Original Article

Cost-saving medication therapy management for outpatients

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Abstract

Objective: Medication costs comprise the majority of health system budgets and continue to increase faster than other health-care expenditures. The objective of this study is to evaluate the causes and monetary value of cost-saving prescription interventions made by clinical pharmacists in outpatient pharmacy.

Materials and Methods: Outpatient prescriptions were randomly audited for a period of 11 months (August 2017–June 2018) using a customized outpatient prescription audit tool integrated with computerized physician order entry. Drug-related problems were communicated to respective prescribers, and their response to each intervention was documented in accordance with PCNE classification. Both unit dose cost and anticipated dose cost savings were calculated to evaluate the monetary benefit for patients.

Results: Unit dose cost of INR 4875.73 and anticipated dose cost of INR 26890.8 were saved from outpatients. Majority of the prescribing errors were associated with therapeutic duplication (43.4%) and drug interaction (25.7%) that account for anticipated dose cost savings of INR 17812.65 for patients. Major contributory drug classes that reduced the cost of therapy were antibiotics (24.23%), proton-pump inhibitors (13.27%), and analgesics (12.34%). Prescribers' response to pharmacist intervention varied, 53% responded to stop the drug, 21% responded to change the brand, and 20% changed the frequency of administration. Necessary instructions were verbally given to patients without making any modification in the prescription for 3.2% ($n = 10$) of cost-saving interventions.

Discussion and Conclusion: As clinical pharmacist has the expertise to detect, resolve, and prevent medication errors, the development of clinical pharmacy practice in a hospital outpatient pharmacy will have a significant impact on reducing prescription errors and health-care cost also.

Keywords: Anticipated dose cost, clinical pharmacist, cost-saving interventions, outpatient prescription errors, prescription audit tool, unit dose cost

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INTRODUCTION

Inpatient medication-ordering errors occur at rates as high as 1.5–5.3 per 100 orders or 1.4 errors per admission. However, limited evidence is available regarding the outpatient medication errors, in terms of their frequency, impact, and the role of clinical pharmacist in preventing them, using computerized physician order entry (CPOE).[1]

Once a prescription is made, a variety of factors may intervene between the intended prescription and administration of medication, resulting in alteration in the dose, timing, frequency of administration, and even the identity of

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the drug. Such circumstances remain unrecognized in the absence of proper monitoring process.[2]

Medication errors are associated with significant amount of additional costs, even without patient harm. Considering the substantial cost associated with medication errors, the elimination or reduction of medication errors should be further emphasized and promoted.[3] Among medication errors, prescribing errors account for a large proportion. Prescribing is a process whereby a doctor, nurse, or other registered professionals authorize the use of medications or treatments for a patient and provides instructions about how and when those treatments should be used.[4]

Pharmacist intervention has been reported to improve the quality of medication use process and disease management through effective interaction with both patients and other health-care professionals. Clinical pharmacists' intervention is a proven and effective method to mitigate outpatient prescription errors.[5] Reduction of error-related cost is a key potential benefit of interventions related to medication errors.[6] Medication error also leads to substantial cost between US $ 6 billion and US $ 29 billion per year. Furthermore, it may lead to prolongation of hospital stay by 2 days that causes an additional burden of $ 2000 to $ 2500 per patient. Several studies have demonstrated that the specific interventions in the medication order and processing might reduce the risk of errors, but many hospitals have no system for recording medical errors; thus, these errors remain underreported across health-care organizations.[7] Medication error reporting process to relevant authorities will help to evaluate the causes or create process to reduce the risk in the future.

Electronic prescribing was defined as the clinicians computerized ordering of specific medication regimens for individual patients. Electronic prescribing offers the potential to substantially reduce medication errors and also to improve health-care efficiency. However, some electronic prescribing efforts have met unexpected challenges and faced uncertainties.[8] However, electronic prescribing will make a monitoring platform for the pharmacist, to identify potential prescription errors.

MATERIALS AND METHODS

This was a prospective cohort study conducted in the outpatient pharmacy of Aster Medcity Hospital, a quaternary care hospital serving both inpatients and outpatients. Prescriptions generated via CPOE at outpatient pharmacy were randomly selected and audited by two clinical pharmacists from August 2017 to June 2018. Institutional Scientific Committee approved this study, and information related to patients and physicians remained confidential.

Clinical pharmacists audited the prescription as and when it was generated, and no selection criteria were used to select the prescription for auditing. All drug-related problems (DRPs) associated with the audited prescriptions were communicated to the physician via telephone, by the clinical pharmacists. If the prescriber accepted the intervention and modified the prescription, it was considered as a prescription with DRP, and the cost saved for each such medication was documented under the respective cause. Unit dose cost (cost of a tablet or vial) alone is inadequate for comparison because the unit dosage or treatment duration or mode of administration to achieve the same clinical outcome will not be the same for different medicines; hence, both the unit dose cost and anticipated dose cost (cost for prescribed course of treatment if continued) were calculated to estimate the cost savings. Unit dose cost of each drug was collected from outpatient bill generated against respective drug for the patient.

Possible causes for DRPs in prescription were categorized according to PCNE classification for DRPs.[9] [Table 1].

Data analysis

Categorical and continuous variables are presented as numbers and percentages. Data were collected using random sampling method without prespecified sample size calculation, and variables were statistically evaluated using Fisher's exact test and Chi-square test. For the inferential statistical tests applied, $P < 0.05$ will be considered as of nominal significance, and any such evidence will be considered as hypothesis generating only. Analysis was performed with Minitab LLC, Pennsylvania, USA.

RESULTS

General data

A total of 20281 outpatient prescriptions were reviewed in this study, from August 2017 to June 2018. During this period, 310 medication errors were reported, of which 112 (36.1%) were found to be cost saving for patients. The percentage of sampling varied from 9% to 32% [Table 2].

Cost-saving interventions by clinical pharmacists

Total savings in anticipated dose cost of INR 26890.8 and in unit dose cost of INR 4875.73 were estimated. Anticipated dose cost savings were majorly observed in interventions found to be comparatively high in interventions for inappropriate duplication of therapeutic group (43.4%)

Table 1: Pharmaceutical Care Network Europe classification scheme for drug-related problems V8.0 - the causes (including possible causes for potential problems)

	Primary domain	Code V8.01	Cause
Prescribing	1. Drug selection The cause of the (potential) DRP is related to the selection of the drug	C1.1	Inappropriate drug according to guidelines/formulary
		C1.2	Inappropriate drug (within guidelines but otherwise contraindicated)
		C1.3	No indication for drug
		C1.4	Inappropriate combination of drugs or drugs and herbal medication
		C1.5	Inappropriate duplication of therapeutic group or active ingredient
		C1.6	No drug treatment in spite of existing indication
		C1.7	Too many drugs prescribed for indication
	2. Drug form The cause of the DRP is related to the selection of the drug form	C2.1	Inappropriate drug form (for this patient)
	3. Dose selection The cause of the DRP is related to the selection of the dose or dosage	C3.1	Drug dose too low
		C3.2	Drug dose too high
		C3.3	Dosage regimen not frequent enough
		C3.4	Dosage regimen too frequent
		C3.5	Dose-timing instructions wrong, unclear, or missing
	4. Treatment duration The cause of the DRP is related to the duration of treatment	C4.1	Duration of treatment too short
		C4.2	Duration of treatment too long
Dispensing	5. Dispensing The cause of the DRP is related to the logistics of the prescribing and dispensing process	C5.1	Prescribed drug not available
		C5.2	Necessary information not provided
		C5.3	Wrong drug, strength, or dosage advised (OTC)
		C5.4	Wrong drug or strength dispensed
Use	6. Drug use process The cause of the DRP is related to the way the patient gets the drug administered by a health professional or carer, despite proper dosage instructions (on the label)	C6.1	Inappropriate timing of administration and/or dosing intervals
		C6.2	Drug underadministered
		C6.3	Drug overadministered
		C6.4	Drug not administered at all
		C6.5	Wrong drug administered
	7. Patient related The cause of the DRP is related to the patient and his behavior (intentional or nonintentional)	C7.1	Patient uses/takes less drug than prescribed or does not take the drug at all
		C7.2	Patient uses/takes more drug than prescribed
		C7.3	Patient abuses drug (unregulated overuse);
		C7.4	Patient uses unnecessary drug
		C7.5	Patient takes food that interacts
		C7.6	Patient stores drug inappropriately
		C7.7	Inappropriate timing or dosing intervals
		C7.8	Patient administers/uses the drug in a wrong way
		C7.9	Patient unable to use drug/form as directed
	8. Other	C8.1	No or inappropriate outcome monitoring (including Therapeutic Drug Monitoring)
		C8.2	Other cause; specify
		C8.3	No obvious cause

PCNE=Pharmaceutical Care Network Europe, DRP=Drug-related problem, OTC=Over the counter, TDM=Therapeutic drug monitoring

and for inappropriate combination of drugs (25.7%); these accounted for savings of INR 17812.65. Unit dose cost saving of INR 2816.94 resulted from interventions for unindicated drugs (3.5%) and for inappropriate duplication of drugs. From the Chi-square test, drug selection, dose selection, and treatment duration domains were statistically significant in reduction of unit dose cost and anticipated dose cost for patients at $P < 0.01$ [Table 3].

Drug class involved in cost-saving interventions

Drugs involved in cost-saving interventions were classified according to their pharmacological category. Gastrointestinal regulators, antacids, and vitamins were the major pharmacological drug classes, which contributed to cost savings of INR 7401.33, INR 3350.69, and INR 3245.78, respectively [Table 4].

Prescribers' response to cost-saving interventions

Prescribers make necessary changes in the prescriptions, as and when they receive information from the clinical pharmacists regarding the interventions. Fifty-three percent of prescribers responded by stopping the drugs from the prescription, 21% by changing the brand name with another therapeutic equivalent brands, and 20% by changing the frequency [Figure 1]. Figure 2 describes the causes of each cost-effective error and respective response received from prescribers. For 3.2% ($n = 10$) of cost-saving prescription interventions, instructions were

Table 2: General data of the reviewed prescriptions

Prescription review	August	September	October	November	December	January	February	March	April	May	June
Prescription audited	1205	815	1137	2806	2683	3065	2676	1354	1402	2014	1124
Percentage sampling	12	9	12	29	30	32	30	14	15	22	13

Gender and age distribution	Medication errors, *n* (%)	Cost effective interventions, *n* (%)	*P*
Gender			
Male	123 (39.6)	49 (43.7)	0.452
Female	187 (60.3)	63 (56.2)	
Age group			
1-20	29 (9.03)	6 (5.3)	<0.001
21-40	106 (34.1)	31 (27.6)	
41-60	95 (30.6)	35 (31.2)	
61-80	78 (24.8)	38 (33.9)	
81-100	2 (0.64)	2 (1.7)	

There is no significant difference in distribution of medication errors and cost-saving interventions among males and females, but different age groups have shown significant impact on both medication errors and cost-saving interventions at $P<0.001$

Table 3: Anticipated and unit dose cost saved for drug-related problems

Primary domain	Causes (%)	Unit dose cost saved (INR)	Anticipated dose cost saved (INR)	*P*
Drug selection	C1.2 (1.8)	54.26	401.2	<0.001
	C1.3 (3.5)	1503.14	2404.39	
	C1.4 (25.7)	583.81	3694.78	
	C1.5 (43.4)	1313.94	14,117.87	
Dose selection	C3.1 (0.9)	1075	1075	<0.001
	C3.2 (12.4)	162.4	2764.17	
	C3.4 (8.8)	134.89	2028.27	
	C3.5 (0.9)	23.63	94.52	
Treatment duration	C4.1 (0)	0	0	<0.001
	C4.2 (1.8)	24.66	310.6	

C1.2=Inappropriate drug (within guidelines but otherwise contraindicated), C1.3=No indication for drug, C1.4=Inappropriate combination of drugs, C1.5=Inappropriate duplication of therapeutic group or active ingredient, C3.1=Drug dose low, C3.2=Drug dose high, C3.4=Dosage regimen too frequent, C3.5=Dose-timing instructions wrong, unclear, or missing, C4.1=Duration of treatment too short, C4.2=Duration of treatment too long, INR=International normalized ratio

Table 4: Pharmacological category of drugs reported with cost-saving interventions

Pharmacological category	Number of errors (%)	Saved anticipated dose cost
GI regulators	40 (35.4)	7401.33
Antacids	23 (20.4)	3350.69
Flavanoids	1 (0.9)	393
Antibiotics	9 (8)	2235.05
Antiplatelet	5 (4.4)	256.74
Dyslipidemic agents	1 (0.9)	588.3
Antiplatelet dyslipidemic agent combination	2 (1.8)	1728.4
Antianginal	2 (1.8)	419.3
Anxiolytics	2 (1.8)	18.62
Antispasmodics	2 (1.8)	98.54
Vitamins	7 (6.2)	3245.78
Antihistamines	4 (3.5)	1268.8
Nasal decongestants	3 (2.7)	844.26
Antiemetics	1 (0.9)	69.02
Antifungals	1 (0.9)	188.4
Drugs for bladder dysfunction	1 (0.9)	118
Corticosteroids	2 (1.8)	1468.69
Drugs for neuropathic pain	1 (0.9)	378
Nonsteroidal anti-inflammatory agents	2 (1.8)	66.08
Laxatives	1 (0.9)	316
Anticonvulsant	1 (0.9)	37.8
Others	2 (1.8)	2395

Drugs were classified according to CIMS pharmacological category. CIMS=Current Index of Medical Specialities, GI=Gastrointestinal

given to patients to make change in the administration timing of interacting drugs ($n = 6$), to take both therapeutic equivalent drugs if symptoms not subsided during the course of therapy ($n = 2$) and to take the prescribed drug on whenever needed basis for drugs prescribed with long duration ($n = 2$).

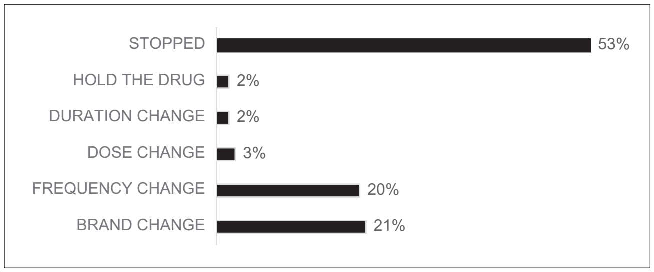

Figure 1: 94% of prescribers responded by either stopping the brand with reported intervention or changing the frequency of brand of reported drugs

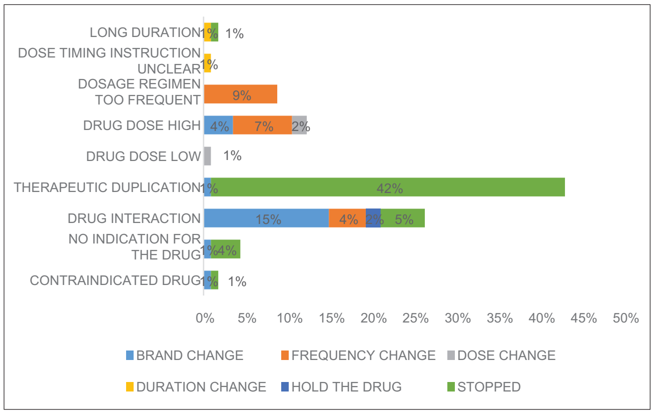

Figure 2: Bar diagram of prescribers varying response to each causes of drug-related problems according to PCNE classification

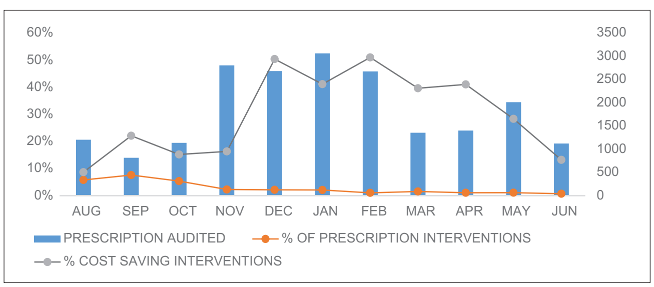

Figure 3: Of 20,281 prescriptions audited by the clinical pharmacists, percentage of total prescription interventions reduced to 1%–2%, but cost-saving interventions varied on each month

Clinical pharmacists' intervention reduced the prescription errors

With the intervention of pharmacists, the number and percentage of prescription interventions and cost-saving interventions among the prescriptions varied from August 2017 to June 2018. DRPs associated with the outpatient prescriptions were decreased from 6%–7% to 1%–2% [Figure 3]. Reported errors were prevented by clinical pharmacist before the drugs reached the patients.

DISCUSSION AND CONCLUSION

In the present study, we demonstrated that in addition to monitoring and prevention of medication errors for outpatients, clinical pharmacist can also play an important role in reducing prescription cost related to these errors. Therapeutic duplication and drug interaction lead to majority of electronic prescription errors for outpatients.

PCNE classification was used to address DRPs associated with outpatient medication errors in our study. Another commonly used approach is based on the classification of the stages of medication use, such as prescribing, transcribing, dispensing, administration, and monitoring. Another approach is to classify errors according to their types, such as wrong medication, dose, frequency, administration route, or patient. A further approach is to classify errors based on physiological principles, including knowledge based or rule based, action based, and memory based or lapses.[10] These classifications do not specifically address the underlying cause of commonly encountered outpatient errors, which occurred during drug prescription process in the present study.

Direct cost of INR 26,890.8 was saved from 112 number of outpatient prescriptions in our study. An 18-month study at nephrology ward in Iran estimated that clinical pharmacist interventions decreased patients' direct medication cost by 4.3%.[11] A model-based estimate study conducted in India revealed that the cost of universal health-care delivery through the existing mix of private and public health institutions would be INR 1713 per person per annum in India; this cost would be 24% higher if branded drugs were used.[12] Another study analyzed a 9-year data and found a 42% decrease in drug cost compared with a control group, reflecting a saving of US $ 225,000.[13] Treatment cost attributable to medication errors were in the range of $ 8.439 using the Blinder–Oaxaca decomposition method and $ 8898 using the recycled prediction method.[3]

In our study, 69.9% of errors in the electronic prescription were due to therapeutic duplication and drug interaction. A study conducted by Wetterneck *et al.* concluded that the duplicate medication order errors increased with CPOE and clinical decision support (CDS) implementation, if the multiple factors contributing to the risk of these errors are not anticipated or cannot be resolved before implementation. Effectiveness of CDS in the future will depend not only on the design and implementation of the functionality but also on consideration of changes to the work system in which it is implemented.[14] Another study on the analysis of outpatient prescriptions and pharmaceutical intervention demonstrated that among 22,279 prescriptions, 247 interventions were detected. Of these interventions, 27.6% were related to problems concerning the dosage, 15.4% to unconformity, and 6.9% to contraindications.[15] Electronic prescribing and computerized decision support have been studied extensively, but the findings are mixed. Some studies suggest that computerized tools can reduce prescribing errors, but some suggest negative consequences. Emerging evidence suggests that the involvement of human factors on workflow features, tool design, and context needs to be considered for successful implementation.[4]

About 27.4% of the cost was saved from prescriptions of gastrointestinal regulators and 12.4% with antacids and vitamins in this study. A descriptive study was conducted by Machado-Alba *et al.* in ambulatory pharmacies, in which errors were detected through an electronic surveillance system and then reviewed by a pharmacist. The study reported errors to the extent of 55% during dispensing process and 40.1% in prescription. Errors in medication name, concentration, dosage form, and quantity were the most common prescription errors. Multivariate analysis indicated that administration, dispensation, transcription processes, sensory organ medications, antibacterial for systemic use, wrong medication name, and concentration were significantly associated with the risk of medication errors (Categories B–I according to NCCMERP categorization of medication errors).[16]

A study has reported a prescriber approval rate of 47.2%, denial rate of 16.5%, and no response for 36.3%, for valid medication recommendations from pharmacists. It was found that prescribers' approval was significantly high for cost-saving interventions when compared with guideline adherence interventions and safety interventions.[17] Another study reported that pharmacists and doctors (11.7% and 17.1%) were afraid of committing medication errors to patients or worried about patient discovering the error (5.3% and 5.7%). This study concluded a lack of mutual trust on the competency of doctors and pharmacists as experts in DRPs as well as poor patient relationship.[18]

Even though the results of this study are informative and represents the outcome of a real-time intervention, patients provided with verbal instructions instead of making changes in the prescriptions (3.2% of cost-saving prescriptions) may lead to errors for those patients who are having memory lapses or not clear about the verbal instructions given by the prescriber.

High prevalence of medication errors and inappropriate prescription is a major issue in outpatients that can often lead to adverse drug events. Patients are likely to see multiple doctors per encounter or admission; hence, clinical pharmacists can act as final interceptors in detecting medication errors before they reach the patients. More research needs to be carried out on outpatient prescription errors and cost-effective medication management plan for outpatients, as it shall have a positive impact in reducing the burden of total health-care costs, especially in a developing country like India

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Conflicts of interest

There are no conflicts of interest.

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