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Prevalence of Drug-Drug Interactions in Hospitalized Geriatric Patients: An Observational Cohort Study

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Abstract:

Purpose: The purpose of the study is to enhance patient safety by identifying, preventing and managing adverse outcomes caused by combined medication use.

Background: Drug–drug interactions (DDIs) are a significant concern in hospital settings, particularly among elderly patients who are considered a high-risk population due to polypharmacy and age-related physiological changes. Despite this, there is a lack of comprehensive systematic reviews addressing the prevalence of DDIs in hospitalized elderly populations. This study aims to evaluate and summarize the existing evidence on the prevalence of DDIs among hospitalized elderly patients. Additionally, it seeks to identify the most commonly implicated drugs, drug classes, and drug combinations associated with these interactions. Original observational studies reporting the prevalence of actual or potential DDIs in hospitalized patients aged 60 years or older were included. The primary outcomes assessed were the prevalence of DDIs and the number of DDIs per patient. Subgroup analyses were conducted for studies focusing on geriatric units.

Methodology: A prospect of observational study was conducted at tertiary care Hospital over 6 months. A total of 100 patients are having drug drug interactions. The patients having drug drug interactions after resolving issue the quality of life of patient improves, after collecting all information about patient that includes demographic details, subjective evidence ,objective evidence, assessment ,treatment before and after. Individual patient information was collected, data analysis was analyzed by using standard deviation.

Results: A total 100 patients were included in the research. The prevalence of DDIs varied widely, ranging from 2.34% to 80%. In geriatric unit settings, prevalence rates were notably higher, ranging from 80.5% to 90.5%. The number of DDIs per patient ranged from 1.0 to 9.0. The drugs most frequently associated with DDIs included aspirin, pantoprazole, ceftriaxone, diclofenac, amikacin, telmisartan, atorvastatin, clopidogrel. The most commonly implicated drug classes were anti platelets, NSAIDS, antibiotics, proton pump inhibitors, Angiotensin receptor blocker, and statins.

Conclusion: The prevalence of DDIs in hospitalized elderly patients varies considerably. This variability may be attributed to differences in patient health status, complexity of care, and methodological approaches. These findings highlight the need for standardized methods and improved monitoring systems to better assess and manage DDIs in this vulnerable population.

Keywords: DDIs, polypharmacy, NSAIDS, pharmacokinetics DDIs, Pharmacodynamic DDIs ect.

1. INTRODUCTION

A drug–drug interaction (DDI) is described as the ability of one drug to enhance, diminish and/or modify the action or effects of another drug when administered successively or simultaneously.1 DDIs are a particularly important type of adverse drug event as they can alter drug effectiveness and security.2 Although not always avoidable, DDIs are often predictable.3 Pharmacodynamic DDIs are those related to the pharmacological activity of inter acting drugs, through direct effect on receptor function, interference with a biological or physiological control process or additive/opposed pharmacological effect, and are less frequent. Pharmacokinetic DDIs are related to the effects of one drug on the absorption, distribution, metabolism or excretion of another drug, and can modify drug concentrations levels, leading to ineffectiveness or toxicity, and are more prevalent than pharmacodynamics DDIs.4 Considering mechanisms and prevalence, pharmacokinetic DDIs have a higher impact on patient safety than pharmacodynamic DDIs. Actual DDIs are identified from patient adverse outcomes whereas potential DDIs are those identified through analysis of the pharmacokinetic and pharmacodynamics profiles of each drug in use, and identification of possible adverse events due to the association.5 Since a potential DDI may or may not result in an adverse outcome, the incidence of actual DDIs in the literature is consistently lower compared with potential DDIs,6 and therefore each patient should be evaluated individually, considering the risk–benefit ratio. The prevalence of DDIs in the hospital setting is variable. Studies conducted with hospitalised patients in different clinical settings have shown a prevalence of 5.3–83.9%.7–12 It is estimated that up to two-thirds of intensive care patients experience at least one potential DDI during their hospital stay.13 It seems that the majority of prescribed inter acting drug combinations involve a limited number of drugs,14 and the main mechanism of DDIs is pharmacokinetic, involving drug metabolism via cytochrome P450.15 Elderly patients are considered a high risk popu lation for DDIs.16 The prevalence of DDIs in elderly outpatients with multi morbidity was recently reported to be between 2.1% and 100%, where the number of DDIs per 100 patient ranged from 30 to 388.3.17 The incidence of DDIs during hospital stay is not well defined. Ageing is an independent risk factor for DDIs,18 as elderly patients tend to receive more medications than other ages group as a conse quence of the many physiological changes related to the ageing process and the accompanying health problems.19 Therefore, in this population, potential DDIs are often unavoid able. However, the risk of adverse outcomes due to DDIs seem to be particularly serious in the elderly. A systematic review has shown that DDIs were responsible for 0.57% of hospital admissions in general but for 4.8% of elderly patients.20 to date, no systematic review has specifically addressed the prevalence of DDIs in elderly patients in an inpatient setting. The aim of this systematic review was to collate the evidence about actual and potential DDI prevalence in the hospitalised elderly patient obtained from observational studies.

2. METHODOLOGY

Study Design:

The current study is prospective observational research conducted over a 6-month period, at LSSH in the inpatient departments. This study aims to evaluate and summarize the existing evidence on the prevalence of DDIs among hospitalized elderly patients. Additionally, it seeks to identify the most commonly implicated drugs, drug classes, and drug combinations associated with these interactions.

Study Period:

The study was conducted for a period of 6 months.

Study Site:

Study was conducted at inpatient department in LALITHA SUPER SPECIALITIES HOSPITAL at Guntur.

Sample Size:

The sample size consists 100 patients

Study Criteria:

The study was carried out by considering the following criteria

Inclusion Criteria:

- Patient with age group 60-80 years.
- Both gender (male and female).
- Patient who are presented with atleast one DDI.
- Patients who had sufficient data to study outcomes. Willingness to participate and provide informed consent.

Exclusion Criteria:

- Patients below 60 years.
- Patients with unsufficient data.

- Outpatient are not involved in the study.
- Dental patients are not involved in the study.
- Patients who are not willing to answer.
- Mental problem and difficulties in understanding and completing questionnaire and refusal.

Study Procedure:

This prospective study was carried out in the hospital with prior permission from the in patients

⬇

Enrolling the patients who are having drug drug interactions coming under the inclusion criteria with prior permission from the patients

⬇

Data was collected from the enrolled patients by interviewing them face by face

⬇

The study we conducted can improve the patients regarding quality of life

Study Method:

This study was conducted at Lalitha super specialties hospital after getting ethical clearance from institutional ethical committee. Those patients who will come under the inclusion criteria are monitored and data will be collected during the study period.

Data Collection Form:

Data collection was carried out by face-to-face interviews with the patients. The information collected includes demographic data (i.e., age and gender) History of the patient and prescription pattern of the past medication and follow up medication. Analyzing the prescription pattern and medication errors, drug drug interactions of the patient according to case sheets.

Stastical Analysis:

The values were expressed as mean ± SD are followed by an ANOVA was used to determine quality of life of inpatients. The Statistical significance was set at $p < 0.05$ and considered significant.

3. RESULTS

A total of 100 patients were enrolled in the study. Data was collected from patients who presented with atleast one drug drug interaction over a six-month period. Detailed demographic information for all patients was recorded.

Table-1. *Age Factor Distribution.*

S.No	Age	No.Of Patients (Male) N=100	Percentage (%)	No.Of Patients (Female) N=100	Percentage (%)
1	60-70	36	36%	37	37%
2	Above 70	17	17%	10	10%

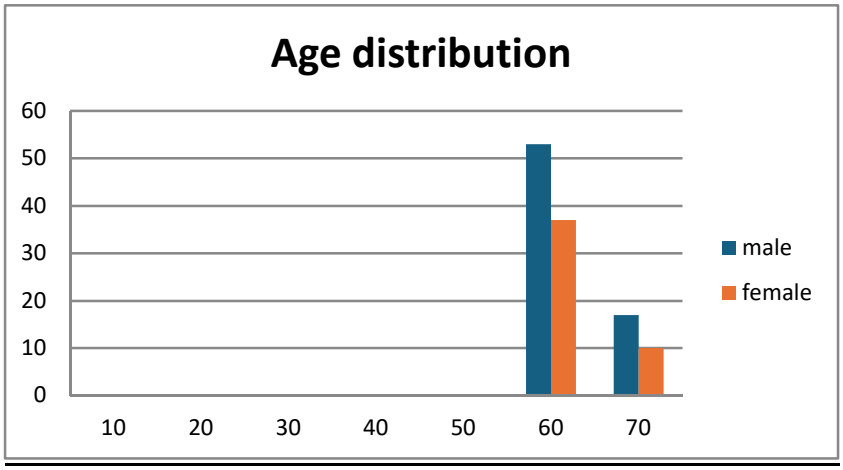

Fig1: *Age Factor Distribution*

From the table, it is evident that the majority of male patients fall within the 60-70 age group, accounting for 53% of the total male population. In contrast, the female patient population shows a more evenly distributed age range, with the highest percentage (37%) in the 60-70 age group as well, but significantly lower overall numbers compared to males.

Table-2: *Gender Distribution*

S.No	Gender	No.Of Patients(Both M & F)N=100	Percentage (%)
1	Male	53	53%
2	Female	47	47%

It presents an analysis of patient demographics based on gender within a sample size of 100 individuals.The findings indicate a significant predominance of male patients,comprising 53% (53 individuals) of the total cohort, while female patients accounted for 47% (47 individuals). The results underscore the gender disparity in patient representation, prompting further investigation into the underlying factors contributing to this imbalance. The study aims to contribute to the understanding of gender differences in healthcare access and outcomes, which may have implications for clinical practice and health policy.

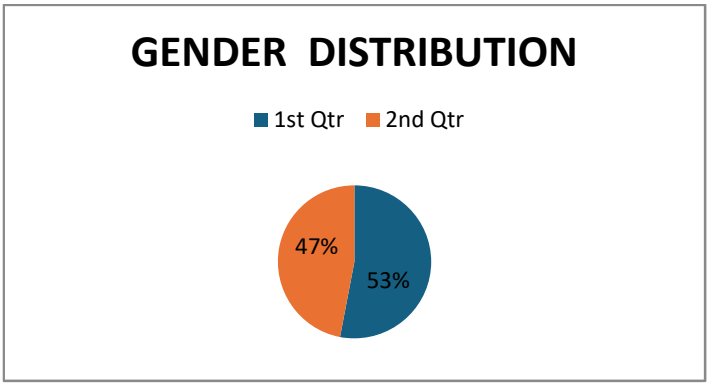

Figure No: 2. *Gender Distribution*

Table-3: *Bmi Distribution*

S:No	Bmi(Kg/M^2)	No.Ofpatients(Both M&F)N=100	Percentage (%)
1	<18.5	5	2.7 %
2	18.5-24.9	67	37.2 %
3	25.0-29.9	87	48.3 %
4	30.0-34.9	21	11.6 %

It investigates the Body Mass Index (BMI) distribution among a sample of 100 patients, comprising both male and female participants. The findings reveal that a significant majority of the patients fall within the overweight and pre-obese categories, with 48.3% of patients having a BMI between25.0-29.9.Additionally,37.2%ofpatients are classified as having a normal weight (BMI 18.5-24.9), while a smaller proportion, 11.6%, fall into the obese category (BMI 30.0-34.9).Only2.7% of the patients are underweight (BMI<18.5).This study highlights the prevalence of overweight and obesity among the patient population,suggesting a need for targeted interventions to address weight management and related health issues.

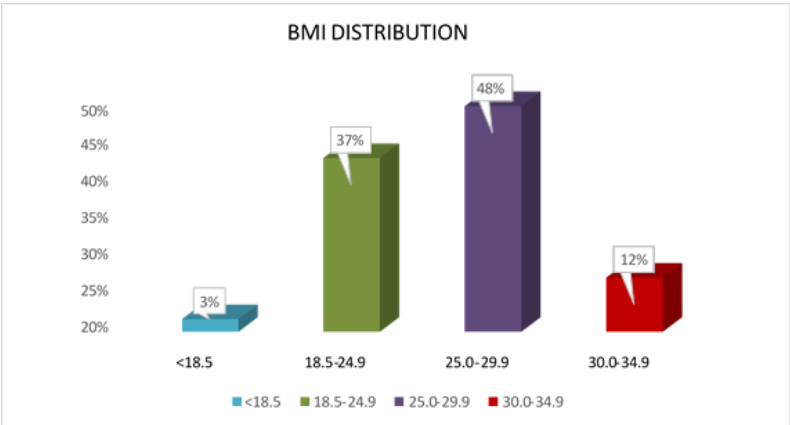

Figure No: 3. *Bmi Distribution*

Table No: 4. *Tabulation Of Prevalence Of Drug Drug Interactions In Various Departments.*

S.no	Departments	No.of DDI identified
1.	General medicine	229
2.	General surgery	65
3.	Orthopaedics	15
4.	Gynecology	10

DDI are highly concentrated in general medicine, contributing to nearly ¾ of all interactions .monitoring and preventive strategies should prioritize general medicine, followed by genral surgery.

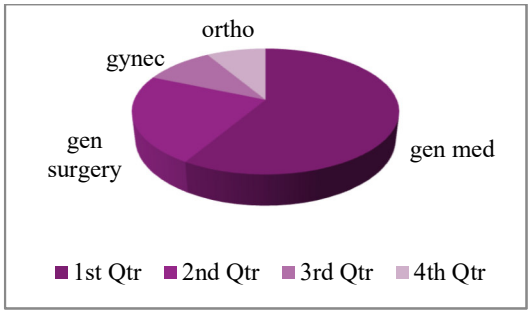

Figure No 4: *Department Wise Distribution*

Data collected from above patient records, general medicine 71%, general surgery department 24%, gynecology department 3%, orthopedics department 2%.

The analysis indicates that drug–drug interactions (DDIs) are more commonly observed in the elderly population, particularly among patients aged above 60 years, with a comparatively lower representation in those above 70 years. A gender-wise distribution shows that males experience a higher incidence of DDIs than females. Among the various clinical conditions, cardiovascular diseases (25 cases) and gastrointestinal disorders (24 cases) are the leading contributors, followed by neurological conditions (18 cases) and infections (12 cases). Respiratory diseases (7 cases), neoplasms (6 cases), musculoskeletal disorders (4 cases), and endocrine disorders (2 cases) account for smaller proportions. Overall, a total of 889 drugs were prescribed across all patients, with a median of 9 drugs per patient, indicating a high level of polypharmacy. This substantial medication burden, particularly in older male patients with cardiovascular and gastrointestinal conditions, likely contributes to the increased risk of DDIs, highlighting the need for careful prescription review and monitoring.

Table No: 5. *Drug classes most often prescribed to the patient*

Therapeutic class	Number of patients with a prescription for this drug class
Antimicrobials	85%
Antiplatelets and anticoagulants	16%
Antihypertensives	23%
Antianginal	20%
Lipid lowering agents	6%
Antiaarrythmic	1%
Diuretics	15%
Antiepileptics and neuropathic agents	8%
CNS depressants	27%
Analgesics	45%
Antiulcer drugs	58%
Antiemetic sand prokinetcs	11%
Laxatives	4%
Antidiabetic	32%
Thyroid drugs	3%
Respiratory	22%
Corticosteroids	9%
Hepatoprotective	7%
Vitamins,minerals,supplements	60%
Electrolytes and fluid therapy	9%
Hematopoietic agents	2%
Miscellaneous	16%
Proton pump inhibitors	9%
H2 blockers	5%

Antimicrobials (85%) were prescribed to all patients, indicating that infection management was the primary focus. Among cardiovascular-related drugs: Antihypertensives (23%) and antianginal drugs (20%) were commonly used, suggesting a significant number of patients had cardiac conditions. Antiplatelets and anticoagulants (16%) were also frequently prescribed, reflecting risk of thrombosis or cardiovascular events.Diuretics (15%) indicate management of fluid overload or heart failure. Lipid-lowering agents (6%) were used in fewer patients, likely for long-term cardiovascular risk control.Antiarrhythmic drugs (1%) were rarely prescribed, showing low prevalence of arrhythmias.

The data suggests a high burden of infectious diseases along with cardiovascular comorbidities. Treatment is mainly focused on: Infection control Blood pressure and heart disease management. Other conditions like dyslipidemia and arrhythmias are present but less common. Vitamins & mineral supplements (60%) – highest usage, indicating widespread nutritional support and deficiency management. Antiulcer drugs (58%) – very common, suggesting routine gastro protection (especially with NSAIDs/steroids). Analgesics (45%) – reflects a high burden of pain and inflammation. Antidiabetics (32%) – shows significant prevalence of diabetes among patients.CNS depressants (27%) – indicates use for sedation, anxiety, or neurological condition.

3.1. Moderately Used Classes

Respiratory drugs (22%) – indicates respiratory comorbiditie. Antiemetics & prokinetics (11%) – for nausea/vomiting management. Corticosteroids (9%) and PPIs (9%) – used for inflammation and acid suppression. Electrolytes & fluid therapy (9%) – supports hydration and electrolyte balance. Antiepileptics/ neuropathic agents (8%) – for seizures and neuropathic pain. Hepatoprotectives (7%) – indicates liver-related support.

3.2. Less Frequently Used Classes

Laxatives (4%) – limited use for constipation. Thyroid drugs (3%) – fewer patients with thyroid disorders. Hematopoietic agents (2%) – low incidence of anemia/blood disorders.H2 blockers (5%) – less preferred compared to PPIs. Miscellaneous (16%) – includes drugs not fitting into major categories.

The prescribing pattern shows: Strong emphasis on gastroprotection (antiulcer + PPIs) High use of supportive therapy (vitamins, fluids) significant presence of chronic conditions like diabetes and respiratory diseases Indicates polypharmacy with focus on symptom relief and comorbidity management.

Most patients received vitamins, antiulcer drugs, and analgesics, indicating a focus on supportive care, gastro protection, and pain management, along with treatment of chronic diseases like diabetes and respiratory conditions.

Table NO: 6. *drugs combinations that were responsible for potential interacting drug combination*

Potential drug- drug interactions	Potential adverse effect	Severity	Frequency (n)
Antitussive+urinary spasmodic	Sedation,confusion	Moderate	1%
Antitusssive+beta 3agonists	CNS toxicity	Moderate	1%
Antispasmodic+beta3agonist	Urinary retention	Moderate	1%
Antibiotic+NSAID	Renal damage	Moderate	5%
Antiplatelet+PPI	Decrease GI irritation	Minor	13%
NSAID+ARB	Decrease bp control and renal risk	Minor	1%
Cephalosporins+aminoglycoside	Nehrotoxicity	Minor	1%
Pencillin+aminoglycoside	Nephrotoxicity	Minor	1%
Aminoglycoside+NSAID	Acute kidney injury	Minor	3%
Antibiotic+PPI	Reduced efficacy	Moderate	2%
Antibiotic+opioid	Seizures ,sedation	Minor	2%
Dopaminergic+dopamineagonist	Dyskinesia	Moderate	1%
Antiparkinson+ARB	Hypotension	Moderate	1%
Antiparksinson+anticonvulsant	Sedation	Moderate	1%
ARB+anticonvulsant	Dizziness	Minor	1%
Fibrate+statin	Myopathy	Minor	1%
Antiplatelet+supplement	Bleeding	Moderate	1%
Antiplatelet+ARB	Decrease bp control	Minor	5%
Statin+PPI	Mininmal	Minor	5%
NSAID+ARB	Renal failure	Minor	1%
Fluoroquinolone+NSAID	Seizures	Minor	2%
Steroid +NSAID	GI ulcer	Minor	1%
Steroid+antidiabetic	Hyperglycemia	Moderate	1%
Steroid+ARB	Hypertension	Minor	2%
NSAID+antidiabetic	Lactic acidosis risk	Minor	2%
Antibiotic+antiplatelet	CNS stimulation	Minor	2%

Statin+antiplatelet	Increase statin levels	Moderate	6%
Antidepressant+anticonvulsants	Sedation	Moderate	1%
Antiplatelet+antidepressant	Bleeding	Minor	2%
Anti TB+PPI	Decrease PPI effect	Moderate	1%
Antibiotic+antidiabetic	Hypoglycaemia	Moderate	1%
Anticoagulant+antidiabetic	Bleeding	Moderate	2%
Antiplatelet+antiemetic	Increase absorption	Minor	1%
Antiduretic +antiplatelet	Risk of bleeding	Moderate	3%
Antidiuretics+PPI	Hyponatremia	Moderate	4%
Beta blockers +antidiabetics	Hypoglycaemia	Moderate	2%

The interactions mainly involve CNS depression, cardiovascular effects, and metabolic toxicity, with high-risk combinations like statin–fibrate and NSAID–ARB, requiring careful monitoring despite generally good documentation. Most DDIs are pharmacodynamic, leading to renal toxicity, CNS depression, and altered BP control, with generally good documentation and delayed onset, highlighting the importance of careful monitoring and rational prescribing. This set of interactions mainly highlights bleeding complications, metabolic disturbances, and pharmacokinetic changes, with most interactions being well-documented and delayed in onset, requiring careful monitoring in clinical practice.

4. STASTICALANALYSIS

Anova: Anova (Analysis of Variance) is a statistical method used to determine if the means of three or more independent groups differ significantly by comparing the variance between groups to the variance within groups. It tests the null hypothesis that all group means are equal, with a significant result suggesting at least one mean is different.

Key Concepts and Types:

One-Way ANOVA: Compares means across a single categorical factor (e.g., test scores for 3 different teaching methods).

Two-Way ANOVA: Examines the effect of two factors simultaneously and their interaction (e.g., how both diet and exercise affect weight loss).

F-Statistic: The test statistic used to determine significance, calculated by dividing the mean square between groups by the mean square within groups.

Assumptions: Data should follow a normal distribution, have homogeneous variances (similar variance between groups), and observations should be independent

Key Components of ANOVA:

Sum of Squares: Measures total variation in the data.

Mean Square: Calculated by dividing sum of squares by degrees of freedom.

Significance Level (-value): If the value is less than the chosen significance level (e.g., 0.05), you reject the null hypothesis.

Step 1: Define Groups

We performed one-way ANOVA using:

Independent vriable (factor): Severity (Moderate vs Minor)

Dependent variable: Frequency (%)

So we divide data into two groups:

Step 2: Organize Data

Moderate group (Frequency %)

1, 1, 1, 5, 2, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 2, 3, 4, 2

Total values (n_1) = 19

Minor group (Frequency %)

13, 1, 1, 1, 3, 1, 1, 5, 5, 1, 2, 1, 2, 2, 2

Total values (n_2) = 15

Step 3: Calculate Means

Mean of Moderate:

X1= sum/n

= 34/19

= ~1.79

Mean of Minor:

X2= sum/n

= 41/15

= ~2.73

Step 4: Overall Mean

X= 34+41/19+15

= 75/34

= ~2.21

Step 5: calculate sum of squares

(A). between groups (SSB)

SSB = n1(x1-x) 2 + n2(x2-x) 2

=19(1.79-2.21)2 + 15(2.73 – 2.21)2

=19(0.1764) + 15(0.2704)

= 3.35 + 4.06

= 7.41

(B). Within Groups (SSW)

SSW measures variation within each group:

SSW = ∑ (Xi−X¯group) 2

We calculate it separately for each group, then add them.

5. DISCUSSION

The present analysis evaluated potential drug–drug interactions with respect to their severity and frequency using one-way ANOVA. The findings indicate that the majority of interactions were classified as either moderate or minor in severity, with relatively low individual frequencies across categories. Although certain combinations, such as antiplatelet with proton pump inhibitors and statin with antiplatelet agents, showed comparatively higher frequencies, most interactions occurred infrequently (1–5%). The ANOVA results demonstrated that the difference in mean frequency between moderate and minor severity groups was not statistically significant ($F(1,32) = 1.38$, $p = 0.25$). This suggests that the observed variation in frequency is likely due to random variation rather than a true difference based on severity classification.

Clinically, this indicates that both moderate and minor interactions are distributed similarly in terms of occurrence and should be given comparable attention during prescription review. Notably, interactions involving NSAIDs, antibiotics, and antiplatelet agents were recurrent, highlighting their importance in routine clinical practice due to potential risks such as renal impairment, bleeding, and central nervous system effects. Even though many interactions were categorized as minor, their cumulative impact, especially in polypharmacy settings, cannot be overlooked. Therefore, continuous monitoring, rational prescribing, and awareness of common interaction patterns are essential to minimize adverse outcomes. Overall, the study emphasizes that severity classification alone may not predict the frequency of drug interactions, reinforcing the need for comprehensive clinical evaluation in patient management.

6. CONCLUSION

The present study concludes that drug–drug interactions are a common occurrence in clinical practice, with a predominance of moderate and minor severity interactions observed in the analyzed data. Despite variations in individual frequencies among different drug combinations, statistical analysis using one-way ANOVA revealed no significant difference in the frequency distribution between moderate and minor severity groups ($F(1,32) = 1.38$, $p = 0.25$). This indicates that the likelihood of occurrence of drug interactions is not significantly influenced by their severity classification. Therefore, both moderate and minor interactions should be considered equally important during clinical evaluation and medication review.The study also highlights that commonly used drug

classes such as NSAIDs, antibiotics, antiplatelets, and antihypertensive agents are frequently involved in interactions, emphasizing the need for careful prescribing practices. Although many interactions were categorized as minor, their potential to contribute to adverse effects, especially in patients receiving multiple medications, should not be underestimated. Moderate interactions, on the other hand, may require closer monitoring and possible dose adjustments to prevent complications. Overall, the findings underscore the importance of vigilant pharmacovigilance, routine screening for potential drug interactions, and the implementation of strategies to enhance patient safety. Healthcare professionals should remain aware of common interaction patterns and adopt a multidisciplinary approach to minimize risks. In conclusion, effective management of drug–drug interactions is essential to improve therapeutic outcomes and ensure safe and rational use of medications in clinical settings.

Table No: 7: *The major drug drug interactions shown combinations*

Potential drug- drug interactions	Potential adverse effect	Severity	Frequency (n)
Antibiotic+NSAID	Renal damage	Moderate	5%
Antiplatelet+PPI	Decrease GI irritation	Minor	13%
Antiplatelet+ARB	Decrease BP control	Minor	5%
Statin+PPI	Mininmal	Minor	5%
Statin+antiplatelet	Increase statin levels	Moderate	6%

The major drug drug interactions shown combinations are Antibiotic+NSAID, Antiplatelet+PPI, Antiplatelet+ARB, Statin+PPI, Statin+Antiplatelet.while giving these drug combinations clinicians should ensure the safety of patient and monitor vitals, laboratory investigations.

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