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Analyzing the iatrogenic triad: Discovering strategies to prevent harm in the elderly

Vinodkumar MUGADA[1], Srinivasa Rao Yarguntla[2], Satya Sai Srinivas Allada[1], Kamala Kumari Paravastu[2], Stephanie Margaret Puvvada[1]
[1]Department of Pharmacy Practice, Vignan Institute of Pharmaceutical Technology, Duvvada, India
[2]Department of Pharmaceutics, Vignan Institute of Pharmaceutical Technology, Duvvada, India

Corresponding Author Information
Vinodkumar MUGADA
https://orcid.org/0000-0002-9364-9874
viptpharmd@gmail.com
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ABSTRACT

Objectives: The iatrogenic triad are a significant global health problem in the elderly population. This study aims to evaluate the iatrogenic triad in the elderly and identify potential preventative measures to mitigate its occurrence.
Methods: A preliminary observational study was conducted on 150 ambulatory elderly patients to assess potentially inappropriate medications (PIM), polypharmacy, and drug interactions. AGS Beers Criteria, 2019, Polypharmacy, Medication Complexity Regimen Index (MRCI) and Micromedex (a drug information software) were used to assess the harmful triad. Before and after data collection, we observed, identified, and unfolded potential strategies to avoid the harmful triad in the elderly population.
Results: The medication regimen complexity index (MRCI) is 30.49 ± 13.77, suggesting a moderate level of complexity in the drug regimens of elderly patients. Among the potentially inappropriate medications (PIMs) identified by the AGS Beer criteria for 2019, glimepiride (45) and diclofenac (23) were found to be the most frequently prescribed. Moderate-level drug-drug interactions were identified between aspirin and metoprolol (20), metoprolol and metformin (13), and aspirin and enalapril (11). All drug-ethanol and drug-food interactions were found to be rapid and often unknown to patients. Furthermore, the study found that MRCI and polypharmacy were statistically significantly associated with the number of PIMs and drug interactions ($p<0.01$). Based on data collection, the study identified three possible ways to prevent the iatrogenic triad in elderly patients: interaction, collaboration, and continuing education.
Conclusions: In conclusion, this study sheds light on the medication regimen complexity, PIMs, and drug interactions in elderly patients. The study also highlights three possible ways to prevent the iatrogenic triad, namely interaction, collaboration, and continuing education. By implementing these strategies, healthcare providers can help to prevent harm and improve the quality of care for elderly patients.

Keywords: aged, potentially inappropriate medication list, drug interactions, polypharmacy, medication regimen complexity index.

INTRODUCTION

The iatrogenic triad, which consists of potentially inappropriate medications (PIMs), polypharmacy, and drug-drug interactions (DDI)[1], is a significant concern in the field of geriatrics. PIMs refer to the use of a medicine for which the risks outweigh the potential benefits, particularly when more effective alternatives are available.[2] High prevalence rates of PIM usage (ranging from 18 to over 40%) have been observed across various healthcare settings.[3]

Moreover, older patients frequently use a greater number of medications, leading to polypharmacy. This increased medication use is likely to result in PIM within this population. Furthermore, PIM usage has been associated with hospitalization [4] and mortality,[5] underscoring the importance of addressing this issue in geriatric care.

Co-morbidities and polypharmacy (> 5 medications) serve as the primary factors that contribute to an increased risk of drug-drug interactions (DDI) in elderly patients. Furthermore, age-related changes in drug pharmacodynamics and pharmacokinetics may heighten the likelihood of developing DDI.[6] To assess the complexity of medication regimens, the medication regimen complexity index (MRCI) is employed. This validated 65-item scoring system considers the number of medications, dosage forms, administration instructions, frequency of dosing, and restrictions on food dosing.[7] Additionally, polypharmacy and higher medication complexity are responsible for approximately 50% of medication nonadherence rates in elderly patients.[8]

Drug-drug interactions (DDIs), such as when anticoagulants intensify blood thinners' effects, can increase medication regimen complexity index (MRCI), introducing more variables like dosage timing. This increased complexity can hinder medication adherence; a patient juggling multiple medications might miss doses. Therefore, minimizing DDIs and managing MRCI is crucial to promote adherence, thereby optimizing health outcomes.

To date, no outpatient studies have investigated the impact of pharmacist intervention on medication regimen complexity index (MRCI) in the elderly population. [9, 10] However, drug interactions, if unavoidable, can be managed through increased awareness and knowledge. In a study by Bories et al. (2021),[11] a higher prevalence of PIMs and severe to moderate drug-drug interactions were observed in hospital settings contrasted to nursing homes and primary care, independent of polypharmacy rates.

To the best of our knowledge, there is a scarcity of research in India that investigates drug-alcohol and drug-food interactions in patients, as well as seeks to identify potential methods to prevent the iatrogenic triad. Our study aimed to assess PIMs, drug interactions, and medication regimen complexity in elderly patients. Through our investigation, we have identified three potential strategies that may help prevent or mitigate the harmful triad in this population, emphasizing the need for continued research and intervention development in this area.

MATERIALS AND METHODS

Study design, study site, and duration of the study

A descriptive cross-sectional study was conducted on 150 elderly patients attending outpatient departments at a government-funded, 1,000-bed hospital. This facility charges a nominal amount for diagnostic and other medical services, while providing necessary medications at no cost to the patients. Due to its operation in the public sector and its status as one of the major hospitals for nearby regions, the hospital faces a disproportionate doctor-to-patient ratio. The hospital offers surgery and emergency services around the clock. The study spanned six months, from January 7 to July 7, 2022. The manuscript was reported in accordance with the STROBE guidelines.

Study participants, sampling technique, and sample size estimation

This study focused on elderly patients who had been prescribed at least one medication, irrespective of the presence of any co-existing medical conditions. Patients with time constraints were excluded from the study to ensure data reliability. A convenience sampling approach was employed to select each participant, providing a practical and efficient method for participant recruitment. Due to the study's timeline constraints, a total of 150 patients were ultimately included in the research, allowing for a manageable sample size while still offering valuable insights into the topic.

Ethical Approval

The Institutional Ethical Committee approved the study (VIPT/IEC/89/2022). The participants were informed of the aim and objectives of the study. We assured the confidentiality of the data and obtained informed consent from each participant.

Study Instruments

American Geriatric Society (AGS) Beer's Criteria, 2019 [12]

The 2019 AGS Beers Criteria is an update to the 2015 Beers Criteria, providing a comprehensive list of potentially inappropriate medications (PIMs) that should be avoided in elderly patients in specific situations or, in most cases, across the board, particularly when considering certain diseases or conditions. This updated criteria includes a list of PIMs for most older adults, drugs to be avoided for those with certain conditions, drug-drug interactions to be aware of, drugs to use with caution, and guidance on dose adjustments in cases of renal failure. For each class of potentially inappropriate medications, the criteria outline the rationale,

recommendation, quality of evidence, and strength of recommendation, ensuring a well-informed approach to medication management in geriatric care.

Micromedex [13]
Micromedex is an evidence-based medical information software that serves as a reliable source for drug-interaction-related information. In order to emphasize the importance of addressing these interactions, our study reported drug interactions that exhibited major and moderate severity, rapid and delayed onset reactions, as well as those with good and excellent documentation. Nevertheless, in the case of drug-ethanol interactions, we also included results with fair documentation to ensure a comprehensive analysis. Furthermore, we meticulously documented the mechanism of interaction for every instance, highlighting the sophisticated and rigorous approach employed in this academic investigation.

Definitions
Major drug interaction is any life-threatening drug interaction and/or require medical intervention to minimize or prevent serious adverse effects. Moderate drug interaction is any drug interaction that may exacerbate the patient's condition and/or require an alteration in therapy. Excellent documentation indicates controlled studies have established the existence of the interaction. Good documentation lacks well-controlled studies but strongly suggests an interaction. Fair documentation suspects an interaction based on pharmacological considerations from lead clinicians or documentation is good for a pharmacologically similar drug.

Medication Regimen Complexity Index (MRCI) [14]
The Medication Regimen Complexity Index (MRCI) is a validated, 65-item scale designed to quantify the complexity of a patient's drug regimen. This index considers factors such as the number of prescribed medications, dosage form, frequency of administration, and additional instructions for use. Consequently, a higher MRCI score signifies a more intricate and complex medication regimen, thereby emphasizing the importance of understanding and managing medication complexity in clinical practice.

Outcomes
The primary outcome of this study is to thoroughly analyze the iatrogenic triad, which encompasses potentially inappropriate medications, polypharmacy (> 5 medications), and drug-drug interactions. Concurrently, the secondary outcome is to identify effective strategies that can mitigate or prevent harm caused by the iatrogenic triad in elderly patients, ultimately contributing to improved patient outcomes and enhanced quality of geriatric care. Another secondary outcome is to identify the medication regimen complexity using MRCI.

Data Collection
Data collection was carried out in two distinct parts. The initial part encompassed gathering the demographic and clinical details of the patients, such as their age, gender, smoking and alcoholism status, department name, diagnosis of the patient's condition, and the number of prescribed drugs. The subsequent phase involved prescription auditing to identify potentially inappropriate medications, medication regimen complexity, and potential drug-drug interactions, following the guidelines of Beer's criteria (2019).

Data Analysis
Quantitative data were presented as mean and standard deviation or median and interquartile range, depending on whether the data were normally distributed or not. Qualitative data were presented as frequencies and percentages. To investigate the relationship between medication regimen complexity index, polypharmacy (> 5 medications), potentially inappropriate medications, and drug interactions, paired-samples t-test or Wilcoxon test was used based on the normality assumption. The p-value, effect size, and 95% confidence interval were reported for the tests. Spearman's Rho correlation was conducted to examine the degree of association between medication regiment complexity index, polypharmacy, and drug interactions. The level of statistical significance was set at $p<0.05$. Statistical analysis was performed using Jeffrey's Amazing Statistical Programme software (version 0.14.1.0).

RESULTS
A total of 150 elderly patients participated in the study. Table 1 shows that the mean age group of the elderly was 69.30 ± 5.16 years, and the mean score of the medication regimen complexity index is 30.49 ± 13.77. Nearly more than half of the patients are males (52.67%), with most of them being non-smokers (72%) and non-alcoholics (74.67%). Polypharmacy (use of >5 drugs) constituted nearly three-quarters of prescriptions

(72.66%). A total of 158 DDIs were detected in the patients and 97.47% of these interactions were moderate DDIs.

Characteristic	Frequency (%)
Age	69.30 ± 5.16*
Medication Regimen Complexity Index	30.49±13.77*
Males	79 (52.67)
Females	71 (47.33)
Non-smokers	108 (72)
Smokers	30 (20)
Ex-smokers	12 (8)
Non-Alcoholics	112 (74.67)
Alcoholics	24 (16)
Ex-alcoholics	14 (9.33)
Type of Department	
General Medicine	74 (49.33)
Endocrinology	39 (26)
Pulmonology	14 (9.33)
Others†	23(15.33)
Polypharmacy	
<5	41 (27.33)
5-6	65 (43.33)
>7	44 (29.33)
Diagnosis	
Hypertension	113 (75.33)
Diabetes Mellitus	96 (64)
CAD**	15 (10)
COPD***	13 (8.66)
Chronic Kidney Disease	11 (7.33)
Hypothyroidism	10 (6.66)
Drug-Drug Interactions (n=158)	
Major	4(2.53)
Moderate	154 (97.47)

†=orthopedics, nephrology, oncology, general surgery, neurology.
*Mean ±S.D ** Coronary Artery Disease; *** Chronic Obstructive Pulmonary Disease

Name of the Medication	Frequency	Rationale	Recommendation	Quality of Evidence	Strength of recommendation
Glimepiride	45	Older adults are at higher risk of prolonged hypoglycemia	Avoid	High	Strong
Diclofenac	23	High risk of gastrointestinal bleeding or peptic ulcer disease in individuals taking oral or parenteral corticosteroids, anticoagulants, or antiplatelet agents. Induces kidney injury and increases blood pressure. Risks are dose related.	Avoid chronic use, unless other alternatives are not effective, and patient can take gastroprotective agent (proton-pump inhibitor or misoprostol)	Moderate	Strong

Tramadol	3	May exacerbate or cause SIADH (Syndrome of inappropriate antidiuretic hormone) or hyponatremia	Use with Caution	Moderate	Strong
Nifedipine Immediate release	2	Potential for hypotension; risk of precipitating myocardial ischemia	Avoid	High	Strong
Alprazolam	2	Age-related cognitive impairment, delirium, falls, fractures, and motor vehicle crashes.	Avoid	Moderate	Strong
Spironolactone	2	Increased Potassium if Creatinine Clearance <30 ml/min	Avoid	Moderate	Strong
Theophylline	2	Increased risk of theophylline toxicity with cimetidine and ciprofloxacin	Avoid	Moderate	Strong
Chlorzoxazone	1	Older adults have a poor tolerance for most muscle relaxants due to anticholinergic adverse effects, sedation, and fracture risks	Avoid	Moderate	Strong
Levetiracetam	1	CNS adverse effects, Creatinine clearance ≤ 80ml/min	Reduce Dose	Moderate	Strong
Glibenclamide	1	Higher risk of severe prolonged hypoglycemia in older adults	Avoid	High	Strong

According to AGS Beer's criteria, 2019, the most prescribed PIM are glimepiride (45) and diclofenac (23) (Table 2). The most reported drug-drug interactions are aspirin and metoprolol (20), metoprolol and metformin (13), and aspirin and enalapril (11), all with a moderate level of severity of interaction (Table 3).

Drug-Drug Interaction	**Severity**	**Onset**	**Documentation**	**Frequency**	**Mechanism**
Aspirin and Metoprolol	Moderate	Delayed	Good	20	NSAIDS and beta-adrenergic blockers may increase blood pressure.
Metoprolol and Metformin	Moderate	Delayed	Good	13	Beta-blockers may inhibit or increase the blood glucose-lowering effect of antidiabetic agents and may obscure hypoglycemia symptoms.
Aspirin and Enalapril	Moderate	Rapid	Excellent	11	May result in decreased effectiveness of enalapril.
Atenolol and Metformin	Moderate	Delayed	Good	10	The blood glucose-lowering effect of an antidiabetic drug may be increased or decreased, and hypoglycemia symptoms may be obscured.
Atenolol and Glimepiride	Moderate	Delayed	Good	6	It may increase or decrease the blood glucose-lowering effect of the antidiabetic agent, as well as diminish or obscure hypoglycemic symptoms.
Aspirin and Atenolol	Moderate	Delayed	Good	4	May result in increased blood pressure.
Azithromycin and Theophylline	Moderate	Delayed	Good	3	May result in increased serum theophylline concentrations.
Atenolol and Diclofenac	Moderate	Delayed	Good	2	May result in increased blood pressure.
Aspirin and Nitroglycerin	Moderate	Rapid	Good	2	Increased Nitroglycerin levels and additive platelet dysfunction.

Clopidogrel and Esomeprazole	Major	Rapid	Excellent	1	Reduces antiplatelet activity and plasma levels of clopidogrel active metabolite.
Atorvastatin and Phenytoin	Moderate	Delayed	Excellent	1	Reduces atorvastatin plasma concentrations and efficacy.
Clopidogrel and Tramadol	Major	Rapid	Good	1	Reduces efficacy of clopidogrel.

Measure 1	**Measure 2**	**p-value††**	**Effect Size***	**95% CI for Effect Size**		**Correlation†**
				Lower	**Upper**	**r; p-value**
MRCI	No. of PIM	<0.00001	1.000	1.000	1.000	0.03; 0.773
Polypharmacy	No. of PIM	<0.00001	1.000	1.000	1.000	0.58; <0.0001
Polypharmacy	Interactions	<0.00001	0.950	0.927	0.965	0.005; 0.959
MRCI	Interactions	<0.00001	1.000	1.000	1.000	0.50; <0.0001
†-Spearman's Rho Correlation; ††- Wilcoxon Test; *Effect Size- effect size is given by the matched rank biserial correlation						

MRCI and polypharmacy are statistically significantly associated with interactions and the number of PIMs. However, polypharmacy has a statistically significant positive correlation with the number of PIMs, whereas MRCI has a statistically significant positive correlation with drug interactions (Table 4). All drug-ethanol and drug-food interactions are rapid, and patients are unaware of them (Table 5).

Drug- Ethanol Interactions					
Name of the drug	**Severity**	**Onset**	**Documentation**	**Frequency**	**Warning**
Aspirin	Moderate	Rapid	Good	8	A combination of ETHANOL and ASPIRIN may increase gastrointestinal bleeding risk.
Nitroglycerin	Moderate	Rapid	Fair	2	Hypertension may result from concurrent use of NITROGLYCERIN and ETHANOL.
Cetirizine	Major	Rapid	Fair	1	CETIRIZINE and ETHANOL may cause CNS depression when used together.
Amitriptyline	Moderate	Rapid	Good	1	AMITRIPTYLINE and ETHANOL combined may result in enhanced CNS depression.
Tramadol	Major	Rapid	Fair	1	TRAMADOL and ETHANOL may cause respiratory depression and CNS depression when used concurrently.
Drug-Food Interactions					
Furosemide	Moderate	Rapid	Excellent	11	FOOD and FUROSEMIDE may reduce efficacy and exposure to furosemide.
Metoprolol	Moderate	Rapid	Excellent	26	METOPROLOL concentrations may increase when used with FOOD.
Paracetamol	Moderate	Rapid	Good	21	Acetaminophen effectiveness may be decreased if used concurrently with cabbage.
Theophylline	Moderate	Rapid	Good	4	FOOD and THEOPHYLLINE may alter theophylline concentrations.
Montelukast	Moderate	Rapid	Excellent	4	Use of MONTELUKAST and GRAPEFRUIT JUICE together may increase montelukast exposure.
Ciprofloxacin	Moderate	Rapid	Good	5	DAIRY FOODS and CIPROFLOXACIN may decrease ciprofloxacin concentrations.

DISCUSSION

The key results of the study revealed that the mean age was 69.30 ± 5.16 years, and the mean medication regimen complexity index (MRCI) score was 30.49 ± 13.77. Polypharmacy was present in 72.66%, and 158 drug-drug interactions (DDIs), mostly moderate, were detected. The most common potentially inappropriate medications (PIMs) were glimepiride and diclofenac. MRCI and polypharmacy significantly correlated with DDIs and PIMs, with patients largely unaware of rapid drug-ethanol and drug-food interactions.

A recent study found that individuals with an MRCI score of 22 or higher upon hospital discharge were more prone to unanticipated hospital readmissions within 30 days.[15] Another study indicated that a cut-off score of 33 on the MRCI was optimal in identifying medication-related readmission risks. [16] However, it should be noted that these thresholds may vary based on different contexts. Nonetheless, few studies,[17, 18] have consistently demonstrated that polypharmacy, i.e., the use of five or more medications, is a predictor of unplanned hospitalizations.

Wimmer et al.[18] found that older adults living at home who had complex medication regimens and were taking a high number of medications were more likely to experience unplanned hospitalizations. The study also revealed that the two predictors, medication regimen complexity and number of medications, had similar sensitivity and specificity in predicting unplanned hospitalizations. These results indicate that it may be possible to use these parameters to anticipate unplanned hospitalizations in the elderly. To support this, the MRCI has been recently proposed as a tool for identifying individuals who may benefit from medication therapy management. [19]

The concept of the iatrogenic triad in the elderly refers to three interrelated elements that can adversely affect the health of older adults: polypharmacy (the concurrent use of multiple medications), drug-drug interactions, and the use of potentially inappropriate medications (PIMs). [20] A study conducted in Brazil explored the prevalence and inter-relationship of these elements in older adults. The research found that a high percentage of the elderly population was exposed to the iatrogenic triad. Specifically, 44.6% experienced polypharmacy, 72.3% were at risk of drug-drug interactions, and 42.1% were using potentially inappropriate medications as per Beers criteria. Almost one-third (29.3%) of the study's participants were exposed to all three elements of the iatrogenic triad simultaneously. The study also found that frailty and having a caregiver were associated with this triad. [20]

Research has demonstrated that the iatrogenic triad is prevalent in the elderly population. For instance, a study on elderly women reported that nearly 90% of the participants used at least one element of the iatrogenic triad. The study also noted a high index of continuous use medications, PIMs, and potential drug interactions, particularly among enzymatic inhibitors. It was observed that old age was associated with the presence of all elements of the iatrogenic triad, underscoring the importance of vigilant medication management in this population.[21]

According to the 2019 AGS Beer's criteria, more than half of the prescriptions in our study (54.60%) include medications that are inappropriate for elderly patients. Among such medications, the antidiabetic drugs, glimepiride and glibenclamide, pose a higher risk of prolonged hypoglycemia in the elderly population. The evidence supporting this recommendation is of high quality, and the recommendation itself is strongly endorsed. Prolonged hypoglycemia can lead to adverse outcomes, including bone fractures from falls, seizures, long-term cognitive impairment (such as dementia), frailty, extended hospital stays, and even mortality in hospitals. [22] It is crucial for physicians to be aware of these potentially inappropriate medications (PIMs) to avoid their use in elderly patients. If physicians are aware, there is an opportunity to replace the PIMs with alternative drugs where the benefits outweigh the risks.

No scholarly research originating from India has documented any instances of drug-alcohol or drug-food interactions. Our study highlights the rapid onset and potential severity of drug-alcohol and drug-food interactions, which range from moderate to major. Patients who are not educated on these interactions by a clinical pharmacist are often unaware of the associated risks, which can result in therapeutic failure. For instance, concurrent intake of food can decrease furosemide exposure and efficacy, while alcohol consumption while taking aspirin can increase the risk of gastrointestinal bleeding. These interactions are typically unknown to both patients and physicians, underscoring the need for clinical pharmacist involvement in such cases.

Moreover, our study identifies three potential strategies to prevent the iatrogenic triad in elderly patients, namely interaction, collaboration, and continuing education. Notably, we found no previous studies in India that have outlined such systematic approaches for mitigating the risks associated with the iatrogenic triad in the elderly.

Interaction

Patients will have the opportunity to interact with the clinical pharmacist (Figure 1). Typically, patients are required to register as an outpatient and then wait to consult with a physician. During this waiting period, the clinical pharmacist will meet with the patient and collect a best possible medication history (BPMH) using a standard proforma. The BPMH includes information such as current medications, drugs discontinued within the last six months, drug allergies, over-the-counter medications, alternative medicine, vitamin and mineral supplements, herbal supplements, and recent immunizations. The clinical pharmacist will record this comprehensive information in the patient's case sheets. The patient will then consult with the physician using the updated case sheet. Public hospitals should actively foster collaboration with pharmacy colleges to encourage their participation as stakeholders in the process of mitigating the iatrogenic triad in the vulnerable population such as elderly. By cultivating a symbiotic relationship between these institutions, a more comprehensive approach can be employed to address and prevent potential complications arising from medical interventions.

Collaboration

In light of the information obtained from the Best Possible Medication History (BPMH) and drug allergy records provided by the clinical pharmacist, the physician will proceed to prescribe appropriate drugs. The clinical pharmacist will then conduct a thorough review of the prescription to identify potentially inappropriate medications, drug interactions, and instances of polypharmacy. In cases where discrepancies are identified, both the physician and clinical pharmacist will consult established evidence and guidelines to inform their decision-making. Upon reaching a consensus, the physician will proceed to individualize and deprescribe the therapy as necessary (Figure 1).

Collaborative interventions between pharmacists and physicians have been shown to improve the medication appropriateness index scores of elderly patients. [23] A collaborative care approach with a focus on pharmacists has been found to be effective in reducing drug-related problems, potential drug-drug interactions (DDIs), and potentially inappropriate medications (PIMs), as well as improving positive clinical outcomes related to quality-of-life measures in elderly patients with mental health concerns. [24] Moreover, interventions aimed at optimizing medication usage have been successful in reducing the risk of serious adverse drug reactions (ADRs) in older adults. [25] Nonetheless, the acceptability of pharmacist-led interventions as a means of optimizing treatment is a crucial consideration.

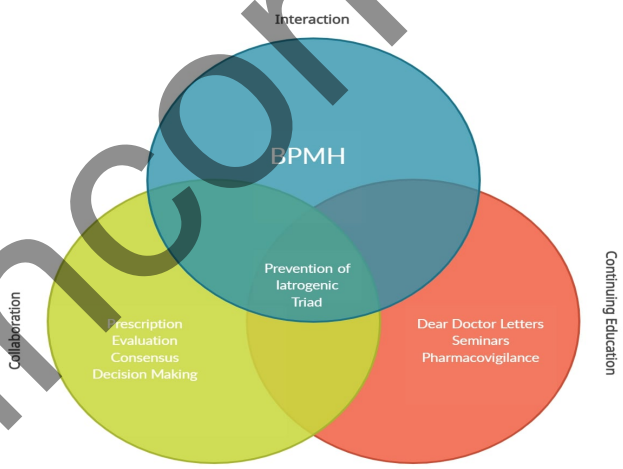

Fig.1: Interaction of outpatients, continuing education, and collaboration of physicians, with a clinical pharmacist.

Continuing Education

Continuing medical education is an essential tool for keeping physicians abreast of new developments and advances in medicine. This education is facilitated through a variety of channels such as dear doctor letters,

seminars and conferences, and pharmacovigilance activities. Dear doctor letters disseminate vital information, including new drug approvals by the FDA, recent inappropriate drug usage in high-risk populations, and adverse drug reactions that commonly occur in hospitals. Clinical pharmacist-led seminars and conferences cover diverse aspects of drug safety, while pharmacovigilance activities enable unsolicited reporting of adverse drug reactions by healthcare and allied healthcare personnel in high-risk populations. The implementation of such measures serves to deter the prescribing or caution the use of drugs that pose potential risks to patient safety (Figure 1).

In the D-PRESCRIBE randomized trial, Martin et al. (2018) [26] established a pharmacist-led intervention group aimed at promoting educational deprescribing brochures and providing evidence-based pharmaceutical opinions to recommending deprescribing to physicians. The study focused on older adults in Quebec and compared the outcomes of the intervention group to those receiving standard care. Results revealed that, after six months, participants who received the educational intervention discontinued prescriptions for inappropriate medications. However, further research is necessary to establish the generalizability of these findings to broader patient populations.

The interplay between these three methods - interaction, collaboration, and continuing education - can significantly minimize the iatrogenic triad in the elderly. The patient-centered approach, coupled with a strong professional collaboration and an emphasis on continual learning, forms a robust defense against the potential pitfalls associated with polypharmacy and complex medical care in the elderly population. They form a synergistic approach that addresses various aspects of medication safety and management. By combining these factors, we can improve medication-related outcomes, reduce the iatrogenic triad, and enhance the overall well-being of the elderly population.

Limitations

The study has some limitations. Firstly, the small sample size is small and affects generalizability of the results. Secondly, the health policy making of integrating pharmacist into the patient care may require feasibility and acceptability of multi stakeholders. However, considering the benefit of the approach and significant number of pharmacy colleges in Andhra Pradesh, it may be possible to implement in real time for optimal results.

Potential Implications of the study

This study has important implications for improving the quality of care for elderly patients and preventing the iatrogenic triad. By implementing the strategies identified in the study, healthcare providers can reduce the risk of harm and improve outcomes for this vulnerable population.

Improved medication management for the elderly: The study's findings highlight the need for healthcare providers to review and adjust medication regimens for elderly patients to reduce the risk of PIMs, polypharmacy, drug interactions, and medication regimen complexity. This could lead to better health outcomes and quality of life for elderly patients.

Development of clinical guidelines: The study's findings could inform the development of clinical guidelines for medication management in elderly patients. These guidelines could provide healthcare providers with a framework for assessing medication regimens, identifying PIMs, and managing drug interactions in elderly patients.

CONCLUSION

We observed the iatrogenic triad in the elderly. The iatrogenic triad in the elderly may be prevented using three possible ways that we observed in our study: interaction of patients with the clinical pharmacist to obtain the best possible medication history; a collaboration of the clinical pharmacist with physicians for informed decision-making and optimizing the pharmacotherapy; and continuing education activity led by a clinical pharmacist to update the knowledge on drug safety and prescribing in the physicians.

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