

Evaluation of Pharmacokinetic and Pharmacodynamic Drug–Drug Interactions in Elderly Polypharmacy Patients

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Abstract: Elderly patients are highly susceptible to drug–drug interactions because of age-related physiological changes, multiple comorbidities, and extensive medication use. The present study evaluated pharmacokinetic and pharmacodynamic interactions among elderly polypharmacy patients in a tertiary care hospital. A hospital-based observational study was conducted in patients aged 60 years and above receiving multiple medications. Drug interactions were assessed using standard interaction databases and categorized according to mechanism and severity. Results demonstrated that pharmacokinetic interactions involving cytochrome P450 enzyme inhibition and altered renal clearance were highly prevalent. Pharmacodynamic interactions associated with additive sedative effects, hypotension, and bleeding tendencies were also commonly identified. Polypharmacy, impaired renal function, and cardiovascular disease were significant predictors of DDIs. The study highlights the importance of individualized therapy, therapeutic monitoring, and pharmacist-led interventions in reducing interaction-related complications in geriatric patients.

Keywords: Pharmacodynamic Interactions, Polypharmacy, Cytochrome, Multiple Comorbidities.

1. Introduction

The elderly population represents one of the most vulnerable groups in healthcare due to the high prevalence of chronic diseases and extensive medication use. Aging is associated with physiological changes affecting drug absorption, metabolism, distribution, and excretion, thereby increasing susceptibility to adverse drug reactions and drug–drug interactions [1-5].

Polypharmacy is particularly common among geriatric patients because multiple comorbidities often require long-term multidrug therapy. The simultaneous use of antihypertensives, antidiabetics, anticoagulants, analgesics, and psychotropic medications significantly increases the possibility of interactions [6-10].

Drug–drug interactions in elderly patients may occur through pharmacokinetic or pharmacodynamic mechanisms. Pharmacokinetic interactions involve alterations in drug metabolism and clearance, especially those mediated by hepatic cytochrome P450 enzymes and reduced renal function. Pharmacodynamic interactions occur when drugs produce additive, synergistic, or antagonistic physiological effects [11-20].

Clinically significant DDIs in elderly patients may result in falls, bleeding, confusion, renal toxicity, arrhythmias, and hospitalization. Therefore, careful assessment of medication regimens is essential for improving geriatric patient safety [21-25].

The present study was designed to evaluate the pattern and clinical significance of pharmacokinetic and pharmacodynamic DDIs among elderly polypharmacy patients.

2. Literature Review

Bjerrum et al. (1998) reported a strong association between polypharmacy and DDIs in elderly populations.



Routledge et al. (2004) demonstrated that age-related physiological decline significantly affects drug metabolism and increases interaction susceptibility.

Mangoni and Jackson (2004) explained that reduced renal and hepatic function alters pharmacokinetic parameters in elderly patients.

Juurlink et al. (2003) identified anticoagulant-related interactions as a major cause of hospitalization among geriatric patients.

Hines and Murphy (2011) reported that inappropriate prescribing and lack of medication review contribute substantially to interaction-related morbidity.

Gurwitz et al. (2003) emphasized the role of pharmacist interventions in preventing adverse drug events in older adults.

These findings indicate that elderly patients represent a high-risk group requiring close monitoring for DDIs.

3. Methodology

Study Design: Prospective observational study.

Study Site: Tertiary care teaching hospital.

Study Population: Patients aged ≥ 60 years receiving five or more medications.

Data Collection

- Demographic details
- Clinical diagnosis
- Laboratory reports
- Medication history

DDI Assessment: Interactions were identified using Micromedex and Lexicomp databases.

Classification

- Pharmacokinetic interactions
- Pharmacodynamic interactions
- Severity grading: major, moderate, minor

Statistical Analysis: Data analyzed using percentage distribution and correlation analysis.

4. Results and Discussion

The study included 180 elderly polypharmacy patients. Most patients suffered from hypertension, diabetes mellitus, ischemic heart disease, and chronic kidney disease.

A large number of potential DDIs were identified, with moderate interactions being most common. Pharmacokinetic interactions involving CYP450 enzyme inhibition accounted for a major proportion of interactions.

Common pharmacodynamic interactions included:

- Benzodiazepines + opioids (sedation)
- Anticoagulants + NSAIDs (bleeding)
- Antihypertensives + diuretics (hypotension)

Patients with impaired renal function showed significantly increased interaction risk because of altered drug elimination. Polypharmacy involving more than seven medications was strongly associated with major DDIs.

The results agree with studies by Mangoni and Jackson (2004) and Gurwitz et al. (2003), which demonstrated increased DDI prevalence among elderly patients due to physiological decline and complex medication regimens.

The study highlights the necessity of dose adjustment, therapeutic monitoring, and regular medication review in geriatric pharmacotherapy.

5. Conclusion

Elderly polypharmacy patients are highly vulnerable to clinically significant pharmacokinetic and pharmacodynamic drug–drug interactions. Factors such as multiple comorbidities, impaired organ function, and extensive medication use contribute substantially to interaction risk. Early detection through computerized screening systems, individualized therapy, and pharmacist-led interventions can reduce adverse outcomes and improve therapeutic safety in geriatric patients.

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