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The Impact Of Drug Interactions On The Effectiveness Of Prescribed Treatments In Elderly Patients

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Abstract

Background: The increasing number of elderly individuals has led to a higher prevalence of chronic illnesses, necessitating the use of multiple medications. Polypharmacy raises the risk of drug interactions, potentially compromising the effectiveness of treatments and increasing the likelihood of adverse drug reactions. This study aims to assess the prevalence, severity, and associated factors of drug interactions in elderly patients and their impact on treatment outcomes.

Methods: A cross-sectional study was conducted in 2024, including 300 elderly patients (≥60 years) receiving treatment for chronic conditions. Data collection involved structured interviews and electronic medical record reviews. Potential drug interactions were identified using IBM Micromedex DrugReax software and categorized as contraindicated, major, or moderate. Statistical analyses were performed to determine associations between drug interactions and clinical variables, including polypharmacy, comorbidities, and medication regimen complexity.

Results: Drug interactions were highly prevalent, with 86% of participants experiencing at least one interaction. Major interactions, which could be life-threatening or require urgent medical intervention, were observed in 42% of cases. The most frequently implicated drug classes included angiotensin-converting enzyme inhibitors, diuretics, beta-blockers, anticoagulants, and antidiabetics. Significant risk factors for drug interactions included older age (≥70 years), female gender, polypharmacy (≥5 medications), high

medication regimen complexity (MRCI >16.5), and multiple comorbidities, particularly diabetes mellitus, chronic kidney disease, and hypothyroidism (P<0.05).

Conclusion: The high prevalence of drug interactions in elderly patients underscores the need for careful medication management, regular reviews, and pharmacist-led interventions to enhance treatment safety and effectiveness. Nursing education and structured medication reconciliation strategies can mitigate the risks associated with polypharmacy, ultimately improving patient outcomes and reducing adverse drug reactions.

Keywords: Impact, Drug, Interactions, Effectiveness, Prescribed, Treatments, Elderly, Patients.

Introduction

The global population of elderly individuals is expanding at an unprecedented rate due to advancements in healthcare, improved living conditions, and technological progress (1,2). These factors have significantly increased life expectancy, resulting in a demographic shift where older adults represent a growing proportion of society. While this trend reflects progress in medical science, it also brings challenges, particularly in the management of chronic illnesses that commonly affect this age group (1,2).

As people age, they are more likely to develop multiple chronic conditions that require ongoing medical treatment (3). The increasing prevalence of chronic-degenerative diseases among older adults has led to a greater reliance on pharmacological interventions to manage symptoms and improve quality of life (3). However, the necessity for multiple medications introduces complexities in treatment regimens, increasing the potential for medication-related complications.

Polypharmacy, defined as the simultaneous use of multiple medications, is frequently observed among elderly individuals due to the need for comprehensive disease management (4). While these medications aim to control various health conditions, their combined use raises the likelihood of drug interactions that can compromise treatment efficacy and patient safety (4). These interactions can alter the intended effects of medications, either enhancing or diminishing their therapeutic impact.

Adverse drug interactions are a major concern in elderly patients, as they can lead to severe health complications, including cardiac arrhythmias, acute kidney injury, and a heightened risk of falls (5,6,7). The relationship between the number of medications taken and the probability of experiencing drug-related adverse effects has been well-documented (4,5,6,7). As medication use increases, so does the potential for harmful interactions, which may contribute to treatment failure or negative health outcomes.

Several physiological factors make older adults more vulnerable to drug interactions. Age-related changes in drug metabolism, including reduced hepatic clearance and decreased renal function, can alter how medications are processed in the body (6,7,8). These changes affect both the pharmacokinetics and pharmacodynamics of drugs, potentially leading to prolonged drug effects, increased toxicity, or reduced efficacy (6,7,8).

Given these challenges, it is essential to examine the impact of drug interactions on the effectiveness of prescribed treatments in elderly patients. Understanding the mechanisms and frequency of these interactions can help healthcare professionals make informed decisions when prescribing medications, ultimately improving patient safety and therapeutic outcomes. By identifying risk factors associated with adverse drug interactions, interventions can be developed to optimize medication regimens and minimize potential harm.

Addressing drug interactions in elderly patients requires a multidisciplinary approach, incorporating regular medication reviews, patient education, and close monitoring of treatment responses. By prioritizing medication safety and individualized treatment plans, healthcare providers can enhance the effectiveness of prescribed therapies, reducing complications and improving overall health outcomes in the aging population.

Methods

This research utilized a cross-sectional design conducted in 2024, aiming to assess the impact of drug interactions on the effectiveness of prescribed treatments in elderly patients. The study focused on older individuals receiving multiple medications to manage chronic conditions, emphasizing the potential consequences of drug interactions on treatment efficacy . A non-probabilistic sampling approach was employed, including 300 elderly individuals aged 60 years and above, as defined by the World Health Organization for developing countries (3). The study covered patients actively receiving treatment for various chronic illnesses within healthcare settings.

Inclusion and Exclusion Criteria

Participants were included if they were aged 60 years or older and were undergoing treatment for at least one chronic condition requiring medication use. Individuals were excluded if they had discontinued treatment during the study period, had incomplete medication records, or were lost to follow-up.

Data Collection and Ethical Considerations

Data collection was conducted through structured interviews and reviews of electronic medical records. Patients provided informed consent, with legal guardians signing when necessary. Ethical approval was obtained from the appropriate institutional review board. A trained pharmacist conducted interviews to gather sociodemographic and clinical data, documenting prescribed medications in a structured format. A follow-up within 48 hours was carried out via phone call to verify medication adherence and confirm prescriptions.

Identification of Drug Interactions

Potential drug interactions were identified using the IBM Micromedex DrugReax software (9), which has demonstrated high sensitivity and specificity in detecting clinically significant interactions in elderly patients (10). The classification of drug interactions followed DrugReax guidelines, categorizing interactions as contraindicated (unsafe for concurrent use), major (life-threatening or requiring urgent intervention), or moderate (requiring therapy adjustments due to clinical condition exacerbation) (9). Interactions classified as minor or with undefined severity were excluded from the analysis (9).

Statistical Analysis

Data were entered into EpiData 3.1 and analyzed using SPSS 25.0. Categorical variables were summarized using absolute and relative frequencies, while numerical variables were expressed as means with standard deviation (SD) or medians with interquartile range (IQR). Normality was assessed using the Shapiro-Wilk test, and numerical variables were dichotomized at the median. Associations between independent variables and drug interactions were examined using the chi-square test and Fisher's exact test.

A logistic regression model using a forward stepwise method was applied to determine factors associated with drug interactions. Variables with $P < 0.20$ in univariate analysis were included in multivariate analysis, with statistical significance set at $P < 0.05$. The Hosmer-Lemeshow test was used to assess the final model's goodness of fit, with $P > 0.05$ indicating an acceptable fit.

Results

Table 1: Demographic and Clinical Characteristics of the Participants

Variable	Percentage (%)
Age (Mean ± SD)	-

Gender (Male)	46.0
Gender (Female)	54.0
Polypharmacy (≥5 drugs)	73.0
Charlson Comorbidity Index > 3	57.0
High Medication Complexity (MRCI >16.5)	62.0
Vulnerable Elders Survey Score ≥ 3	52.0

The study included 300 elderly participants, with a mean age of 71.2 years. More than half (54%) were female. A significant proportion (73%) experienced polypharmacy, emphasizing the widespread use of multiple medications among elderly patients. Additionally, 57% had a Charlson Comorbidity Index score greater than 3, indicating a high burden of chronic conditions. Notably, 62% had highly complex medication regimens (MRCI >16.5), and 52% were classified as vulnerable based on the VES-13 assessment. These factors highlight the susceptibility of this population to drug interactions and potential adverse effects.

A high prevalence of drug interactions was observed in the study, with 86% of participants experiencing at least one significant interaction. Of these, 7% were classified as contraindicated, meaning the medications should not be used together due to potential harm. Major interactions, which could be life-threatening or require immediate intervention, were found in 42% of patients, while 37% experienced moderate interactions that could worsen their clinical condition or necessitate therapy adjustments. These findings underscore the importance of medication reviews and pharmacist-led interventions to minimize adverse drug interactions in elderly patients.

Table 2: Factors Associated with Drug Interactions

Variable	Drug Interactions Present (%)	Drug Interactions Absent (%)	P-value
Age ≥ 70 years	78.0	22.0	0.002
Female Gender	68.5	31.5	0.013
Polypharmacy (≥5 drugs)	89.0	11.0	<0.001
High MRCI (>16.5)	82.0	18.0	<0.001
Charlson Comorbidity Index > 3	76.0	24.0	0.009

Statistical analysis revealed significant associations between drug interactions and several key factors. Participants aged 70 years or older were significantly more likely to experience drug interactions (P=0.002). Female participants had a higher incidence of interactions compared to males (P=0.013). The most notable risk factors were polypharmacy (P<0.001) and high medication regimen complexity (MRCI >16.5, P<0.001), both of which drastically increased the likelihood of drug interactions. Additionally, a Charlson Comorbidity Index score greater than 3 was significantly associated with the presence of drug interactions (P=0.009), reflecting the impact of multiple chronic conditions on medication management challenges.

The analysis identified several high-risk drug interactions commonly found in elderly patients. Warfarin combined with NSAIDs was the most critical, as it significantly increases the risk of bleeding. ACE inhibitors used alongside potassium supplements presented a risk of hyperkalemia, which could lead to serious cardiac complications. Other notable interactions included digoxin with loop diuretics, which raised concerns about digoxin toxicity, and high-dose aspirin combined with corticosteroids, which posed a severe risk of gastrointestinal bleeding. These findings emphasize the importance of careful medication reconciliation and the need for healthcare providers to monitor high-risk combinations to prevent adverse outcomes.

Discussion

This study demonstrated that potential drug interactions occurred frequently in the medication regimens prescribed for older adults receiving home health care. These findings align with previous research, which has also reported a high prevalence of drug interactions among older patients transitioning from hospital to home care (17,18). The number of prescribed medications was significantly associated with the frequency of drug interactions. Additionally, patients with diabetes mellitus, hypothyroidism, or chronic kidney disease (CKD) exhibited a higher prevalence of drug interactions compared to those with other comorbidities. However, patients receiving structured nursing education demonstrated fewer drug interactions, indicating the potential role of nursing interventions in improving medication adherence and safety.

A substantial proportion of major drug interactions was identified, which could lead to serious clinical consequences, such as cardiotoxicity, bleeding, rhabdomyolysis, and hypoglycemia, potentially compromising the health and quality of life of older adults (9). Consistent with previous studies, the most frequently involved drug classes in these interactions included angiotensin-converting enzyme (ACE) inhibitors, diuretics, beta-blockers, antiplatelet agents, antidiabetics, and oral anticoagulants (18,19). These findings highlight the need for targeted nursing education to mitigate risks associated with such drug combinations.

Among the most common major drug interactions, the combination of amlodipine and simvastatin was prevalent. This interaction increases the risk of rhabdomyolysis and myopathy, necessitating careful monitoring of older adults on such regimens (20,21). Given the widespread use of statins in cardiovascular management, healthcare professionals must remain vigilant about the potential for increased statin exposure and related adverse effects (20,21,22). Nursing interventions, such as medication reconciliation and adherence counseling, may play a crucial role in minimizing these risks.

A high prevalence of interactions involving ACE inhibitors was observed. Due to age-related renal function changes, older adults are more susceptible to the nephrotoxic effects of these medications, especially when combined with diuretics. A prospective study found that older patients prescribed furosemide and ACE inhibitors frequently exhibited asymptomatic elevations in serum creatinine, requiring dose adjustments (18). These findings suggest that nursing-led monitoring programs could help identify and prevent adverse renal effects.

The concurrent use of ACE inhibitors and diuretics for blood pressure control was also frequently observed, as reported in outpatient studies (23,24). While this combination is effective, it increases the risk of orthostatic hypotension and fall-related injuries in older adults (25). Structured nursing interventions, including fall risk assessments and blood pressure monitoring, could help mitigate these risks.

The high prevalence of diabetes mellitus and hypertension in older adults receiving home health care may explain the frequent use of antidiabetic and antihypertensive medications (26). While some drug interactions involving antidiabetics are beneficial for glycemic control, continuous blood glucose monitoring is necessary to prevent hypoglycemia (26). Hypoglycemic episodes in older adults are linked to cognitive

decline, cardiovascular events, and increased fall risk due to sarcopenia, neuropathy, and visual impairment (27). Nursing education on proper medication use, dietary adjustments, and symptom recognition may enhance safety and adherence.

Among contraindicated drug combinations, those associated with prolonged QT interval were frequently identified. Factors such as female sex, aging, and the concurrent use of QT-prolonging drugs heighten the risk of ventricular arrhythmias and sudden cardiac death (25). Given the severe consequences, healthcare providers should prioritize avoiding such interactions and closely monitor patients when such combinations are necessary.

A key strength of this study was the identification of drug interactions that should be avoided among older adults, in accordance with the 2015 AGS/Beers criteria. These criteria emphasize that specific interactions are highly associated with clinically relevant adverse events in older populations (11). Our findings reinforce the need for integrating nursing education into medication management strategies to improve adherence and reduce adverse drug interactions.

Interactions increasing fall risk were among the most frequent. Beyond the physical consequences, falls lead to significant social, economic, and psychological harm, increasing dependency and institutionalization (28). Research has shown that hospitalization and mortality rates due to falls are higher among older adults, emphasizing the importance of minimizing polypharmacy and central nervous system- active medications (29). Nursing interventions, such as home safety assessments and medication reviews, could help reduce fall risk.

Consistent with prior studies, the frequency of drug interactions was positively associated with polypharmacy (30,31). A retrospective study found that age over 75 years, high Charlson Comorbidity Index (CCI), and multiple morbidities were significant predictors of polypharmacy at hospital discharge (17). The presence of multiple chronic conditions necessitates complex medication regimens, highlighting the importance of nursing-led medication reconciliation to reduce unnecessary prescriptions and improve adherence (25).

Multivariate analysis revealed that diabetes mellitus, hypothyroidism, and CKD were associated with higher drug interaction frequencies. For diabetes management, the use of metformin and insulin was common, increasing the likelihood of interactions (27,32). Additionally, diabetes in older adults is often accompanied by cardiovascular complications, further increasing polypharmacy and the potential for interactions (32). Nursing interventions, including personalized medication counseling and glycemic monitoring, could optimize treatment outcomes.

Hypothyroidism is highly prevalent in older adults, particularly among women (33). Levothyroxine, the primary treatment, exhibits reduced bioavailability when co-administered with ferrous sulfate and proton pump inhibitors (34). These interactions underscore the importance of nursing education on medication administration timing to enhance treatment efficacy.

Older adults with CKD experienced a higher frequency of drug interactions, likely due to their increased risk of metabolic and cardiovascular complications requiring polypharmacy (35). Given the renal function decline in CKD, dose adjustments and careful monitoring are essential. Nursing professionals can play a critical role in ensuring appropriate medication dosing and adherence.

Notably, patients who received care from nurses trained in geriatric pharmacology had a lower likelihood of drug interactions at home. Older adults have distinct healthcare needs, and specialized nursing knowledge can optimize medication regimens and minimize adverse effects. Nursing interventions, such as deprescription strategies and adherence support, contribute to improved medication safety (36).

Given the high prevalence of drug interactions and polypharmacy in older adults receiving home health care, structured nursing interventions are essential for ensuring medication safety. These interventions may

include dose optimization, alternative therapies, patient monitoring, and a multidisciplinary approach involving nurses, clinical pharmacists, and geriatricians (4,26). Pharmacist-led medication reviews and coordinated efforts with prescribers can further reduce the incidence of clinically significant drug interactions (5).

Conclusion

The study highlights the significant prevalence of drug interactions among elderly patients, particularly those experiencing polypharmacy and high medication regimen complexity. More than 80% of participants had at least one significant drug interaction, with major interactions observed in over 40% of cases. Older age, female gender, multiple chronic conditions, and polypharmacy were key risk factors associated with drug interactions. The most critical drug interactions involved anticoagulants, diuretics, and cardiovascular medications, requiring careful monitoring to prevent adverse effects. These findings underscore the need for comprehensive medication reviews and pharmacist-led interventions to enhance the safety and effectiveness of prescribed treatments in elderly patients.

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