomes. Data were analyzed descriptively and with logistic regression to identify predictors of DDIs.

**Results:**
The prevalence of polypharmacy (≥5 drugs) was 68%, with 32% of patients exposed to ≥1 clinically significant DDI. Among hospital patients, 21.7% had recent ADR-related admissions, primarily due to cardiovascular and urological drug combinations. The survey revealed poor awareness of DDI risks (only 16% had received pharmacist counseling). A significant association was found between polypharmacy and DDI risk ($p<0.01$).

**Conclusion:**
Older adults face high rates of medication overload and DDI-related harm, particularly those with complex comorbidities. Regular medication reviews, pharmacist-led interventions, and EHR-integrated DDI alerts are critical to reducing avoidable harm. Public education and tailored prescribing policies are urgently needed.

**Keywords:**
Polypharmacy, Drug–Drug Interactions, Older Adults, Medication Overload, Adverse Drug

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Reactions, Geriatrics, Clinical Pharmacology.

**Introduction:**

The aging of global populations has intensified concerns over medication safety, particularly the challenge of polypharmacy and its consequences in older adults. Polypharmacy, commonly defined as the concurrent use of five or more medications, is not inherently harmful but becomes problematic when associated with inappropriate prescriptions, drug–drug interactions (DDIs), and adverse drug reactions (ADRs) (1–3). Among elderly patients, especially those managing multiple chronic illnesses such as hypertension, diabetes, benign prostatic hyperplasia (BPH), or urolithiasis, the risk of clinically significant DDIs is substantially elevated (4,5). As a result, medication overload has emerged as a major patient safety issue in geriatric care (6).

In older adults, physiological changes—such as reduced renal clearance, altered hepatic metabolism, and increased blood–brain barrier permeability—affect drug pharmacokinetics and pharmacodynamics, increasing the susceptibility to ADRs (7). Additionally, cognitive decline, functional limitations, and caregiver dependencies complicate adherence and understanding of complex medication regimens (8). Despite the availability of tools like the Beers Criteria and STOPP/START guidelines, a significant proportion of inappropriate prescribing and unrecognized DDIs persist, particularly in low- and middle-income countries (9,10).The clinical consequences of medication overload are substantial. It has been linked to falls, delirium, acute kidney injury, hospitalization, and even mortality (11–13). For instance, Hughes et al. (2023) reported a pooled prevalence of clinically significant DDIs of 28.8% among older community-dwelling adults, while Očovská et al. (2023) found over 46% of elderly hospital inpatients were exposed to interactions capable of worsening their clinical outcomes (1,3). In Pakistan, the use of overlapping cardiovascular and urological medications is particularly common among older men, heightening the risk of hypotension, electrolyte disturbances, and urinary retention (8,14). Yet, real-world data on DDI patterns and associated outcomes in the elderly population remain limited.

Several tools have been proposed to mitigate medication overload, including medication reconciliation protocols, pharmacist-led medication reviews, and electronic clinical decision support systems (15,16). However, these interventions remain underutilized, especially in under-resourced clinical settings. Moreover, most of the available evidence comes from Western contexts, with limited empirical evaluation in South Asia.This study seeks to address this gap by evaluating drug interaction patterns among older adults using a combination of secondary literature, real-world data from a tertiary hospital, and a small community survey. The study focuses on identifying the prevalence of polypharmacy, types of interacting drug classes, frequency of ADR-related admissions, and patient knowledge regarding medication safety. By integrating these sources, the research aims to provide actionable insights for clinicians and policymakers to improve medication safety in geriatric populations.

Ultimately, the study underscores the importance of systematic medication reviews, risk stratification, and individualized prescribing practices to reduce avoidable harm in older

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adults. As life expectancy increases and multimorbidity becomes the norm rather than the exception, addressing medication overload and DDIs is not only a pharmacological concern but a critical public health priority.

## Materials and Methods

This cross-sectional study employed a mixed-methods design and was conducted in Lahore, Pakistan, from January to April 2025. Data were collected from three primary sources: a retrospective hospital record review, a community-based survey, and a targeted review of peer-reviewed literature. The quantitative analysis was guided by a positivist approach, while qualitative insights drawn from participant responses were interpreted through an interpretivist lens. The study setting included one tertiary care hospital for clinical data collection and two urban outpatient clinics for the administration of community surveys among older adults.

## Population and Sampling Method

The study population consisted of individuals aged 65 years and above. For the hospital dataset, 115 patient records were randomly selected from medical, urology, and geriatric departments using stratified sampling to ensure gender and condition diversity. Inclusion criteria required patients to have at least one chronic illness and be prescribed a minimum of three medications during hospitalization. Records missing medication data or clinical outcomes were excluded. The community component involved a convenience sample of 50 older adults attending two outpatient clinics. These participants were surveyed regarding their medication practices, awareness of drug–drug interactions (DDIs), and experiences with adverse drug reactions (ADRs). Additionally, secondary literature data were extracted from 20 high-quality, peer-reviewed studies published between 2018 and 2024, selected to provide comparative insight into the prevalence and impact of polypharmacy and DDIs in older populations globally.

## Data Collection Procedures

Hospital data were abstracted using a standardized template and included demographics, comorbidities, number and types of prescribed drugs, presence of potential or confirmed DDIs, and incidence of ADR-related admissions. The identification of DDIs was done using Lexicomp® interaction checker and was validated through Beers Criteria and the STOPP/START framework. The community survey employed a structured questionnaire available in English and Urdu, covering participants' awareness of medication risks, use of herbal supplements, sources of prescription guidance, and history of medication counseling. All survey participants provided verbal consent and completed the form in the presence of a trained healthcare volunteer. From the literature sources, effect estimates such as hazard ratios (HRs), relative risks (RRs), confidence intervals (CIs), and sample sizes were extracted

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and tabulated for later comparison with our local findings.

## Variables and Outcome Measures

The primary outcome of interest was the prevalence of clinically significant drug–drug interactions among the older adult population. Secondary outcomes included the total number of medications per patient, the frequency of ADR-related hospital admissions, and survey-based awareness metrics such as prior pharmacist counseling, knowledge of polypharmacy risks, and understanding of drug side effects. The hospital dataset additionally allowed analysis of the most frequently interacting drug classes and associated complications, such as hypotension, falls, urinary retention, and electrolyte imbalances.

## Statistical Analysis

All quantitative data were analyzed using SPSS v26.0 and R v4.2.1. Descriptive statistics—such as means, standard deviations, and frequencies—were computed for all variables. Bivariate associations were assessed using Chi-square tests for categorical variables and independent t-tests for continuous variables. Logistic regression analysis was performed to identify predictors of DDIs, using the number of medications, age, gender, and comorbidity count as covariates. Statistical significance was set at $p < 0.05$. Comparative metrics from key studies were also reported, including the pooled DDI prevalence from Hughes et al. (2023) at 28.8% (95% CI: 19.3–40.7), and the ADR relative risk from Nicholson et al. (2024) of 1.72 (95% CI: 1.34–2.09). The statistical approaches employed in referenced literature—such as Cox proportional hazard models and multivariate regressions—were mirrored where feasible to enhance methodological consistency.

## Data Management and Reliability

To ensure the reliability and integrity of collected data, two independent reviewers extracted and cross-verified information from hospital records and survey responses. Any discrepancies in interpretation or data coding were resolved through consensus or referred to a third reviewer for adjudication. Only high-quality, peer-reviewed articles were included in the literature review, and each reference was verified using PubMed indexing and DOI cross-checks. Data from hospital files were anonymized, and 20 randomly selected cases were re-abstracted to assess consistency in variable coding. All survey data were digitized immediately after collection and encrypted for secure storage. Throughout the process, standard data management protocols were followed to prevent duplication, bias, or loss.

## Ethical Considerations

Ethical approval was obtained from the Institutional Review Board (IRB) of the participating hospital under reference number IRB/2025/MedOverload/015. Participants in the community survey were informed verbally about the purpose of the study, and consent was documented. Hospital data were de-identified prior to analysis, and no patient names, MRNs, or direct identifiers were retained. The study complied with the principles outlined in the Declaration

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of Helsinki regarding the protection of human subjects in clinical and public health research.

**Results:**

| Variable | Value (n/%) or Mean ± SD |
|---|---|
| Mean Age (years) | 76.2 ± 6.4 |
| Gender (Male/Female) | 59 (51.3%) / 56 (48.7%) |
| Mean Number of Medications | 6.8 ± 2.1 |
| Common Comorbidities | HTN, DM (34%), IHD, DM (22%), CKD (16%), COPD (11%), None (17%) |
| Patients with ≥5 Drugs | 78 (67.8%) |
| DDI Detected (via Lexicomp) | 37 (32.2%) |
| ADR-related Admissions | 25 (21.7%) |
| Most Common Interacting Drugs | ACE inhibitors + Diuretics, NSAIDs + Antihypertensives, Anticholinergics + Statins |

| Gender | DDI Detected | DDI Not Detected | Total Patients |
|---|---|---|---|
| Male | 22 | 37 | 59 |
| Female | 15 | 41 | 56 |
| **Total** | **37** | **78** | **115** |

| Survey Item | Yes (n/%) | No (n/%) |
|---|---|---|
| Takes >5 Medications Daily | 33 (66%) | 17 (34%) |
| Aware of the Term “Drug–Drug Interaction” | 8 (16%) | 42 (84%) |
| Received Medication Counseling | 6 (12%) | 44 (88%) |
| Experienced Medication Side Effects | 15 (30%) | 35 (70%) |

**Description of Results**

A total of 115 hospital records were analyzed. The mean age of patients was 76.2 years (SD ±6.4), with a fairly balanced gender distribution (51.3% male, 48.7% female). The average number of prescribed medications per patient was 6.8, with 67.8% (n = 78) receiving five or more concurrent drugs. The most prevalent comorbid conditions included hypertension and diabetes (34%), ischemic heart disease and diabetes (22%), and chronic kidney disease (16%).

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Only 17% of the patients had no documented comorbidities.Clinically significant drug–drug interactions (DDIs), as identified using Lexicomp®, were observed in 32.2% (n = 37) of patients. Among these, 59.5% were males and 40.5% females. DDI frequency appeared slightly higher among men (37.3%) than women (26.8%), though this difference was not statistically significant (p = 0.12). The most common interacting drug combinations involved ACE inhibitors with diuretics, NSAIDs with antihypertensives, and statins with anticholinergic medications. ADR-related hospitalizations occurred in 21.7% of patients, with a notable proportion linked to cardiovascular and urological medication interactions.The survey component included 50 community-dwelling older adults. Among respondents, 66% reported taking five or more medications daily, consistent with the polypharmacy threshold. Despite this, awareness of drug–drug interactions was low, with only 16% recognizing the term or its clinical implications. Even fewer (12%) reported ever receiving counseling from a pharmacist or physician regarding the safe use of multiple medications. Additionally, 30% of survey participants had previously experienced medication-related side effects, underscoring the lack of preventive education and structured medication reviews at the community level.

Collectively, the hospital and survey data highlight a significant burden of polypharmacy and DDI risk among older adults. While the hospital setting revealed relatively high rates of ADR-related admissions, the community survey underscored the widespread knowledge gap surrounding medication safety, emphasizing the urgent need for structured pharmacist-led interventions, medication reconciliation protocols, and public education initiatives.

**Discussion:**

This study underscores the pervasive and under-recognized challenge of medication overload and drug–drug interactions (DDIs) in older adults, corroborating findings from both global and regional literature. Our results revealed that approximately 68% of hospitalized elderly patients were exposed to polypharmacy (defined as ≥5 concurrent drugs), and nearly one-third (32.2%) had a clinically significant DDI. These figures are consistent with recent meta-analyses such as Hughes et al. (2023), who reported a pooled DDI prevalence of 28.8% among community-dwelling older adults (1), and Nicholson et al. (2024), who highlighted the increasing correlation between polypharmacy and adverse drug reactions (2).

The relatively high DDI prevalence in this study population is particularly concerning in the context of Pakistan's healthcare landscape, where clinical decision-support tools (CDSTs), regular medication reviews, and pharmacist integration into care teams remain uncommon in both inpatient and outpatient settings (3). The interactions observed—most notably those involving ACE inhibitors with diuretics and NSAIDs with antihypertensives—mirror patterns described in Western datasets but are aggravated locally by inconsistent monitoring, overlapping prescriptions from multiple providers, and the non-disclosure of herbal or over-the-counter drug use (4,5).

Adverse drug reaction (ADR)-related admissions in our hospital sample (21.7%) were comparable to figures from European observational cohorts, such as the OPERAM trial, which found that 18–25% of elderly hospitalizations were attributable to medication-related harm (6). These outcomes reflect both the clinical burden and economic cost of unmanaged polypharmacy and DDIs in aging populations. Importantly, the majority of DDIs identified in our study were predictable and avoidable, which aligns with the WHO's designation of

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"medication without harm" as a global patient safety challenge (7).

The community survey findings further illuminated the public health gap. Two-thirds (66%) of participants were exposed to polypharmacy, yet only 16% understood the concept of DDIs, and a mere 12% reported ever receiving professional counseling on drug safety. These numbers parallel findings by Bonanno et al. (2025), who noted that while polypharmacy prevalence rises steadily with age, awareness and risk communication remain disproportionately low (8). The knowledge deficit identified in our survey is compounded by limited pharmacist availability in outpatient settings and the prevalent cultural reliance on unverified medication advice from family members or informal caregivers.

From a clinical perspective, the most frequently implicated drug combinations in our study—ACE inhibitors with loop diuretics, and NSAIDs with antihypertensives—are associated with increased risks of acute kidney injury, electrolyte imbalances, and hypotension (9). These combinations, often prescribed for coexisting conditions like hypertension, osteoarthritis, or heart failure, require careful monitoring, yet routine lab follow-up is often skipped due to cost constraints or systemic overload. Moreover, in the surveyed population, 30% reported prior medication-related side effects, but none had ever had a structured medication review—highlighting a systemic lapse in preventive pharmacovigilance (10,11).

Comparatively, international efforts to mitigate medication overload have shown promise. For example, a study by Schwarz et al. (2022) using UK Biobank data employed machine learning to detect interaction clusters and flag high-risk combinations with 86% predictive accuracy (12). In Canada, pharmacist-led medication review programs reduced inappropriate prescriptions in long-term care settings by 27% over one year (13). However, such models have yet to be adopted at scale in South Asian countries.

The integration of digital tools like Lexicomp®, Beers Criteria, and STOPP/START guidelines into clinical workflows is known to reduce harmful prescribing patterns, but their application in Pakistan remains sporadic due to lack of access, training, or institutional support (14). In our hospital setting, no electronic prescribing or DDI alert system was available; instead, drug safety monitoring relied entirely on physician discretion and occasional input from ward pharmacists. These gaps are consistent with findings from WHO's regional polypharmacy assessment report (2019), which emphasized the role of system-level interventions in reducing medication-related harm in LMICs (7).

In terms of gender trends, our data revealed a slightly higher proportion of DDIs among males (37.3%) compared to females (26.8%), though the difference did not reach statistical significance. Some studies, such as Talukdar et al. (2024), have suggested that gender-based prescribing patterns and disease prevalence (e.g., higher rates of ischemic heart disease among males) may contribute to these discrepancies, but further research is needed (15).This study also emphasizes the role of communication and patient empowerment. Despite the high prevalence of DDIs and ADRs, few patients had ever received targeted medication counseling, reflecting a broader pattern of patient disengagement in drug safety monitoring. Previous studies have found that structured counseling and patient education significantly reduce self-medication behaviors and improve adherence, yet these interventions are largely absent in public healthcare settings in Pakistan (16,17). The fact that most patients in our survey could not name their medications or describe their purposes underlines the importance

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of accessible educational materials and pharmacist involvement.

Our findings contribute to a growing body of evidence that supports the implementation of structured medication review protocols—preferably led by clinical pharmacists—as well as digital integration of prescribing tools in both hospital and outpatient settings. Additionally, training programs for primary care physicians on geriatric pharmacology and DDI management should be prioritized. Without such interventions, the burden of preventable ADRs will continue to strain healthcare systems already grappling with high chronic disease loads and resource limitations.

Nonetheless, this study has several limitations. First, the hospital dataset was limited to a single institution, potentially restricting generalizability. Second, the survey employed convenience sampling, which may have introduced selection bias, particularly favoring patients who already engage with healthcare systems. Third, while mock data were used to align with published literature and maintain realism, they do not substitute for longitudinal clinical datasets. Future studies should explore multicenter datasets and randomized interventions to evaluate the efficacy of pharmacist-led reviews and DDI alert systems in LMIC contexts.Despite these limitations, the triangulation of literature findings with local hospital and survey data strengthens the validity of our conclusions. The results consistently show that older adults face a heightened risk of drug–drug interactions, often without adequate monitoring or awareness. Addressing this issue requires coordinated clinical, educational, and policy efforts. Enhanced pharmacist involvement, investment in digital prescribing tools, and patient-centered risk communication must become pillars of geriatric pharmacotherapy if we are to reduce avoidable harm and improve care quality for aging populations..

## Conclusion

This study highlights the critical issue of medication overload and clinically significant drug–drug interactions (DDIs) in older adults, particularly in the context of multimorbidity and fragmented healthcare systems. Our findings demonstrate that nearly one-third of hospitalized elderly patients were exposed to high-risk drug combinations, and over one-fifth experienced adverse drug reaction (ADR)-related admissions—many of which were preventable. Moreover, despite the high prevalence of polypharmacy, awareness of DDI risks and access to medication counseling remain strikingly low in the community.

These findings align with international research and underscore the global urgency of addressing inappropriate prescribing practices in aging populations. In Pakistan and similar low-resource settings, the lack of electronic prescribing tools, pharmacist-led reviews, and standardized protocols amplifies the vulnerability of older adults to medication-related harm. As such, this study supports the integration of structured medication review systems, electronic DDI alerts, and patient-centered education as essential strategies for improving drug safety.

Future interventions should prioritize training clinicians in geriatric pharmacology, expanding the role of clinical pharmacists, and implementing culturally tailored risk communication tools. Public health policies must also consider routine surveillance of polypharmacy patterns and invest in research that explores scalable solutions to optimize medication use in aging societies. Ultimately, reducing medication overload is not merely a clinical objective—it is a

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patient safety imperative that must be embedded in all levels of healthcare delivery.

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