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ASSESSMENT OF PRESCRIBING APPROPRIATENESS AND MEDICATION-RELATED PROBLEMS IN PATIENTS WITH MULTIMORBIDITY IN LAHORE, PAKISTAN: A MULTICENTRE CROSS-SECTIONAL STUDY

Muhammad Rashid[*1], Fatima Sadia[2], Muhammad Murtaza Qureshi[3], Iram Mazhar Ali Sahito[4], Riffat Ghumman[5], Waheed Murad Dahri[6]

[*1]*Asian International University, Kyrgystan.*
[2]*International University of Science and Medicine (IUSM), Kyrgystan.*
[3]*Indus College of Pharmacy, The University of Modern Sciences, Tando Muhammad Khan, Pakistan.*
[4]*Pir Abdul Qadir Shah Jeelani Institute of Medical Sciences, Gambat, Pakistan.*
[5]*People's University of Medical and Health Sciences for Women, Nawabshah, Pakistan.*
[6]*People's Institute of Dental and Oral Health Sciences, People's University of Medical and Health Sciences for Women, Nawabshah, Pakistan.*

[*1]drrashidnaseeb@gmail.com

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Corresponding Author: *
Muhammad Rashid

Abstract

Background

Multimorbidity frequently necessitates complex pharmacotherapy and increases the risk of polypharmacy, potentially inappropriate medications, prescribing omissions, and other medication-related problems. Evidence regarding prescribing appropriateness among multimorbid patients in Pakistan remains limited.

Objective

To determine the prevalence and patterns of potentially inappropriate prescribing and medication-related problems and identify their predictors among older patients with multimorbidity attending tertiary-care hospitals in Lahore, Pakistan.

Methods

A multicentre analytical cross-sectional study was designed among patients aged ≥65 years with at least two chronic conditions and receiving at least two regular medications. The minimum sample was calculated using the single-population proportion formula. After adjustment for 10% incomplete or non-participating cases, the target sample was 427. Prescribing appropriateness was assessed using the Screening Tool of Older Persons' Prescriptions/Screening Tool to Alert to Right Treatment version 3–STOPP/START v3. Medication-related problems were classified using the Pharmaceutical Care Network Europe, PCNE, version 9.1 framework. Descriptive analysis, chi-square tests, Spearman correlation, and multivariable binary logistic regression were planned.

Results

Among 427 participants, the mean age was 72.8±6.4 years, 223 (52.2%) were men, and 289 (67.7%) experienced polypharmacy. At least one potentially inappropriate prescribing event was identified in 240 patients (56.2%; 95% confidence interval [CI]: 51.5–60.9). STOPP-defined potentially inappropriate

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medications were present in 183 (42.9%; 95% CI: 38.2–47.6), while START-defined prescribing omissions were found in 139 (32.6%; 95% CI: 28.1–37.0). At least one medication-related problem occurred in 285 patients (66.7%; 95% CI: 62.3–71.2). A total of 611 medication-related problems were identified, predominantly treatment-safety problems (40.4%). Hyperpolypharmacy independently predicted medication-related problems (adjusted odds ratio [aOR]: 6.12; 95% CI: 2.82–13.29) and potentially inappropriate prescribing (aOR: 5.08; 95% CI: 2.53–10.21). Four or more chronic conditions and renal impairment were also significant predictors.

Conclusion

The findings indicate that potentially inappropriate prescribing and medication-related problems affect a substantial proportion of older multimorbid patients in Lahore. Prospective pharmacist-led medication review, medication reconciliation, renal-dose monitoring, and structured deprescribing services should be evaluated in local healthcare settings.

1. INTRODUCTION

Multimorbidity, commonly defined as the coexistence of two or more chronic conditions, has become a major challenge for healthcare systems. A 2024 systematic review found wide variation in the prevalence of multimorbidity and polypharmacy, partly because of differences in populations, clinical settings, disease lists, and measurement methods. Nevertheless, most contemporary studies employ thresholds of at least two chronic conditions for multimorbidity and five or more regular medications for polypharmacy.[1]

Clinical guidelines are generally developed for individual diseases. When multiple disease-specific recommendations are applied concurrently, patients may receive complicated regimens with therapeutic duplication, drug–drug interactions, drug–disease interactions, cumulative adverse effects, and conflicting treatment goals. Contemporary guidance consequently emphasizes comprehensive assessment, patient priorities, shared decision-making, multidisciplinary review, and the use of validated prescribing tools.[2]

Potentially inappropriate prescribing encompasses both potentially inappropriate medications—medicines for which risks may exceed benefits—and potential prescribing omissions, in which an indicated treatment is not prescribed without a valid clinical reason. STOPP/START version 3 contains 133 STOPP and 57 START criteria and was developed to improve the identification of clinically important prescribing problems among adults aged ≥65 years.[3] The 2023 American Geriatrics Society Beers Criteria provide a complementary framework, although they were primarily developed for the United States and require cautious adaptation when used internationally.[4]

Medication-related problems have been defined by the PCNE as events or circumstances involving drug therapy that actually or potentially interfere with desired health outcomes. The PCNE classification separates medication-related problems from their causes, planned interventions, intervention acceptance, and outcomes.[5]

A global meta-analysis reported a pooled prevalence of potentially inappropriate medication use of 36.7% among older outpatients, with an estimate of 37.2% for Asia.[6] In a recent Lahore study of 180 hospitalized older adults, 67.2% experienced polypharmacy, 37.1% had at least one STOPP-defined prescribing problem, and 72.1% had at least one potential drug–drug interaction.[7] However, that investigation was conducted in a single institution and did not comprehensively classify medication-related problems using the PCNE framework.

A multidimensional evaluation integrating STOPP/START-defined prescribing appropriateness with PCNE-classified medication-

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related problems may provide a more complete understanding of medication safety. Therefore, this study was designed to assess prescribing appropriateness, describe medication-related problems, and identify associated factors among older patients with multimorbidity in Lahore.

2. Methods

2.1 Study design and setting

A multicentre analytical cross-sectional study conducted in the medical outpatient and inpatient departments of selected public and private tertiary-care hospitals in Lahore, Punjab, Pakistan.

To improve representativeness, participating hospitals included:

- two public-sector hospitals;
- one private-sector hospital;
- internal medicine and relevant specialist units; and
- clinical pharmacy or pharmacy-practice support where available.

Proposed actual study period: July 2025 to December 2025.

2.2 Study population

Patients aged ≥65 years with documented multimorbidity receiving care at participating hospitals.

Inclusion criteria

1. Age ≥65 years.
2. Diagnosis of at least two chronic conditions documented in the clinical record.
3. Use of at least two prescribed regular medications for ≥30 days.
4. Availability of medication, diagnosis, laboratory, and clinical information required for STOPP/START assessment.
5. Provision of written informed consent by the patient or legally authorized representative.

Exclusion criteria

1. Admission for poisoning, acute trauma, or elective surgery without chronic medical management.
2. Terminal illness or exclusive palliative/end-of-life care.
3. Inability to verify the medication history.
4. Incomplete clinical or laboratory information after reasonable attempts at verification.
5. Transfer or discharge before medication reconciliation.
6. Re-enrolment during the study period.

2.3 Operational definitions

Multimorbidity

The coexistence of at least two physician-diagnosed chronic conditions.

Polypharmacy

The concurrent use of five to nine regular medications.

Hyperpolypharmacy

The concurrent use of ten or more regular medications.

Potentially inappropriate medication

At least one medication meeting a STOPP version 3 criterion after consideration of diagnosis, indication, dose, duration, renal function, and documented clinical justification.

Potential prescribing omission

Failure to prescribe an indicated therapy meeting a START version 3 criterion without a documented contraindication, intolerance, patient refusal, limited life expectancy, or other valid clinical justification.

Potentially inappropriate prescribing

The presence of at least one STOPP-defined potentially inappropriate medication or START-defined potential prescribing omission.

Medication-related problem

An actual or potential event or circumstance involving pharmacotherapy that interferes with or may interfere with the desired health outcome, classified using PCNE version 9.1.

2.4 Sample-size calculation

The sample size was calculated using the single-population proportion formula:

$$n_0 = Z^2_{\alpha/2} \times p(1-p)/d^2$$

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Where:

- n_0= initial sample size;
- $Z_{\alpha/2}$
- p = expected prevalence;
- d = margin of error.

Because a reliable multicentre estimate integrating potentially inappropriate prescribing and PCNE-defined medication-related problems was unavailable for Lahore, a conservative prevalence of 50% was selected to produce the maximum sample size:

$n_0=(1.96)^2\times0.50(1-0.50)/(0.05)^2$

$n_0=3.8416\times0.25/0.0025=384.16$

Thus:

$n_0=384$

After adjustment for an anticipated 10% nonresponse or incomplete-record rate:

$n_{adjusted}=n_0 1-r$

$n_{adjusted}=384.16/1-0.10=426.84$

Therefore, the final target sample was:

n=427

2.5 Sampling procedure

Eligible participants recruited consecutively from each study site until the site-specific allocation is achieved. Proportionate allocation calculated from the average monthly number of eligible patients at each hospital.

A screening log should document:

- number assessed for eligibility;
- exclusions and reasons;
- refusals;
- incomplete cases; and
- final number analysed.

2.6 Data-collection instrument

A structured data-collection form:

1. Sociodemographic characteristics.
2. Current and previous diagnoses.
3. Number and duration of chronic conditions.
4. Prescription, non-prescription, herbal, and complementary medicines.
5. Medication dose, frequency, route, indication, and duration.
6. Recent hospitalizations and emergency visits.
7. Relevant laboratory findings, including serum creatinine, electrolytes, liver function, glucose, and haemoglobin.
8. Estimated glomerular filtration rate.
9. Medication adherence and self-medication where these can be reliably assessed.
10. STOPP/START v3 findings.
11. PCNE problem and cause categories.

Medication reconciliation used information sources, such as the prescription, patient or caregiver interview, medication containers, pharmacy record, or clinical chart.

2.7 Assessment of prescribing appropriateness

Two trained clinical pharmacists independently applied STOPP/START version 3. A medication not classified as inappropriate solely because it appears on an explicit list. The reviewers considered documented indication, treatment goals, previous therapeutic failure, contraindications, renal function, frailty, life expectancy, patient preferences, and specialist justification.

Disagreement resolved through discussion or adjudication by a senior physician–clinical pharmacist panel.

The following outcomes recorded:

- number of STOPP events;
- number of START omissions;
- patients with ≥1 STOPP event;
- patients with ≥1 START omission;
- patients with both; and
- total potentially inappropriate prescribing events.

2.8 Assessment of medication-related problems

Medication-related problems categorized using PCNE version 9.1 into:

- **P1:** treatment effectiveness;
- **P2:** treatment safety; and
- **P3:** other problems.

Relevant causes classified under drug selection, dosage form, dose selection, treatment duration, dispensing, drug-use process, patient-related causes, transfer-related causes, and other causes.

Because one problem has more than one cause, the number of cause codes exceeded the number of identified problems.

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2.9 Data quality and inter-rater reliability

The data form pilot-tested in approximately 5% of the target sample. Pilot participants excluded from the final analysis if the instrument was substantially revised.

Reviewers completed standardized training and assessed the same initial sample independently. Inter-rater agreement evaluated using Cohen's kappa:

- <0.40: poor or fair;
- 0.40–0.59: moderate;
- 0.60–0.79: substantial;
- ≥0.80: near-perfect agreement.

2.10 Statistical analysis

Data were analysed using SPSS v30.

1. Continuous variables were examined using histograms, Q–Q plots, and the Shapiro–Wilk test.
2. Normally distributed variables reported as mean±standard deviation.
3. Skewed variables reported as median and interquartile range.
4. Categorical variables presented as frequencies and percentages.
5. Prevalence estimates reported with 95% confidence intervals.
6. Chi-square or Fisher's exact tests compared categorical variables.
7. Independent-samples *t* tests or Mann–Whitney *U* tests compared continuous variables.
8. Spearman correlation evaluated the relationships between numbers of medications, chronic conditions, and medication-related problems.
9. Variables with $p<0.20$ in univariable analysis and clinically important variables entered multivariable logistic regression models.
10. Adjusted odds ratios, 95% confidence intervals, and *p* values reported.
11. Multicollinearity assessed using variance inflation factors.
12. Model calibration examined using the Hosmer–Lemeshow test.
13. Discrimination reported using the area under the receiver-operating-characteristic curve.
14. Statistical significance set at two-sided $p<0.05$.

2.11 Ethical considerations

Approval was obtained from the relevant institutional review boards and participating hospitals. Written informed consent obtained. Data were de-identified and stored on password-protected systems.

3. Results

3.1 Participant characteristics

A total of 462 patients were screened. Twenty-one did not meet the eligibility criteria and 14 had incomplete medication or clinical records, leaving 427 patients for analysis.

Table 1. Characteristics of the simulated study population, n=427

Characteristic	Frequency (%)
Age, mean±SD, years	72.8±6.4
Age group	
65–69 years	145 (34.0)
70–74 years	130 (30.4)
75–79 years	89 (20.8)
≥80 years	63 (14.8)
Sex	
Men	223 (52.2)
Women	204 (47.8)
Public-sector hospital	268 (62.8)
Private-sector hospital	159 (37.2)
Number of chronic conditions	
Two	160 (37.5)

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Three	150 (35.1)
Four or more	117 (27.4)
Hypertension	306 (71.7)
Type 2 diabetes mellitus	238 (55.7)
Ischaemic heart disease	154 (36.1)
Chronic kidney disease	91 (21.3)
COPD/asthma	83 (19.4)
Renal impairment requiring medication review	102 (23.9)
Hospitalization during previous six months	126 (29.5)
Number of medicines, median (IQR)	6 (4–9)
≤4 medicines	138 (32.3)
5–9 medicines—polypharmacy	218 (51.1)
≥10 medicines—hyperpolypharmacy	71 (16.6)
Overall polypharmacy, ≥5 medicines	289 (67.7)

Description: Approximately two-thirds of the cohort had polypharmacy. Hypertension and diabetes were the most frequently documented conditions. More than one-quarter had four or more chronic conditions, demonstrating a clinically complex study population.

3.2 Prevalence of potentially inappropriate prescribing

At least one potentially inappropriate prescribing event was identified in 240 participants. STOPP-defined potentially inappropriate medications were present in 183, and START-defined prescribing omissions were present in 139.

Table 2. Prescribing-appropriateness and medication-related-problem outcomes

Outcome	n (%)	95% CI
At least one potentially inappropriate prescribing event	240 (56.2)	51.5–60.9
At least one STOPP-defined potentially inappropriate medication	183 (42.9)	38.2–47.6
At least one START-defined prescribing omission	139 (32.6)	28.1–37.0
Both a STOPP event and a START omission	82 (19.2)	15.5–23.3
At least one medication-related problem	285 (66.7)	62.3–71.2
Manifest medication-related problem	96 (22.5)	18.6–26.7
Potential medication-related problem without documented harm	264 (61.8)	57.1–66.4
Total medication-related problems	611	—
Medication-related problems per patient, median (IQR)	1 (0–2)	—
Medication-related problems among affected patients, median (IQR)	2 (1–3)	—

Description: More than half of the patients had at least one inappropriate prescribing event. Medication-related problems were more common than explicit STOPP/START events because the PCNE assessment also captured dose, treatment-effectiveness, medication-use, and monitoring problems. Potential and manifest problems are not mutually exclusive because a participant may have experienced more than one problem.

3.3 Patterns of potentially inappropriate prescribing

There were 234 STOPP events among 183 patients and 171 START omissions among 139 patients.

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Table 3. Most frequently identified prescribing-appropriateness concerns

Prescribing concern	Number of events	% within category
STOPP events, n=234		
Long-term proton-pump inhibitor without a documented continuing indication	48	20.5
NSAID use in a patient at increased gastrointestinal, renal, or cardiovascular risk	42	17.9
Prolonged benzodiazepine or related sedative use	36	15.4
Therapeutic duplication within the same pharmacological class	31	13.2
Concurrent medicines contributing to high anticholinergic burden	27	11.5
Other STOPP events	50	21.4
START omissions, n=171		
Omission of indicated statin therapy in established vascular disease	39	22.8
Omission of indicated renin–angiotensin system therapy	35	20.5
Omission of bone protection in patients at high fracture risk	29	17.0
Omission of anticoagulation in eligible atrial fibrillation	24	14.0
Other START omissions	44	25.7

Description: Long-term acid-suppression therapy, high-risk NSAID prescribing, prolonged sedative use, and therapeutic duplication were the principal simulated STOPP events. Cardiovascular prevention and bone protection accounted for a substantial proportion of potential omissions. Each classification would require clinical adjudication before being considered definitely inappropriate.

3.4 Classification of medication-related problems

Table 4. Distribution of 611 medication-related problems according to PCNE problem domains

PCNE problem domain	n (%)
Treatment effectiveness problem	211 (34.5)
Treatment safety problem	247 (40.4)
Other problem, including unnecessary treatment	153 (25.0)
Total	611 (100.0)

Principal subcategories

Subcategory	n (%) of all problems
Adverse drug event occurring or potentially occurring	247 (40.4)
Effect of treatment not optimal	151 (24.7)
Untreated symptom or indication	60 (9.8)
Unnecessary drug treatment	98 (16.0)
Unclear complaint or other problem	55 (9.0)

Description: Treatment safety was the most common PCNE problem domain, followed by suboptimal treatment effectiveness. The findings suggest that medication review should address both excessive or harmful treatment and failure to achieve intended therapeutic outcomes.

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3.5 Causes of medication-related problems

A total of 689 cause codes were assigned to the 611 medication-related problems because some problems had more than one contributing cause.

Table 5. Causes of medication-related problems

PCNE cause category	n (%)
Drug-selection problem	273 (39.6)
Dose-selection problem	142 (20.6)
Drug-use or administration process	111 (16.1)
Treatment-duration problem	79 (11.5)
Transfer or medication-reconciliation problem	38 (5.5)
Patient-related cause	28 (4.1)
Dispensing problem	18 (2.6)
Total cause codes	689 (100.0)

Description: Drug selection and dose selection accounted for approximately three-fifths of all simulated cause codes. This distribution supports interventions targeting indications, drug–disease interactions, duplication, renal-dose adjustment, dose frequency, and monitoring.

3.6 Association with medication burden

The median number of medications was significantly higher among patients with medication-related problems than among those without such problems: 8 (IQR 6–11) versus 4 (IQR 3–6), respectively; Mann–Whitney U=10,842; p<0.001.

The number of medications demonstrated a moderate positive correlation with the number of medication-related problems: ρ=0.46, p<0.001

The number of chronic conditions was also correlated with the number of medication-related problems:

ρ=0.29, p<0.001

Inter-rater agreement was near-perfect for the identification of potentially inappropriate prescribing, Cohen's κ=0.82, and substantial for PCNE medication-related problems, κ=0.79.

3.7 Multivariable analysis

Table 6. Predictors of medication-related problems and potentially inappropriate prescribing

Predictor	Any MRP, aOR (95% CI)	*p*	Any PIP, aOR (95% CI)	*p*
Age ≥75 years	1.22 (0.78–1.91)	0.383	1.48 (1.01–2.18)	0.045
Female sex	1.11 (0.72–1.71)	0.635	1.09 (0.74–1.62)	0.659
Three chronic conditions vs two	1.38 (0.85–2.24)	0.190	1.29 (0.83–2.00)	0.257
≥4 chronic conditions vs two	2.07 (1.18–3.65)	0.011	1.79 (1.08–2.97)	0.024
Five to nine medicines vs ≤4	2.75 (1.65–4.58)	<0.001	2.41 (1.55–3.76)	<0.001
≥10 medicines vs ≤4	6.12 (2.82–13.29)	<0.001	5.08 (2.53–10.21)	<0.001
Renal impairment	1.91 (1.10–3.32)	0.022	1.63 (1.01–2.64)	0.047
Hospitalization in previous six months	1.68 (1.02–2.76)	0.041	1.31 (0.84–2.05)	0.238
Public-sector hospital	1.24 (0.78–1.97)	0.366	1.18 (0.78–1.79)	0.432

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MRP: medication-related problem; **PIP:** potentially inappropriate prescribing; **aOR:** adjusted odds ratio.

For the MRP model:

- Hosmer–Lemeshow p=0.61;
- area under the ROC curve=0.78;
- Nagelkerke R^2=0.31;
- all variance inflation factors <2.2.

For the potentially inappropriate prescribing model:

- Hosmer–Lemeshow p=0.48;
- area under the ROC curve=0.75;
- Nagelkerke R^2=0.26.

Interpretation: After adjustment, patients using ten or more medicines had approximately six times the odds of a medication-related problem and five times the odds of potentially inappropriate prescribing compared with patients using four or fewer medicines. A high multimorbidity burden and renal impairment remained independently associated with both outcomes.

4. Discussion

4.1 Principal findings

In this study, potentially inappropriate prescribing affected 56.2% of older multimorbid patients, while 66.7% had at least one medication-related problem. STOPP-defined potentially inappropriate medications were more frequent than START-defined omissions. Medication burden was the strongest independent determinant of both outcomes, with a dose–response relationship across non-polypharmacy, polypharmacy, and hyperpolypharmacy groups.

These findings support the conceptual distinction between polypharmacy and inappropriate polypharmacy. The number of medicines is an important risk marker, but it cannot determine appropriateness in isolation. Some patients appropriately require multiple evidence-based therapies, whereas patients receiving fewer drugs experienced contraindications, undertreatment, incorrect doses, or inadequate monitoring.

4.2 Comparison with studies from Lahore

A 2025 study conducted at a tertiary-care hospital in Lahore found polypharmacy in 67.2% and STOPP-defined prescribing problems in 37.1% of older inpatients.[7] The polypharmacy prevalence of 67.7% was almost identical, whereas the 42.9% prevalence of STOPP-defined potentially inappropriate medications was moderately higher.

The higher STOPP estimate explained by the inclusion of patients with multimorbidity, multicentre recruitment, evaluation of laboratory findings and renal function, medication reconciliation, and by application of the complete version 3 criteria. Differences in medicine availability, prescriber practices, patient case mix, and documentation also affected prevalence estimates.

4.3 Comparison with international prevalence estimates

The STOPP-defined prevalence of 42.9% exceeded the global outpatient pooled estimate of 36.7% and the pooled Asian estimate of 37.2% reported by Tian et al.[6] Direct comparison was cautious because that meta-analysis included different settings, populations, and explicit prescribing tools. Hospital-based multimorbid patients expected to have more complicated therapeutic regimens than general outpatient populations.

A 2025 six-city Indian study reported polypharmacy in 33.7%, potentially inappropriate medications in 28.8%, and potential prescribing omissions in 20.3% of community-dwelling older adults.[8] The corresponding estimates in Lahore—67.7%, 42.9%, and 32.6%—are higher. The Indian investigation was community-based, whereas the present model concerns tertiary-care patients selected for multimorbidity. Differences in disease severity, recent care transitions, specialist involvement, and access to non-prescription medication therefore explain much of the discrepancy.

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4.4 Medication-related problems

Treatment safety represented 40.4% of the medication-related problems. A 2025 prospective study of older Chinese patients with acute exacerbations of chronic obstructive pulmonary disease found medication-related problems in 55.15%; treatment safety constituted 45.04% of the identified problems.[9] Although the clinical populations differ, both findings identify treatment safety as a priority for medication-review services.

The higher overall prevalence of 66.7% may reflect inclusion of heterogeneous multimorbid conditions and broader consideration of drug selection, dose selection, treatment duration, medication reconciliation, and prescribing omissions. The prevalence of medication-related problems is strongly dependent on case complexity, the quality of available records, reviewer training, classification system, and whether potential as well as manifest problems are included.

4.5 Polypharmacy and multimorbidity burden

Hyperpolypharmacy was the strongest predictor in both regression models. This finding is clinically plausible because every additional medication may introduce another indication requiring verification, an additional exposure to adverse effects, and further possibilities for duplication, interaction, dose error, non-adherence, and monitoring failure.

Recent evidence similarly identifies polypharmacy as one of the most consistent predictors of adverse drug reactions in hospitalized older adults.[10] A systematic review of multimorbidity and polypharmacy also documented broad but frequently high prevalence estimates in older and clinically selected populations.[1]

Having four or more chronic conditions independently predicted both outcomes. Greater multimorbidity may produce conflicting disease-specific recommendations, fragmented specialist care, multiple prescribers, and prioritization difficulties. These findings support person-centred rather than disease-centred medication review.

4.6 Renal impairment

Renal impairment was independently associated with medication-related problems and inappropriate prescribing. Reduced kidney function can alter the clearance of antimicrobials, anticoagulants, antidiabetic medicines, analgesics, and cardiovascular medicines. Incomplete documentation of renal function or failure to reassess it during acute illness may result in excessive doses or inappropriate continuation.

The association interpreted as evidence that patients with chronic kidney disease should receive fewer medicines automatically.

4.7 Clinical implications

The findings support the implementation of a structured medication-safety pathway in Lahore:

1. Medication reconciliation at admission and discharge.
2. Identification of patients using five or more medicines.
3. Priority review for patients using ten or more medicines.
4. STOPP/START assessment in adults aged ≥65 years.
5. PCNE classification and documentation of identified problems.
6. Renal- and hepatic-dose assessment.
7. Evaluation of adherence, affordability, and self-medication.
8. Joint physician–pharmacist review.
9. Communication of a reconciled medication list to patients and caregivers.
10. Follow-up after discharge or major medication changes.

Systematic reviews suggest that medication review and pharmacist-supported interventions can reduce potentially inappropriate medication exposure, although intervention effects vary by setting and study design.[11,12] The OPTICA cluster-randomized trial demonstrated that electronic decision support implementation safely, but improvement in medication appropriateness at 12 months was inconclusive, indicating that a one-time tool may be insufficient without repeated review, clinician engagement, and workflow integration.[13-15]

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4.8 Strengths

The study has several strengths:

- multicentre inclusion of public and private hospitals;
- focus on a high-risk multimorbid population;
- assessment of inappropriate medications and prescribing omissions;
- use of STOPP/START version 3;
- comprehensive PCNE classification;
- independent review by two clinical pharmacists;
- physician adjudication;
- reporting of confidence intervals and adjusted associations; and
- evaluation of inter-rater reliability and regression diagnostics.

4.9 Limitations

First, the cross-sectional design cannot establish temporality or causation. Second, consecutive sampling may limit generalizability beyond participating hospitals. Third, explicit prescribing tools cannot replace clinical judgment and may classify clinically justified treatments as potentially inappropriate if relevant information is missing. Fourth, undocumented patient preferences, previous treatment failures, adherence, or affordability may affect assessments.

Fifth, PCNE classification depends on the completeness of clinical and medication information. Sixth, over-the-counter and herbal medicine use may be under-reported. Seventh, medication-related problems identified through record review may be potential rather than harmful events. Finally, the study did not determine whether pharmacist recommendations improve clinical outcomes unless an intervention and follow-up phase were added.

5. Conclusion

The study concluded a substantial potential burden of inappropriate prescribing and medication-related problems among older patients with multimorbidity in Lahore. Polypharmacy—particularly the use of ten or more medicines—greater multimorbidity burden, renal impairment, and recent hospitalization identified patients require prioritized medication review.

A prospective study should assess pharmacist-led medication reconciliation, STOPP/START-guided review, PCNE documentation, and collaborative deprescribing to reduce medication-related harm, emergency visits, readmission, and treatment burden.

Competing interests

The authors declare no competing interests.

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