Drug usage pattern in indoor patients of general medicine department at a tertiary care teaching hospital.

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Abstract

Background: Drug usage research can be defined as the marketing, distribution, prescription, and utilization of drugs in a society, with particular prominence on the resultant medical, social and economic outcomes. Its main application is providing data about pattern, quality and effect of drug use. The probability of toxic reactions increases during excessive drug use. Drug misuse will lead to needless adverse drug effects and drug-drug interactions. Drug-Drug Interactions are an avertable source of morbidity and mortality.

Objectives: To study drug usage pattern for generating data on drug utilization in patients. To identify potential targets in drug prescribing patterns and documents the prevalence of such events. To identify common medications that can cause adverse events in inpatients.

Setting: A Tertiary Care Teaching Hospital.

Methods: We carried out a cross-sectional observational study at a tertiary care teaching hospital in Gujarat. Patients matching the inclusion criteria were enrolled in the study. We collected and recorded patient data related to drug usage pattern in the data collection forms. We evaluated the prescriptions for drug usage pattern, polypharmacy and potentially significant drug-drug interactions using Micromedex Drug Reax.

Main outcome measures: To decrease the number of observable drug-drug interactions and promote patient safety.

Results: We observed that approximately 8.7 drugs were prescribed to each patient. 21.07% drugs were prescribed to the age group of 61-70 years. Cardiovascular agents accounted for highest percentage of prescribed drugs (32.71%), followed by 17.92% supplements and 14.43% gastrointestinal agents. 69 % of drug-drug interactions was found, of which 52.15% were major drug-drug interactions, followed by 43.01% moderate drug-drug interactions. The most percentage of drug-drug interactions was found in the age group 51-60 years which was 25.26%. We observed the highest percentage of drug-drug interactions with anticoagulants (11.20%), followed by diuretics (5.1%) and supplements and other drugs (4.65%). 18.27% out of total drug-drug interactions were perceived in patients, out of which 64.07% were managed.

Conclusions: The escalating drift of polypharmacy and the perceptible drug-drug interactions in indoor patients calls for an interventional study and careful monitoring of patients to reduce the number of adverse outcomes and enhance patient safety.

Keywords: Drug usage pattern, Adverse drug events, Polypharmacy, Drug-drug interactions, Monitoring, Patient safety.

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Introduction

According to WHO, drug usage research can be defined as the marketing, distribution, prescription, and utilization of drugs in a society, with particular prominence on the resultant medical, social and economic outcomes. Its main application is to give data about pattern, quality and effect of drug use. Drug utilization pattern is required to be evaluated from time to time to increase therapeutic efficacy and reduce side effects.

Unsuitable drug prescribing is a worldwide concern. Inappropriate drug prescribing system includes polypharmacy the use of 5 or more number of drugs, underuse i.e., administration of sub-therapeutic dose of drugs, use of combination products which are often more costly and offer no advantage over single compounds and overuse of antimicrobials and injections is quite frequent in all countries, especially in developing countries [1]. This leads to decline in the quality of drug therapy, unnecessary depletion of resources, amplified treatment expenses, increased risk for adverse drug reactions, and emergence of drug resistance.

Polypharmacy leads to adverse consequences including increased mortality, adverse drug reactions, increased length of stay and readmission in hospital. The risk of adverse effects and harm increases with increased number of medications. Drug-Drug Interactions (DDIs) can be defined as simultaneous administration of two or more drugs altering effectiveness of drug on the body in such a manner that the potency or toxicity of one or more drugs is altered. The factors which are significantly associated with having one or more potential interactions include: taking five or more medicines, patient age of 60 years or older and those suffering from cardiovascular diseases.

DDIs often cause adverse drug reactions resulting in increased risk of morbidity and mortality. Approximately 3–26% of all Adverse Drug Reactions (ADRs) that require hospital admission are caused by DDIs [2]. Potential Drug–Drug Interactions (PDDIs) are one of the avoidable drug associated issues that has a higher probability of causing major adverse events or therapeutic failure. Their associated ADRs may lead to increased morbidity or mortality. DDIs are estimated to be responsible for 6%-30% of all the adverse drug events, and they persistently pose a substantial risk to the patient's health outcomes and a hefty economic liability on the health care system. Hence, as they pose an important hazard to the health of millions of patients, requiring to be tackled and proving to be the need of the hour. To facilitate preventable measures, it is highly recommended to have a database which can be used as a reference for the identifiable interactions like that of the drug reax system (Micromedex). Then, it is required to be acquainted with the most frequently occurring preventable interactions. So, it is practical to monitor the DDIs in patients who are on poly-pharmacy and to accumulate the information concerning the commonly occurring drug interactions. The main objective of the study is to generate drug utilization data of inpatients of the general medicine department, to identify potential targets in drug prescribing patterns, to identify of common medications that can cause adverse events in inpatients and the prevalence of such events.

Materials and Methods

Study design and setting

A cross-sectional study has been carried out at a tertiary care teaching hospital in Vadodara, Gujarat for a period of 6 months to study the drug utilization pattern and to find out the effects of drug-drug interactions in inpatient department. We used the Raosoft Software to calculate the sample size [3].

Study population and sample

Eligible patients were all between 18-80 years old who, during the study, were on at least one chronic or acute disease. Patients who were pregnant and lactating were excluded. Oncologic and topical as well as homeopathic and natural drugs were excluded.

Data collection procedures

The data collection form and the informed consent form were designed. The study was explained to the enrolled patients emphasizing the benefits, risk factors of the study as well as the outcomes and informed consent was taken [4]. Data of the patients were collected and recorded in the data collection form. The high-risk medications causing PDDIs in inpatients were identified using the IBM International database.

Data analysis

All data analysis was performed using Microsoft Excel 2007 and Graphpad Prism 8.0. Statistical analysis was carried out using $\chi 2$ (Chi- squared) test.

Results

A total of 100 cases were collected from the General Medicine Department all of which were followed-up for the study.

Number of diseases/co-morbid conditions amongst hospitalized patients

We found that out of the 100 patients, the female patients (127/202) suffered from a greater number of co-morbid conditions than the male patients (75/202) [5]. This proves that females are more prone to diseases and thus require more number of drugs to be treated accordingly although they have a low mortality rate (Table 1 and Figure 1).

Table 1. *Number of diseases/comorbid conditions amongst hospitalized patients.*

Diseases	Number of diseases/comorbid conditions
Males	75
Females	127
Total	202

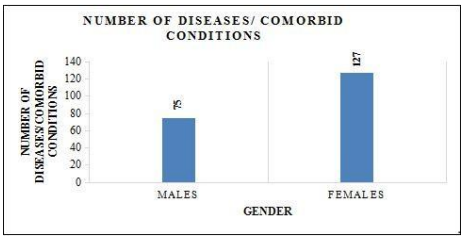

Figure 1. *Number of diseases/comorbid conditions amongst hospitalized patients.*

Number of prescriptions according to gender

We observed the distribution of number of prescriptions according to age in which out of 100 patients 64% (64/100) of the females and 36% (36/100) of the males had received prescriptions (Table 2 and Figure 2).

Table 2. *Number of prescriptions according to gender.*

Gender	Total number of prescriptions
Males	36
Females	64

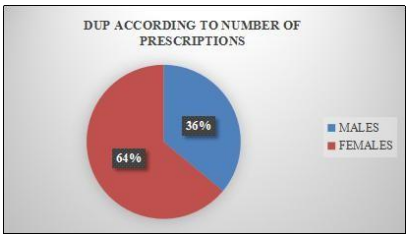

Figure 2. *Number of prescriptions according to gender*.

Total number of drugs used according to gender

We observed the drug distribution according to gender in which females were prescribed 61% (526/859) of the drugs and males were prescribed 39% (333/859) of the drugs (Table 3 and Figure 3) [6].

Table 3. *Total number of drugs used according to gender.*

Gender	Total number of drugs used
Males	333
Females	526

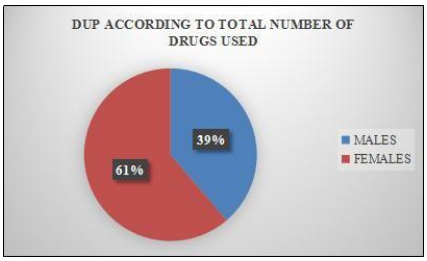

Figure 3. *Total number of drugs used according to gender.*

Drug usage pattern according to age group

We observed that as the age of the patients increased, the prescribed number of drugs also increased almost linearly (within limits of 5-15% of experimental error). The greatest number of drugs prescribed were noticed in the age group of 61-70 years (181), followed by the age group of 51-60 years (165) and 41-50 years (144). Geriatric patients are more susceptible to co-morbid conditions including renal impairment, and were thus prescribed more number of drugs (Table 4 and Figure 4).

Table 4. *Drug usage pattern according to age group.*

Age (in years)	Total number of prescriptions	Total number of drugs used
44136	4	15
21-30	17	148
31-40	16	126
41-50	16	144
51-60	21	165
61-70	18	181
71-80	5	54
81-90	3	26

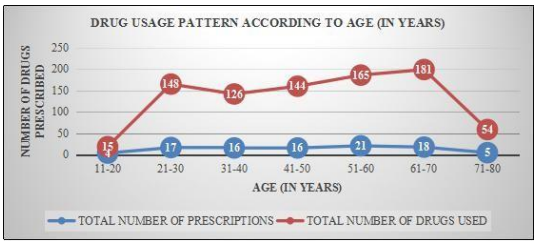

Figure 4. *DUP according to age group.*

Drug usage pattern according to therapeutic class of drugs

It was found that the highest number of drugs prescribed belonged to cardiovascular class (32.7%) (F: 144, M: 137), followed by supplements (17.5%) (F: 99, M: 55), gastrointestinal agents (14.4%) (F: 70, M: 54), antibiotics (5.82%) (F: 30, M: 20), NSAIDs (5.70%) (F: 40, M: 9), laxatives (3.25%) (F: 11, M: 17), antidepressants and anxiolytics (3.02%) (F: 22, M: 4), hypoglycaemic agents (2.91%) (F: 17, M: 8), antihistamines (2.56%) (F: 20, M: 2), respiratory agents (1.39%) (F: 10, M: 2) and others (10.24%), (F: 63, M: 25) (Table 5 and Figure 5).

Table 5. *Drug usage pattern according to therapeutic class of drugs.*

Therapeutic class	Others	Respiratory agents	Antihistamines	Hypoglycemic agents	Antidepressants and anxiolytics	Laxatives	Nsaids	Antibiotics	Gi agents	Supplements	Cvs agents
Females	63	10	20	17	22	11	40	30	70	99	144
Males	25	2	2	8	4	17	9	20	54	55	137
Total	88	12	22	25	26	28	49	50	124	154	281

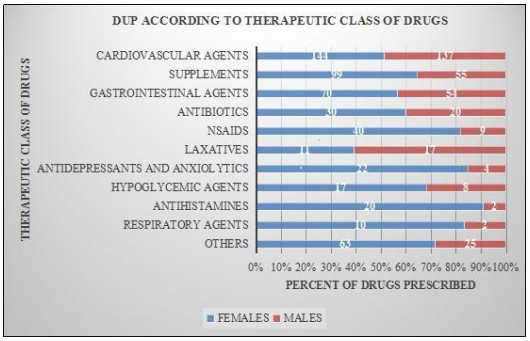

Figure 5. *DUP according to therapeutic class of drugs.*

Drug usage pattern according to cardiovascularagents

We observed that the highest number of drugs prescribed belonged to anticoagulants (31.32%) (F: 46, M: 42), followed by anti-hyperlipidemics (16.01%) (F: 20, M: 24), diuretics (15.66%) (F: 20, M: 24), β blockers (11.7%) (F: 18, M: 15), CCBs (6.40%) (F: 6, M: 12), vasodilators (4.27%) (F: 8, M: 4), ARBs (3.91%) (F: 6, M: 5), α agonists (3.56%) (F: 4, M: 6), ACE inhibitors (2.49%) (F: 4, M: 3), cardiac glycosides (2.13%) (F: 1, M: 5) and others (2.49%) (F: 3, M: 4) (Table 6 and Figure 6).

Table 6. *Drug usage pattern according to cardiovascular agents.*

Cvs agents	Anti coagulants	Diuretics	Anti hyperlipidemics	B blockers	Ccbs	Arbs	Agonists	Vasodilators	Ace inhibitors	Cardiac glycosides	Others
Females	46	20	28	18	6	6	4	8	4	1	3
Males	42	24	17	15	12	5	6	4	3	5	4
Total	88	44	45	33	18	11	10	12	7	6	7

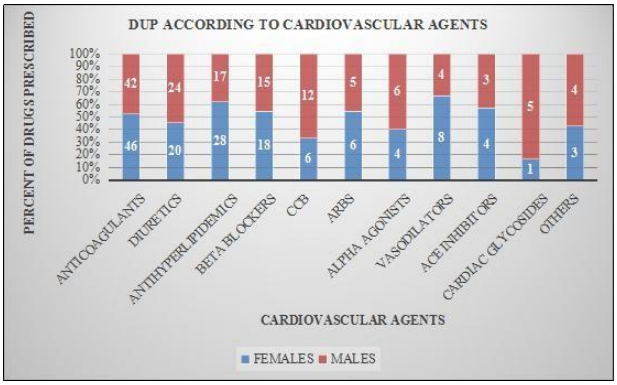

Figure 6. *DUP according to cardiovascular agents.*

Distribution of antibiotics

We found that the highest prescribed class of antibiotics belonged to macrolides (26%) (F: 9, M: 4) followed by quinolones (22%) (F: 3, M: 8), cephalosporins (20%) (F: 6, M: 4), penicillins (13%) (F: 3, M: 3), urinary antiseptics (13%) (F: 6, M: 1) and anti TB agents (6%) (Table 7 and Figure 7).

Table 7. *Distribution of antibiotics.*

Antibiotics	Macrolide	Quinolones	Cephalosporins	Penicillin	Urinary antiseptics	Anti tb agents
Females	9	3	6	3	6	3
Males	4	8	4	3	1	0
Total	13	11	10	6	7	3

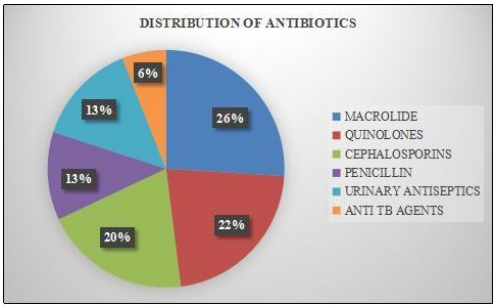

Figure 7. *Distribution of antibiotics.*

Drug usage pattern according to drug excretion

We found that maximum number of prescribed drugs had the renal route of elimination (729/859) (F: 444, M: 285), followed by faecal (130/859) (F: 79, M: 51) and hepatic (90/859) (F: 62, M: 28) (Table 8 and Figure 8).

Table 8. *Drug usage pattern according to drug excretion.*

Drug excretion	Renal	Faecal	Hepatic
Females	444	79	62
Males	285	51	28
Total	729	130	90

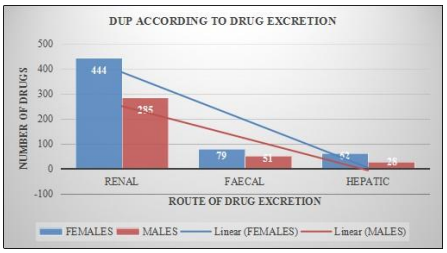

Figure 8. *DUP according to drug excretion.*

Drug usage pattern according to duration of therapy

We observed that, the number of drugs gradually decreased (non-linearly) as the hospital stay of the patients increased. The number of drugs prescribed in 0-5 days were the highest (295) (F: 191, M: 104), followed by that of 6-10 days (231) (F: 125, M: 106), 11-15 days (98) (F: 68, M: 30), 16-20 days (34) (F: 27, M: 7), 21-25 days (20) (F: 12, M: 8) and 26-30 days (14) (F: 3, M: 11) [7]. This meant that a greater number of drugs were prescribed on the initial days of hospital stay thus exposing the patients to a greater number of adverse drug events from the precipitating polypharmacy which has a higher probability of resulting into PDDIs (Table 9 and Figure 9).

Table 9. *Drug usage pattern according to duration of therapy.*

Duration of therapy (in days)	0-5	44475	42309	16-20	21-25	26-30
Males	104	106	30	7	8	11
Females	191	125	68	27	12	3
Total	295	231	98	34	20	14

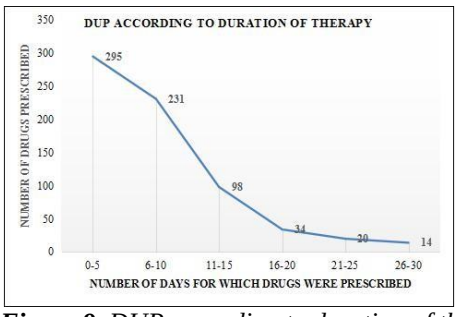

Figure 9. *DUP according to duration of therapy.*

DDIs according to gender

We found that females (54%) (100/186) are more prone to DDIs than males (46%) (86/186) (Table 10 and Figure 10) [8].

Table 10. *DDIS according to gender.*

Gender	Number of drug-drug interactions
Males	86
Females	100

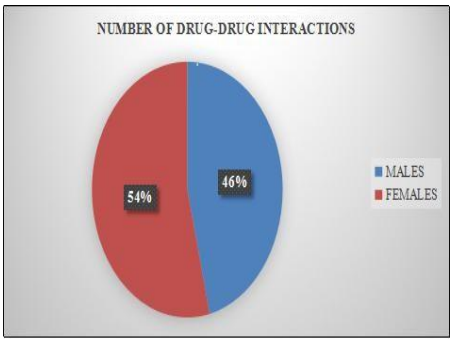

Figure 10. *DDIs according to gender.*

DDIs according to age group

We found that the age group most prone to DDIs was 51-60 years (47/186), followed by 61-70 years (43/186) and 41-50 years (31/186). This is because at this age the cardiovascular functions and the ejection fraction of the heart start declining which requires aggressive therapeutic measures to prevent mortality of the patients [9]. Also, the renal function decreases which can adversely affect the patients most of the drugs that are administered to them are excreted through the kidney. Hence such patients must be monitored very cautiously so as to prevent any adverse events (Table 11 and Figure 11).

Table 11. *DDIS according to age group.*

Age (years)	Number of drug-drug interactions
21-30	26
31-40	23
41-50	31
51-60	47
61-70	43
71-80	11
81-90	5

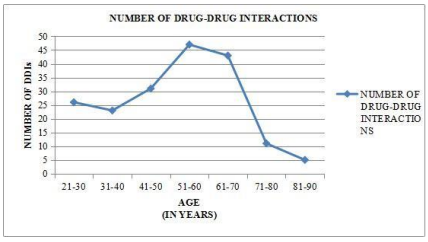

Figure 11. *DDIs according to age group.*

Discussion

In our study the total number of drugs in 100 prescriptions was 859. The average number of drugs/prescriptions is 8.70 indicating polypharmacy [10]. The same was higher as reported. This number is higher than the recommended limit which is 2.0. This may be due to indefinite diagnosis and unreasonable demands by patients. The promptness from personal gain from incentives given by pharmaceutical companies to doctors may also account for this phenomenon. Increase in the number of average drugs per prescription may augment the probability of drug interactions, may bring about unnecessary side effects and also intensifies the prescribing and dispensing errors. This is an important indication that educational intervention of the principles of rational pharmaco therapeutic needs to be introduced.

The link between the number of diseases and high-level polypharmacy is likely due to multiple diagnoses (e.g., cardiovascular diseases, diabetes mellitus, and chronic lung diseases) that pose several therapeutic challenges secondary to a variety of complications. In addition to anti-anginals, concurrent administration of anti-hypertensives, anti-diabetics, and lipid-lowering agents for cardiovascular risk reduction might predispose patients with angina to high-level polypharmacy [11].

Analysis according to gender showed that female patients visited the hospital more (64%) than the male patients (36%). And therefore, they were prescribed with more drugs (61%) than the male patients (39%). More number of female visits, chiefly housewives has been documented in preceding studies. Also, many patients from neigh boring villages visit the hospital among which the female population, being not as much well-read, is ignorant about their health and hygiene thus making them more prone to infections. These factors might also have contributed to a higher number of female visitors to the hospital.

This study showed that prescribed number of drugs increased as the age of the patient increased. The most number of drugs (181) prescribed were noticed in the age group of 61-70 years. Geriatric patients are more prone to co-morbid conditions including renal impairment. This can be the reason geriatric patient were prescribed more number of drugs [12].

In contrast, since the medical department came across maximum number of prescriptions with a greater number of drugs prescribed for chronic clinical conditions like hypertension and diabetes, the patients can require more drugs than that stated by the WHO. In such cases polypharmacy is tolerable. In our study, we observed that the highest number of prescribed drugs belonged to cardiovascular agents (32.7%) in that out of 281 drugs, 144 drugs were prescribed in females and 137 drugs in males, followed by supplements (17.5%) in that out of 154 drugs, 99 drugs prescribed in females and 55 drugs in males. In the cardiovascular class of drugs, we have found that the highest number of drugs prescribed belonged to anticoagulants (31.32%) [13].

In our study, we found that 5.82% of antibiotics were prescribed. Appropriate use of antibiotics is absolutely necessary to prevent emergence of drug resistance and should be mostly used after culture sensitivity testing [14]. Most of the acute respiratory and acute gastroenteritis cases are viral in nature and may not require antibiotics. An antibiotic policy should be formulated so that the clinicians can use them judiciously according to patient need.

In our study, the most prescribed class of antibiotics was macrolides (26%). This finding differs from the study where they found out the most prescribed class of antibiotics was penicillin. Macrolide antibiotics were prescribed at large. We did not explore the appropriateness of the prescription, but the frequent use of high-end antibiotics seems detrimental to health care setup.

Out of 100 prescriptions, DDIs were found in 69 prescriptions and they were not found in the remaining 31 prescriptions. P-value of 2-tailed Chi-squared test was found to be 0.0001 (<0.05%), which portrays a significant correlationship between polypharmacy and DDIs.

The escalating drift of polypharmacy and the perceptible drug-drug interactions in indoor patients calls for an interventional study and careful monitoring of patients to reduce the number of adverse outcomes and enhance patient safety [15]. Also elaborate studies on high risk patients are needed. Proper DDI identification and management system are lacking in most of the hospitals which contribute to this high prevalence of polypharmacy and DDIs.

Conclusion

A Clinical Decision Support System (CDSS) can be implemented to prevent such DDIs. Therefore, it is necessary to set up policies in order to control polypharmacy and hence curb the effects of DDIs, resulting in better patient safety. Also, such policies must be amended periodically to promote and improve the medication reconciliation process and patient safety.

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