

Original Research Article

Pharmacy

Drug-Related Problems and Potentially Inappropriate Medications among Elderly Patients with Diabetes Mellitus: A Prospective Observational Study

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Abstract

Potentially Inappropriate Medications and Drug-Related Problems in Elderly Patients with Diabetes Mellitus

A Prospective Observational Study

Background



- Older adults with diabetes often have multiple comorbidities and take multiple medications.
- This increases the risk of drug-related problems (DRPs) and potentially inappropriate medications (PIMs).

Systematic identification of inappropriate prescribing is essential for improving medication safety in this vulnerable population.

Objectives



- To identify PIMs among elderly patients with diabetes mellitus using the 2019 AGS Beers Criteria.
- To characterize the associated DRPs and their underlying causes using the PCNE Classification V9.1.

Methodology

Design	Prospective observational study (6 months)
Setting	General Medicine Department, HKES's Basaveshwar Teaching and General Hospital, Kalaburagi
Participants	Age >65 years with diabetes mellitus, ≥2 medications, and meeting eligibility criteria
Data collected	Demographics, diagnoses, comorbidities, medication profiles, clinical information
Analysis	PIMs: 2019 AGS Beers Criteria DRPs: PCNE Classification V9.1

Results

Study Population (n = 120)



- Mean age: 65–75 years (84.17%)
- Male: 60.0% (72)
- Diabetes + hypertension: 60.8% (73)

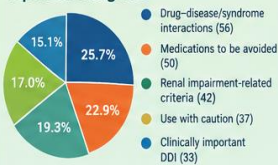


Polypharmacy (>5 meds): 95.0% (114)
Mean medications/patient: 11

PIMs Identified

218 PIMs

Top Beers Categories



Commonly Identified Agents

- Glimepiride (18)
- Nifedipine (12)
- Insulin (9)
- Paroxetine (22)
- Canagliflozin (15)
- Tramadol (9)
- Levetiracetam (19)

PCNE Cause Domains



Conclusion



A substantial burden of PIMs and medication-related safety concerns was observed among elderly patients with diabetes mellitus, with extensive polypharmacy and multimorbidity.

Systematic medication review using explicit prescribing criteria, renal and dose assessment, and structured DRP classification, along with integration of clinical pharmacists, may support earlier identification of harmful prescribing patterns and safer pharmacotherapy.

Safer Prescribing • Better Medication Outcomes • Improved Geriatric Care

Background: Older adults with diabetes mellitus frequently require multiple medications because of multimorbidity, increasing the complexity of pharmacotherapy and the risk of drug-related problems (DRPs) and potentially inappropriate medications (PIMs). Systematic identification of inappropriate prescribing is therefore important for improving medication safety in this vulnerable population. **Objectives:** To identify PIMs among elderly patients with diabetes mellitus using the 2019 American Geriatrics Society (AGS) Beers Criteria and to characterize the associated DRPs and their underlying causes using the Pharmaceutical Care Network Europe (PCNE) Classification V9.1. **Methodology:** A prospective observational study was conducted over 6 months in the General Medicine Department of HKES's Basaveshwar Teaching and General Hospital, Kalaburagi. Patients aged >65 years with diabetes mellitus who were prescribed at least two medications and fulfilled the predefined eligibility criteria were enrolled. Demographic characteristics, diagnoses, comorbidities, medication profiles and relevant clinical information were recorded using a structured data collection form. PIMs were identified using the 2019 AGS Beers Criteria and the identified PIMs were subsequently classified according to the PCNE V9.1 framework. **Results:** A total of 120 elderly patients were evaluated. Most patients were aged 65–75 years (101; 84.17%) and were male (72; 60.0%). Diabetes with hypertension was the predominant comorbidity (73; 60.8%). Major polypharmacy (>5 medications) was present in 114 patients (95.0%), with a mean of 11 medications prescribed per patient. A total of 218 PIMs were identified. The largest Beers category was drug–disease/drug–syndrome interactions (56; 25.7%), followed by medications to be avoided (50; 22.9%), renal impairment-related criteria (42; 19.3%), medications to be used with caution (37; 17.0%) and clinically important drug–drug interactions (33; 15.1%). Glimepiride (18), nifedipine (12), insulin (9), paroxetine (22), canagliflozin (15), tramadol (9) and levetiracetam (19) were among the frequently identified agents across the respective Beers categories. Drug selection was the principal PCNE cause domain, accounting for 192 DRPs (88.9%). **Conclusion:** The study demonstrated a substantial burden of PIMs and medication-related safety concerns among elderly patients with diabetes mellitus, occurring in the setting of extensive polypharmacy and multimorbidity. Systematic medication review using explicit prescribing criteria, renal and dose assessment, and structured DRP classification may facilitate earlier identification of potentially harmful prescribing patterns. Integration of clinical pharmacists into multidisciplinary medication-review processes may further support individualized and safer pharmacotherapy.

Keywords: elderly; diabetes mellitus; drug-related problems; potentially inappropriate medications; Beers Criteria; PCNE; polypharmacy; medication safety.

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INTRODUCTION

Geriatric medicine addresses the complex health-care needs of older adults, among whom multimorbidity, functional vulnerability and polypharmacy frequently coexist. Age-associated physiological changes can modify drug pharmacokinetics and pharmacodynamics, while the simultaneous management of multiple chronic illnesses increases the complexity of therapeutic decision-making. [1] Consequently, older adults are particularly susceptible to medication-related harm, especially when several medicines are prescribed concurrently. Diabetes mellitus is a major chronic disease affecting older adults and frequently occurs alongside hypertension, cardiovascular disease, renal impairment and other chronic conditions. Management of diabetes in older adults therefore extends beyond glycaemic control and requires consideration of comorbidities, functional status, renal function, treatment burden and medication safety. [2,3] The coexistence of diabetes and multiple chronic diseases commonly results in complex medication regimens, thereby increasing opportunities for drug-related problems (DRPs).

DRPs are events or circumstances involving pharmacotherapy that actually or potentially interfere with desired health outcomes. They may arise from inappropriate drug selection, dosing problems, drug–drug interactions, untreated indications, treatment failure or patient-related factors. In a prospective study of 330

adults with diabetes, Sheleme *et al.*, identified 455 DRPs, of which treatment effectiveness problems and untreated indications were the most common.[4]

Potentially inappropriate medications (PIMs) are an important component of medication-safety assessment in older adults. The AGS Beers Criteria provide an explicit, evidence-based framework for identifying medications whose potential risks may outweigh expected benefits in older adults under specified clinical circumstances.⁵ The 2019 criteria classify PIMs into medications potentially inappropriate in most older adults, medications to avoid in specific diseases or syndromes, medications to be used with caution, clinically important drug–drug interactions, and medications requiring renal-dose consideration. [5]

Observational studies show that PIM exposure is common among older adults with diabetes. In hospitalized older Indian adults with type 2 diabetes, Sharma *et al.*, reported at least one PIM in 74% of patients, with higher medication count, lower creatinine clearance and female sex associated with PIM use. [6] In 1,853 older ambulatory adults with diabetes and hypertension, Alwhaibi reported PIM use in 56% and a higher number of medications among PIM users. [7] Lu *et al.*, studying older adults with diabetes in 52 outpatient hospitals in Shenzhen, reported PIM prevalence of 43.2%, 44.88% and 42.40% in 2015, 2016 and 2017. [8]

In an Indian tertiary-care geriatric outpatient clinic, Anand *et al.*, found at least one PIM in 65% of prescriptions, with PIMs, number of medicines and comorbidities correlating with adverse drug reactions. [9] Population-based data show the same pattern: Gagnon *et al.*, found that 56% of 286,962 older individuals with diabetes in Quebec used at least one PIM, with risk rising with comorbidities and number of medications. [10]

PIM screening identifies medicines that warrant clinical scrutiny, but it does not describe the nature and causes of the associated medication problems. The Pharmaceutical Care Network Europe (PCNE) classification characterizes DRPs by problem and cause domains. [11] Combining a standardized DRP classification with an explicit PIM screening tool can therefore give more interpretable information on medication-related risk. Because prescribing patterns, disease burden and drug availability vary between settings, institution-specific data remain important. This study therefore aimed to identify PIMs among elderly patients with diabetes mellitus admitted to a tertiary-care teaching hospital and to characterize the associated medication-related problems using the AGS Beers Criteria and PCNE V9.1.

OBJECTIVES OF THE STUDY

General Objective

To identify potentially inappropriate medications and drug-related problems among elderly patients with diabetes mellitus admitted to the General Medicine Department of a tertiary-care teaching hospital.

Specific Objectives

1. To assess the demographic characteristics of elderly patients with diabetes mellitus.
2. To assess the pattern of comorbidities and polypharmacy in the study population.
3. To identify potentially inappropriate medications using the 2019 AGS Beers Criteria.
4. To classify identified drug-related problems using the PCNE V9.1 classification.
5. To identify the major problem domains and underlying cause domains associated with the identified DRPs.

METHODOLOGY

Study Design: A prospective observational study was conducted over a period of 6 months.

Study Site: The study was conducted in the General Medicine Department of HKES's Basaveshwar Teaching and General Hospital, Kalaburagi.

Source of Data: Data were obtained from the case sheets and medication records of eligible patients admitted to the General Medicine Department. The source project

specifies the study as a prospective observational assessment of elderly patients with diabetes mellitus.

Study Population: Patients aged >65 years who were diagnosed with diabetes mellitus and admitted to the General Medicine Department were considered for inclusion.

Inclusion Criteria

Patients were included if they:

- were admitted to the General Medicine Department;
- had a diagnosis of diabetes mellitus;
- were aged >65 years;
- were of either sex;
- had or did not have comorbidities;
- were prescribed at least two medications; and
- were willing to participate in the study.

Exclusion Criteria

Patients were excluded if they:

- were discharged against medical advice;
- had malignancy;
- died before discharge; or
- were ambulatory/OPD patients.

Study Procedure:

Following institutional approval, eligible patients were screened according to the predefined inclusion and exclusion criteria. Written informed consent was obtained before enrolment. Demographic information, clinical history, diagnoses, comorbidities, drug therapy and relevant laboratory information were collected using a structured data collection form. Medication profiles were reviewed for PIMs using the 2019 AGS Beers Criteria. The identified PIMs were subsequently assessed using the PCNE V9.1 classification framework to characterize the associated problem and cause domains. The source project specifically states that a PCNE checklist was used for DRP assessment and that PIMs were assessed using the Beers Criteria.

Assessment of Potentially Inappropriate Medications

The 2019 AGS Beers Criteria were used to screen medication profiles. The criteria include:

1. medications that are potentially inappropriate in most older adults;
2. medications potentially inappropriate in older adults with specific diseases or syndromes;
3. medications to be used with caution;
4. clinically important drug-drug interactions; and
5. medications requiring dose adjustment or avoidance according to renal function.

Classification of drug-related problems:

Identified medication-related problems were classified using the PCNE Classification V9.1. The PCNE framework distinguishes treatment-effectiveness

problems from treatment-safety problems and separately identifies potential causes, including drug selection, dose selection, interactions and patient-related factors.¹³

Data analysis:

The study findings were summarized using descriptive statistics, principally frequencies and percentages. The final analytical dataset consisted of 120 patients.

RESULTS

Demographic characteristics

A total of 120 elderly patients with diabetes mellitus were evaluated. The majority were aged 65–75 years (101; 84.17%), while 18 (15.0%) were aged 76–85 years and 1 (0.83%) was aged 86–95 years.

Table 1: Age-wise distribution of the study population (n=120)

Age group (years)	No. of patients	Percentage
65–75	101	84.17
76–85	18	15
86–95	1	0.83
Total	120	100

Table 2: Gender-wise distribution of the study population (n=120)

Gender	No. of patients	Percentage
Female	48	40
Male	72	60
Total	120	100

Male patients constituted 60.0% of the study population, while females constituted 40.0%.

Clinical characteristics

Table 3: Major diagnoses observed in the study population (n=120)

Major diagnosis	No. of patients	Percentage
Acute gastritis	6	5
Acute kidney injury	5	4.17
Alcoholic liver disease	4	3.33
Anaphylactic shock	2	1.67
Anxiety disorder	4	3.33
Cellulitis	1	0.83
Chronic heart failure	1	0.83
Cholelithiasis	1	0.83
Chronic pancreatitis	1	0.83
Chronic kidney disease	10	8.33
Chronic liver disease	4	3.33
Coronary artery disease	2	1.67
Cerebrovascular accident	14	11.6
Deep vein thrombosis	3	2.5
Dyslipidemia	2	1.67
Hypothyroidism	1	0.83
Ischaemic heart disease	1	0.83
Meningitis	1	0.83
Rheumatoid arthritis	1	0.83
Sepsis	3	2.5
Typhoid	1	0.83
Uncontrolled diabetes mellitus	17	14.1
Urinary tract infection	8	6.67
Respiratory disease	26	21.6
Cancer	1	0.83
Total	120	100

Respiratory disease was the most frequently recorded major diagnosis (26; 21.6%), followed by uncontrolled diabetes mellitus (17; 14.1%),

cerebrovascular accident (14; 11.6%) and chronic kidney disease (10; 8.33%).

Table 4: Distribution of comorbidities (n=120)

Comorbidity pattern	No. of patients	Percentage
Diabetes mellitus alone	30	25
Diabetes mellitus + cardiovascular disease	5	4.2
Diabetes mellitus + hypertension	73	60.8
Diabetes mellitus + pulmonary disease	12	10
Total	120	100

Diabetes mellitus with hypertension was the predominant comorbidity pattern, occurring in 73 patients (60.8%).

Polypharmacy

Table 5: Distribution of polypharmacy (n=120)

Polypharmacy category	No. of patients	Percentage
Minor	2	1.67
Moderate	4	3.33
Major (>5 medications)	114	95
Total	120	100

Major polypharmacy was present in 114 patients (95.0%). The reported mean number of medications prescribed per patient was 11, with a maximum of 18 and a minimum of 4 medications.

Number of PIMs per prescription

Table 6: Number of PIMs identified per prescription

PIMs per prescription	No. of prescriptions	Percentage
1	30	25
2	82	68.3
3	8	6.7
Total	120	100

Distribution of PIMs According to Beers Categories

Table 7: Distribution of PIMs according to AGS Beers categories (n=218)

Beer's category	No. of PIMs	Percentage
Drug–disease/drug–syndrome interactions	56	25.7
Medications to be avoided	50	22.9
Medications to be used with caution	37	17
Clinically important drug–drug interactions	33	15.1
Renal impairment-related criteria	42	19.3
Total	218	100

Drug–disease/drug–syndrome interactions represented the largest category (56; 25.7%), followed by medications to be avoided (50; 22.9%).

Table 8: PIMs in the category of medications to be avoided in older adults (n=50)

Medication	No. of PIMs
Aspirin	1
Eszopiclone	3
Glimepiride	18
Ibuprofen	2
Insulin	9
Megestrol	2
Meperidine	1
Nifedipine	12
Warfarin	2
Total	50

Glimepiride was the most frequently identified medication in this category (18), followed by nifedipine (12) and insulin (9).

Table 9: PIMs associated with drug–disease/drug–syndrome interactions (n=56)

Disease/syndrome	Drug	No. of PIMs
Delirium	Paroxetine	22
Dementia	Alprazolam/benzodiazepines	5
Heart failure	Verapamil	3
History of gastric/duodenal ulcers	Aspirin	8
Lower urinary tract symptoms/BPH	Ticagrelor	1
Parkinson disease	Metoclopramide	5
Syncope	Olanzapine	8
Urinary incontinence in women	Prazosin	4
Total		56

Paroxetine accounted for the largest number of drugs–disease/drug–syndrome PIMs (22), followed by olanzapine and aspirin (8 each).

Table 10: PIMs in the category of medications to be used with caution (n=37)

Medication	No. of PIMs
Canagliflozin	15
Carbamazepine	3
Mirtazapine	4
Prasugrel	6
Tramadol	9
Total	37

Canagliflozin was the most frequently identified medication in this category (15), followed by tramadol (9) and prasugrel (6).

Table 11: Clinically Important Drug Interactions and Renal Impairment-Related Potentially Inappropriate Medications

Category	Medication / Drug–drug interaction	No. of PIMs	Percentage
Clinically important drug–drug interactions	Tramadol + alprazolam/benzodiazepines	12	36.4
	Warfarin + amiodarone	10	30.3
	Theophylline + ciprofloxacin	7	21.2
	Phenytoin + trimethoprim–sulfamethoxazole	4	12.1
	Subtotal	33	100
Renal impairment-related PIMs	Levetiracetam	19	45.2
	Spiroglactone	13	31
	Amiloride	5	11.9
	Enoxaparin	5	11.9
	Subtotal	42	100

The most frequently identified clinically important drug–drug interaction was tramadol with alprazolam/benzodiazepines (12; 36.4%), followed by warfarin with amiodarone (10; 30.3%). Among renal

impairment-related PIMs, levetiracetam was the most frequently identified (19; 45.2%), followed by spiroglactone (13; 31.0%).

Table 12: Overall Classification of Drug-Related Problems According to PCNE V9.1

PCNE domain	Subdomain / Cause	No. of DRPs	Percentage
Problem domain	Treatment safety (P2)	207	95
	Treatment effectiveness (P1)	11	5
	Subtotal	218	100
Problem subdomain	P2.1 – Adverse drug event, possibly occurring	127	58.3
	P1.2 – Effect of drug treatment not optimal	91	41.7
	Subtotal	218	100
Cause domain	Drug selection (C1)	192	88.9

PCNE domain	Subdomain / Cause	No. of DRPs	Percentage
	Dose selection (C3)	17	7.9
	Interactions (C5)	4	1.9
	Patient-related causes (C7)	3	1.4
	Subtotal	218	100
Cause subdomain	C1.2 – Inappropriate drug according to guidelines/formulary	82	37.6
	C1.3 – Inappropriate drug for other reasons	59	27.1
	C1.5 – No indication for drug	33	15.1
	C1.6 – Inappropriate duplication of therapeutic group/class	32	14.7
	C3.2 – Dosage too high	7	3.2
	C1.1 – Inappropriate/contraindicated drug	2	0.9
	C7.10 – Patient uses unnecessary drug	1	0.5
	C7.2 – Patient unable to use drug/form as directed	1	0.5
	C1.2/C1.3 – Mixed coding in Excel	1	0.5
	Total	218	100

DISCUSSION

This prospective observational study evaluated PIMs and associated DRPs among 120 elderly patients with diabetes mellitus admitted to a tertiary-care teaching hospital. A total of 218 PIMs were identified, indicating a substantial medication-safety burden in a population with extensive polypharmacy and multimorbidity. Combining an explicit screening tool with a structured DRP classification allowed the findings to be described by implicated medicine and by clinically relevant problem and cause domains.

Most participants were aged 65–75 years. Ageing alters drug disposition and response, and coexisting chronic illness increases medication exposure; substantial PIM exposure has likewise been reported in Indian geriatric practice.[9] Male patients formed 60.0% of the cohort. Sharma *et al.*, studying hospitalized older Indian adults with type 2 diabetes, reported a similar male predominance (54.7%). [6] Sex distribution therefore varies between settings and is unlikely to explain the medication burden by itself.

Multimorbidity was prominent: diabetes with hypertension accounted for 60.8% of patients, with additional cardiovascular and pulmonary comorbidity. Managing coexisting conditions commonly requires several drug classes, increasing the potential for drug–disease and drug–drug interactions, therapeutic duplication and inappropriate selection. Alwhaibi similarly found a high prevalence of PIM use in older adults with diabetes and hypertension, with PIM users taking more medications (mean 8 vs 5). [7]

The most striking prescribing feature was major polypharmacy: 95% of patients received more than five medications, averaging 11 per patient. This exceeds the average of nine medications per day in hospitalized older adults with type 2 diabetes reported by Sharma *et al.*, [6] and the average of seven in the ambulatory cohort of Alwhaibi. [7] Anand *et al.*, reported 6.7 ± 2.1 medications per patient in an Indian geriatric outpatient cohort. [9] The higher count in our study may partly

reflect the inpatient setting and concurrent acute and chronic illness.

Of the 218 PIMs, the largest category was drug–disease/drug–syndrome interactions (25.7%), followed by medications to be avoided (22.9%), renal impairment-related criteria (19.3%), medications to be used with caution (17.0%) and drug–drug interactions (15.1%). This spread across Beer's categories show that inappropriate prescribing was not confined to a single pharmacological class.

Our findings are consistent with other diabetic populations. Lu *et al.*, reported PIM prevalence of 42.40–44.88% across three years, with diuretics (20.56%), benzodiazepines (13.85%), NSAIDs (12.94%) and sulfonylureas (6.23%) among the leading PIM classes. [8] Gagnon *et al.*, found that 56% of 286,962 older individuals with diabetes used at least one PIM, mainly benzodiazepines (41%), proton-pump inhibitors (27%) and endocrine medications (25%, mainly glibenclamide). [10] Despite differing populations and designs, these studies support the finding that PIM exposure is common in older adults with diabetes.

The frequency of glimepiride is noteworthy: it appeared 18 times in the "medications to be avoided" category. Sharma *et al.*, also listed glimepiride among their commonly encountered PIMs, alongside sliding-scale human insulin as the most frequent. [6] Sulfonylurea concerns are particularly relevant in older adults because of hypoglycaemia risk, renal function, nutritional status and competing comorbidities. Insulin as a PIM in our dataset should likewise be interpreted against the specific Beers criterion and clinical circumstances, not as implying that insulin is inappropriate as a class.

Drug–disease/drug–syndrome interactions were the largest Beers category, with paroxetine the most frequent drug. A medication may become potentially inappropriate because of a specific disease or syndrome

even when it would be acceptable in another patient, so appropriateness must be judged in clinical context and not by age alone.

Renal impairment-related PIMs accounted for 42 observations, mainly levetiracetam and spironolactone. Renal impairment is common in older adults with diabetes and can substantially alter drug exposure. Sharma *et al.*, found reduced creatinine clearance significantly associated with PIM use (OR 12.90, 95% CI 2.81–59.28 for CrCl <30 mL/min versus 91–120 mL/min). [6] Our findings support routine renal-function assessment in medication review.

Drug–drug interactions accounted for 33 PIMs, most often tramadol with alprazolam or other benzodiazepines, followed by warfarin with amiodarone. This emphasizes reviewing the whole regimen and not individual drugs in isolation, particularly given the pharmacodynamic vulnerability of older adults.

In the PCNE analysis, drug selection was the dominant cause domain (88.9% of DRPs), most often inappropriate drug selection according to guidelines/formulary, followed by inappropriate selection for other reasons, lack of indication and therapeutic duplication. The main medication-related burden was therefore the selection and appropriateness of therapy and not isolated administration problems. In a prospective study of 330 adults with diabetes, Sheleme *et al.*, identified 455 DRPs and found that comorbidity and longer diabetes duration predicted DRPs. [4] Their study used PCNE v8.03 in adult outpatients and was not restricted to PIMs, so the two are not directly comparable.

A Beers-listed medication is potentially inappropriate under specified circumstances; identification does not establish that harm has occurred. It indicates that the prescription warrants review in light of indication, dose, renal function, comorbidities, alternatives and individual circumstances. [5] This distinction applies to the 218 PIM observations here.

Clinical pharmacists can contribute to medication optimization through structured review: identifying PIMs, clarifying indications, assessing dose appropriateness, detecting important interactions and communicating with prescribers. Systematic review approaches have been shown to reduce inappropriate medication exposure in frail older inpatients. [12] Integrating clinical pharmacy services into multidisciplinary care may therefore help translate PIM identification into medication optimization.

This study has limitations. It was conducted at a single tertiary-care hospital with 120 patients, and the inpatient setting may inflate medication burden relative to community populations. DRP identification was operationally limited to PIMs flagged by the Beers

Criteria, so untreated indications, adherence problems, monitoring problems and other DRPs outside this strategy may have been underestimated.

In conclusion, elderly patients with diabetes in this cohort had a substantial burden of potentially inappropriate medication exposure, in the context of extensive polypharmacy and multimorbidity. The findings are consistent with original research from India and other settings showing that PIMs and DRPs are important medication-safety concerns in this population. [4,6-10]

CONCLUSION

The present prospective observational study identified a substantial burden of potentially inappropriate medication use among elderly patients with diabetes mellitus admitted to a tertiary-care teaching hospital. Among 120 patients, 218 PIMs were identified, with drug–disease/drug–syndrome interactions representing the largest Beers category. Major polypharmacy was highly prevalent, with 95% of patients receiving more than five medications and an average medication burden of 11 drugs per patient. Drug selection constituted the predominant PCNE cause domain, indicating that inappropriate or suboptimal medication selection was a major contributor to the identified medication-related problems. Renal impairment-related prescribing concerns and clinically important drug–drug interactions further demonstrated the complexity of pharmacotherapy in this population. These findings support the incorporation of systematic medication review into the care of elderly patients with diabetes, particularly when multiple comorbidities and extensive polypharmacy are present. Routine application of explicit prescribing criteria, assessment of renal function and dose appropriateness, evaluation of drug–drug and drug–disease interactions, and structured DRP classification may facilitate identification of potentially modifiable medication-related risks. Clinical pharmacists can contribute to this process through comprehensive prescription review and multidisciplinary collaboration.

STRENGTHS OF THE STUDY

1. The study used a prospective observational design, allowing systematic assessment of medication profiles during the study period.
2. The study specifically evaluated an elderly diabetic inpatient population, which represents a clinically vulnerable group with high medication burden.
3. The 2019 AGS Beers Criteria provided a standardized explicit framework for PIM identification.
4. The study incorporated the PCNE V9.1 classification system, enabling characterization of DRP problem and cause domains.
5. The study examined several clinically relevant dimensions, including demographic characteristics,

comorbidities, polypharmacy, PIM categories and medication-related causes.

6. The study provides institution-specific evidence from an Indian tertiary-care teaching hospital, contributing to the regional evidence base on medication safety in elderly diabetes.

LIMITATIONS

1. The study was conducted at a single tertiary-care teaching hospital, limiting generalizability to other institutions and health-care settings.
2. The sample size was relatively small, comprising 120 patients.
3. The study was restricted to elderly patients with diabetes mellitus admitted to the General Medicine Department, and therefore the findings may not represent community-dwelling or outpatient populations.
4. The study focused on PIM identification using the Beers Criteria; consequently, DRPs outside the operational PIM-based assessment framework may not have been captured comprehensively.
5. The Beers Criteria are a screening instrument and should not substitute for individualized clinical assessment of indication, risk–benefit balance and therapeutic alternatives.
6. The uploaded dataset contains internal inconsistencies in the PIM-per-prescription table and PCNE coding, which require reconciliation against the original master data before final publication.
7. No causal relationship between PIM exposure and clinical outcomes can be established from the observational design.

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Conflict of Interest; The authors declare no conflict of interest.

Ethical Approval: The study was conducted after obtaining approval from the Institutional Ethical Committee/Institutional Review Board of HKE'S MTRIPS. The source document confirms institutional ethical clearance before commencement of the study.

Informed Consent; Written informed consent was obtained from eligible patients before enrolment in the study.

Data Availability: The data generated during the present study are available from the corresponding

author on reasonable request, subject to institutional and ethical requirements.

Author Contributions: All authors contributed to the conception and design of the study, data collection, analysis and interpretation of findings, manuscript preparation and critical revision of the manuscript. All authors approved the final version.

Patient and Public Involvement: Patients and/or the public were not involved in the design, conduct or dissemination of the research.

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