ORIGINAL ARTICLE

Prevalence and Interrelationship of Polypharmacy, Potentially Inappropriate Prescribing, and Drug-drug Interactions, in a Tertiary Care Hospital, in Lahore, Pakistan: A Cross-Sectional Study

Waqar Ahmed Siddiqui[1], Aamina Quddus Qureshi[2], NosheenIftikhar[3], Shabir Ahmed[4], Hadiya Nadeem[5], Ayesha Saeed[6]

ABSTRACT

Objective: To determine the prevalence and interrelationship of drug-drug interactions (DDIs) potentially inappropriate prescribing (PIPs) and polypharmacy in admitted patients.

Study Design: Cross-sectional study.

Place and Duration of the Study: Conducted at the Medical Inpatient Department of Combined Military Hospital (CMH), Lahore from 15th January 2024 to 18th May 2024.

Materials and Methods: A total of 180 patients aged 65 years and above, taking at least two medications were included. Patients with critical illnesses or psychiatric disorders were excluded. Prescriptions were analyzed for DDIs using Medscape's "drug interaction checker" and PIPs were evaluated using the STOPP/START criteria (version 3). Descriptive statistics, including frequencies and percentages, were used to assess the prevalence and association of polypharmacy, DDIs, and PIPs.

Results: Among all prescriptions analyzed, 37.1% included at least one drug identified by the STOPP criteria. DDIs were present in 72.1% of prescriptions, of which 19.7% were minor, 47.5% were significant, and 4.9% were major. Polypharmacy was observed in 67.2% of cases.

Conclusion: Polypharmacy was common among geriatric patients. A moderate proportion of prescriptions exhibited DDIs, out of them the majority classified as significant. Thus, emphasizing the importance of managing complex medication regimens to avoid adverse effects. These findings underline the necessity for vigilant medication review, deep pharmacological knowledge and management to enhance patient safety.

Key Words: *Drug-drug Interactions (DDIs), Polypharmacy, Potentially Inappropriate Prescribing (PIPs) Prescriptions, Screening Tool of Older Persons' Prescriptions (STOPP) Criteria.*

Introduction

The clinicians and medical practitioners try to inculcate and build upon the knowledge to stay up to date, with pharmacological advancements taking place and new drugs being approved and introduced into the market and thus modify their prescriptions. However, this poses a concern about the use of different medications in prescriptions without a complete medical review.[1] The people who mostly fall victim to such prescriptions are usually the ones suffering from multiple comorbidities requiring multiple medications, especially the geriatric population which comprises of almost 6% of the total population in Pakistan.[2] Multiple drugs also have different effects on the older population as compared to the younger.

Polypharmacy is the practice of writing more than 5 medications on a single prescription.[3] It is mostly prevalent in the Asian community with research showing polypharmacy being practiced in at least 30% of the geriatric community.[4,5] This can be attributed to ease of access to drugs unlike in the other parts of the world practicing controlled medication. Polypharmacy also leads to multiple other problems including drug-drug interactions (DDIs) in the medication prescribed and potentially inappropriate prescribing (PIPs).[6,7] PIP is the over or under-prescribing of medications which may cause

[1]*Department of Pharmacology/ Physiology*[2]*/Medical Students*[5,6]
CMH Lahore Medical College and Institute of Dentistry, Lahore
National University of Medical Sciences, Islamabad
[3]*Department of Paediatrics*
Sharif Medical and Dental College, Lahore
[4]*Department of Paediatrics*
Azra Naheed Medical College, Lahore

Correspondence:
Dr. Waqar Ahmed Siddiqui
Associate Professor
Department of Pharmacology
CMH Lahore Medical College and Institute of Dentistry, Lahore
National University of Medical Sciences, Islamabad
E-mail: dr.waqar.siddiqui1@gmail.com

Received: October 09, 2024; Revised: March 20, 2025
Accepted: March 24, 2025

significant harm whereas DDIs are alteration in the efficacy and the toxicity of one drug due to the presence of another simultaneously administered drug.[8,9] Polypharmacy, DDIs and PIMs, also referred to as "the iatrogenic triad", are responsible for many adverse drug reactions (ADRs) in older patients.[10] This issue leads to numerous hospital admissions, contributing to significant morbidity and mortality while imposing financial strain. [13]

The physiological manifestation of drugs in geriatric population needs to be studied and require the prescription written to be tailored to the individual. Prior research has shown that elderly patients experience a high prevalence of iatrogenic effects, with polypharmacy affecting 5-78% of individuals, DDIs impacting 13-58%, and PIP affecting 2.9-38.5%.[10] While studies in Pakistan have examined these factors individually, few have investigated them concurrently thus posing a need to evaluate the frequency of this triad practice.[11,12] This study was conducted to underscore the need for establishment of standard protocols to minimize iatrogenic risks in this vulnerable group. The aim of this study was to address the knowledge gap by evaluating the prevalence and interconnections of polypharmacy, potentially inappropriate prescribing (PIP), and drug-drug interactions (DDIs) in older patients to help develop better therapeutic strategies.

Materials and Methods

A cross-sectional study, conducted in the medical inpatient department of CMH, Lahore. The ethical approval was obtained from Ethical Review Board of CMH, Medical College Lahore (Ref: 750/ERC/CMH/LMC, dated 24-05-2023). Using Cochran's formula at a 95% confidence interval, a sample size of 174 patients was calculated. Systematic random sampling was employed, enrolling patients aged 65 years and above who were prescribed at least two medications and who provided informed consent. The patients excluded were the ones who had one drug in their prescription or with critical illnesses or psychiatric disorders. Demographic data, medical history (including over-the-counter drug use and substance abuse), and laboratory parameters (e.g., liver and renal function tests) were recorded. Each prescription was categorized using the International Classification of Diseases (ICD) coding.[14]

Polypharmacy was defined as the concurrent use of five or more chronic medications. The Anatomical Therapeutic Chemical (ATC) classification system was used to categorize medications. [15,16] Potentially inappropriate prescriptions (PIPs) were evaluated using the Screening Tool of Older Persons' Prescriptions (STOPP) criteria, version 3. Each prescription was assessed for drug relevance, dosage, and duration.[17,18] Drug-drug interactions (DDIs) were identified using the Medscape Drug Interaction Checker®, with interactions classified as minor, significant, or major. [19] The findings were verified by pharmacology experts.

Data were initially compiled in Microsoft Excel and subsequently analyzed using SPSS version 24. Descriptive statistics, including frequencies and percentages, were calculated. The Chi-Square Goodness-of-Fit test was applied to assess data distribution, with statistical significance set at $p < 0.05$.

Results

Of the 180 samples analysed it was found that 67.2% of the prescriptions were falling under the category of polypharmacy. On further analysis it was found that 52.2% of the prescriptions were written for two or more chronic diseases while the rest 47.8% were written for acute diseases or one chronic disease (Fig 1).

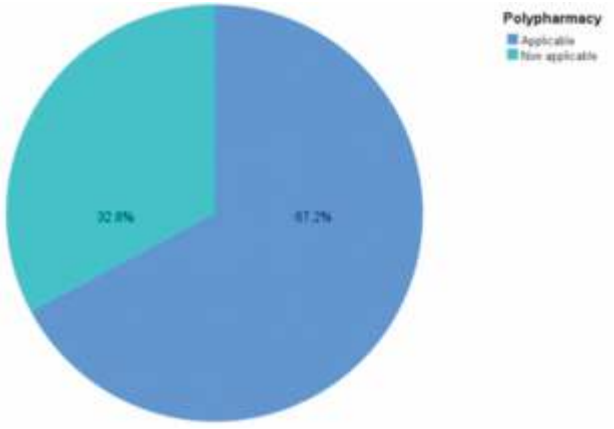

Figure 1: The Frequency of Polypharmacy in Geriatric Patients

After statistical analysis of PIPs, it was found that 37.1% of the prescriptions were found to have medications that were following the STOPP criteria. On further analysis of these medications, it was found that 90.5% of the prescriptions had one PIP and 9.5% had more than one (Fig 2).

https://doi.org/10.57234/jiimc.march25.2276

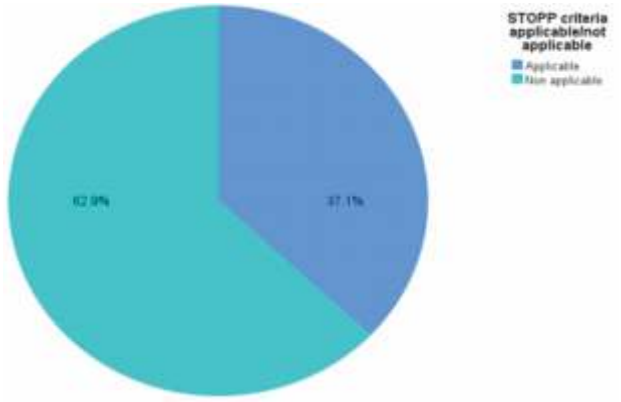

Figure 2: The Frequency of Medications Falling in Potentially Inappropriate Prescription (PIPs)

After analysis of DDIs of the drugs written in the prescriptions by an expert pharmacologist, it was found that 72.1% of the prescriptions had some level of DDI as specified by the Medscape interaction checker®. It was found that 47.5% came under the significant (moderate) category whereas 19.7% fell in the minor category as shown in Fig 1.3 as well as Table I. The prescriptions that fell in the major category were 4.9% (Fig 3).

Table I: The Frequency of DDIs by Categories (Based on Medscape Interaction Checker)

		Frequency (N)	Percent (%)	Valid Percent	Cumulative Percent
Valid	None	51	27.4	27.9	27.9
	Minor	36	19.4	19.7	47.5
	Significant	87	46.8	47.5	95.1
	Major	9	4.8	4.9	100.0
	Total	183	98.4	100.0	
Missing	System	3	1.6		
Total		186	100.0		

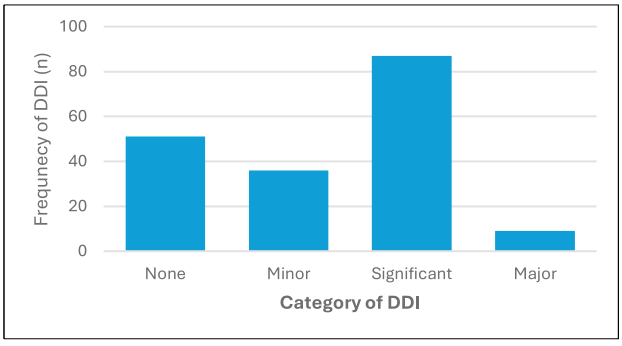

Figure 3: The categories of drug-drug interactions (DDIs) based on Medscape Interaction Checker®.

Discussion

This study highlights significant prescribing patterns among geriatric patients in Pakistan, with polypharmacy identified in 67.2% of prescriptions. This prevalence is consistent with international findings from several European nations, such as Sweden and Italy, but exceeds rates reported in North America.[15] Polypharmacy was notably linked to the presence of multiple chronic diseases, such as hypertension, diabetes, and cardiovascular disorders, a trend similarly observed in other studies from the region and globally.[20]

The prevalence of potentially inappropriate prescribing (PIP) using STOPP criteria was 37.1%, aligning with previous research conducted in similar populations.[21] Large proportions (90.5%) of PIPs were associated with single medication, commonly anticoagulants like clopidogrel and heparin. These results suggest a potential need to adapt PIP screening tools to account for regional disease patterns, such as the higher incidence of atherosclerotic cardiovascular diseases among South Asian populations.[22]

A concerning finding was the high prevalence of drug-drug interactions (DDIs) in 72.1% of prescriptions, with 47.5% categorized as significant and 4.9% as major. This suggests a possible knowledge gap among prescribers regarding common DDIs, particularly in cardiovascular pharmacotherapy. Aspirin and other antiplatelet agents were commonly involved in significant or major interactions, increasing the risk of bleeding, as reported in prior literature.

These findings underscore the importance of routine medication reviews and the integration of reliable DDI screening tools, such as Medscape Drug Interaction Checker®, in clinical workflows.[23] However, as the pharmacokinetics and pharmacodynamics in geriatric populations differ from younger adults, there is a need for age-specific and region-specific DDI screening systems.

The data reflects an ongoing challenge in balancing the necessity of polypharmacy for multimorbidity management with the risks of inappropriate prescribing and harmful drug interactions. While polypharmacy itself is not inherently harmful, inappropriate combinations and unnecessary medications elevate the risk of adverse drug reactions (ADRs) and hospitalizations.[24]

Limitations of this study include its single-center design, which may limit generalizability. Furthermore, reliance on one DDI screening tool may

not capture all potential interactions. Future multicenter studies incorporating multiple interaction-checking platforms and exploring clinical outcomes related to ADRs would provide more comprehensive insights. The study identifies a critical need for clinician training on rational prescribing practices in older adults and the implementation of standard operating procedures to mitigate iatrogenic risks in this vulnerable population.

Conclusion

Polypharmacy, potentially inappropriate prescribing, and drug-drug interactions are highly prevalent among geriatric inpatients, with significant clinical implications. A substantial proportion of prescriptions demonstrated clinically relevant DDIs, particularly within cardiovascular therapies.

These findings emphasize the urgent need for routine medication reviews, tailored prescribing strategies, and the use of reliable drug interaction screening tools to enhance patient safety in older adults. Additionally, there is a need to develop region-specific prescribing guidelines and improve clinician education to minimize iatrogenic risks in this vulnerable population.

Acknowledgment

Disclaimer: Nil

Conflict of Interest: Nil

Funding Disclosure: Not Funded

REFERENCES

1. Bachewar N, Choudhari SR, Dudhgaonkar SJ. Assessment of prescription patterns using WHO drug prescribing indicators in medicine wards of a tertiary care teaching hospital: a retrospective observational study. *Int J Basic Clin Pharmacol*. 2018;6(8):2070-2077. doi:10.18203/2310-2003.ijbcp20173298.
2. Usmani BA, Lakhdir MPA, Sameen S, Batool S, Odland ML, Goodman-Palmer D, et al. Exploring the priorities of ageing populations in Pakistan, comparing views of older people in Karachi City and Thatta. *PLoS One.* 2024;19(7):e0304474. doi:10.1371/journal.pone.0304474.
3. Alsuwaidan A, Almedlej N, Alsabti S, Daftardar O, Al Deaji F, Al Amri A, et al. A comprehensive overview of polypharmacy in elderly patients in Saudi Arabia. *Geriatrics* (Basel). 2019;4(2):36. doi:10.3390/geriatrics4020036.
4. Lee H, Baek YH, Kim JH, Liao TC, Lau WCY, Man KKC, et al. Trends of polypharmacy among older people in Asia, Australia and the United Kingdom: a multinational population-based study. *Age Ageing.* 2023;52(2):afad014. doi:10.1093/ageing/afad014.
5. Bhagavathula AS, Vidyasagar K, Chhabra M, Rashid M, Sharma R, Bandari DK, et al. Prevalence of polypharmacy, hyperpolypharmacy and potentially inappropriate medication use in older adults in India: a systematic review and meta-analysis. *Front Pharmacol.* 2021;12:685518. doi:10.3389/fphar.2021.685518.
6. Shetty V, Chowta MN, Chowta KN, Shenoy A, Kamath A, Kamath P. Evaluation of potential drug-drug interactions with medications prescribed to geriatric patients in a tertiary care hospital. *J Aging Res*. 2018;2018:5728957. doi:10.1155/2018/5728957.
7. Tian F, Chen Z, Zeng Y, Feng Q, Chen X. Prevalence of use of potentially inappropriate medications among older adults worldwide: a systematic review and meta-analysis. *JAMA Netw Open.* 2023;6(8):e2326910. doi:10.1001/jamanetworkopen.2023.26910.
8. Liew TM, Lee CS, Goh SKL, Chang ZY. Potentially inappropriate prescribing among older persons: a meta-analysis of observational studies. *Ann Fam Med*. 2019;17(3):257-266. doi:10.1370/afm.2373.
9. Baclet N, Calafiore M, Fregnac C, Gavazzi G, Forestier E, Roubaud-Baudron C, et al. Explicit definitions of potentially inappropriate prescriptions of antibiotics in hospitalized older patients. *Infect Dis Now*. 2022;52(4):214-222. doi:10.1016/j.idnow.2022.02.004.
10. Novaes PH, da Cruz DT, Lucchetti ALG, Leite ICG, Lucchetti G. The "iatrogenic triad": polypharmacy, drug-drug interactions, and potentially inappropriate medications in older adults. *Int J Clin Pharm.* 2017;39(4):818-825. doi:10.1007/s11096-017-0470-2.
11. Humza AU, Akbar MA, Bilal Awan MA, Yousuf JB, Khan K, Ammar A. Prevalence and comparative analysis of potential drug-drug interactions among hospitalized patients at a tertiary care cardiac institute in Pakistan: Findings from a single centre. *Pak J Pharm Sci*. 2024 Sep;37(5):961-968. doi:10.36721/PJPS.2024.37.5.REG.961-968.1.
12. Saqlain M, Ali H, Kamran S, Munir MU, Jahan S, Mazhar F. Potentially inappropriate medications are used and its association with health-related quality of life among elderly cardiac patients. *Qual Life Res.* 2020 Oct;29:2715-24. doi:10.1007/s11136-020-02530-5.
13. Watanabe JH, McInnis T, Hirsch JD. Cost of prescription drug-related morbidity and mortality. *Ann Pharmacother*. 2018;52(9):829-837. doi:10.1177/1060028018765159.
14. Tanno LK, Calderon MA, Demoly P; Joint Allergy Academies. New allergic and hypersensitivity conditions section in the international classification of diseases-11. *Allergy Asthma Immunol Res.* 2016;8(4):383-388. doi:10.4168/aair.2016.8.4.383.
15. Masnoon N, Shakib S, Kalisch-Ellett L, Caughey GE. What is polypharmacy? A systematic review of definitions. *BMC Geriatr.* 2017;17(1):230. doi:10.1186/s12877-017-0621-2.
16. Zhou JP, Chen L, Guo ZH. iATC-NRAKEL: an efficient multi-label classifier for recognizing anatomical therapeutic chemical classes of drugs. *Bioinformatics*. 2019;36(5):1391-1396. doi:10.1093/bioinformatics/btz757.
17. O'Mahony D, O'Sullivan D, Byrne S, O'Connor MN, Ryan C, Gallagher P. STOPP/START criteria for potentially inappropriate prescribing in older people: version 2. *Age*

Ageing. 2015;44(2):213-218. doi:10.1093/ageing/afu145.
18. Lavan AH, Gallagher P, Parsons C, O'Mahony D. STOPP Frail (Screening Tool of older persons prescriptions in frail adults with limited life expectancy): consensus validation. *Age Ageing*. 2017;46(4):600-607. doi:10.1093/ageing/afx005.
19. Sancar M, Kaşık A, Okuyan B, Batuhan S, İzzettin FV. Determination of potential drug-drug interactions by using various software programs at community pharmacy settings. *Turk J Pharm Sci*. 2019;16(1):14-19. doi:10.4274/tjps.30932.
20. Arabyat RM, Alazzam OM, Al-Azzam SI, Nusair MB. Association between Charlson comorbidity index and polypharmacy: a retrospective database study from Jordan. *Int J Pharm Pract.* 2021;29(6):580-586. doi:10.1093/ijpp/riab067.
21. Hudhra K, García-Caballos M, Jucja B, Casado-Fernández E, Espigares-Rodriguez E, Bueno-Cavanillas A. Frequency of potentially inappropriate prescriptions in older people at discharge according to Beers and STOPP criteria. *Int J Clin Pharm.* 2014;36(3):596-603. doi:10.1007/s11096-014-9943-8.
22. Volgman AS, Palaniappan LS, Aggarwal NT, Gupta M, Khandelwal A, Krishnan AV, et al. Atherosclerotic cardiovascular disease in South Asians in the United States: epidemiology, risk factors, and treatments: a scientific statement from the American Heart Association. *Circulation.* 2018;138(1):e1-e34. doi: 10.1161/CIR.0000000000000580.
23. Suthar J, Tandel A, Patel V. Evaluation of drug-drug interactions in hospitalized geriatric patients at tertiary care hospital. *Indian Drugs.* 2021;58(3):12008. doi:10.53879/id.58.03.12008.
24. Cadogan CA, Ryan C, Hughes CM. Appropriate polypharmacy and medicine safety: when many is not too many. *Drug Saf.* 2016;39(2):109-116. doi:10.1007/s40264-015-0378-5.

CONFLICT OF INTEREST

Authors declared no conflicts of Interest.

GRANT SUPPORT AND FINANCIAL DISCLOSURE

Authors have declared no specific grant for this research from any funding agency in public, commercial or nonprofit sector.

DATA SHARING STATEMENT

The data that support the findings of this study are available from the corresponding author upon request.