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Original Research Article

Assessment of medication errors and prescribing patterns in orthopaedic inpatients at a tertiary care hospital

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ABSTRACT

Background: The objectives of the study were to assess medication errors and prescribing patterns among orthopaedic inpatients at a tertiary care hospital and evaluate compliance with National Accreditation Board for Hospitals (NABH) medication safety standards across prescribing, transcribing, dispensing, and administration processes.
Methods: A cross-sectional observational study was conducted over six months in the Orthopaedic Department of a tertiary care teaching hospital. A total of 110 case records were reviewed. Medication errors were identified using NABH standards, including prescription, transcription, dispensing, and administration errors. Errors were further classified based on severity using the NCC MERP index. Data were analyzed using appropriate statistical methods.
Results: Among 21,312 medication-use opportunities evaluated, 750 medication errors were identified (overall error rate 3.52%). Prescription errors were most frequent (599;7.78%), followed by transcription (122;6.87%), dispensing (23;0.55%), and administration errors (6; 0.08%). Common prescribing errors included non-use of generic names (51.6%), omission of dosage (13.5%), and inappropriate capitalization (8.0%). Most errors were of minor to moderate severity and unlikely to cause direct patient harm. Antibiotics and non-steroidal anti-inflammatory drugs were the most commonly implicated drug classes.
Conclusion: Medication errors were predominantly related to prescribing practices. Strengthening prescription protocols, encouraging generic prescribing, and implementing regular pharmacist-led audits can enhance medication safety and improve compliance with NABH standards.

Keywords: Medication errors, Orthopaedic surgery, Patient safety, Prescribing patterns, Medication safety, NABH

INTRODUCTION

Medication errors are preventable events that may lead to inappropriate medication use or patient harm while the medication is under the control of healthcare professionals, patients, or consumers. These errors may occur at any stage of the medication-use process, including prescribing, transcribing, dispensing, administration, and monitoring. Among these, prescribing errors are particularly important because they often represent the earliest point at which an error can occur and may subsequently propagate throughout the medication-use chain.[1,2]

Medication errors are linked to higher rates of morbidity, longer hospital stays, and higher healthcare costs, and they continue to be a major global patient safety concern. The "Medication Without Harm" campaign was started by the World Health Organization (WHO) in an effort to lessen severe avoidable medication-related injury worldwide after the WHO identified medication-related harm as a significant public health issue.[3] Medication errors are a

significant burden in both inpatient and outpatient settings, according to research from India and other nations.[4-6] One of the most prevalent types of medication errors are prescribing errors, which include failing to prescribe by generic name, choosing the wrong medication, using dangerous abbreviations, omitting important prescription details, and using illegible handwriting. These mistakes could have a negative impact on treatment results and jeopardize patient safety.[7,8]

Due to frequent use of several drugs, including analgesics, antibiotics, anticoagulants, proton pump inhibitors, and supportive therapy, orthopaedic inpatients constitute a particularly vulnerable population. Drug errors are more likely to occur in patients with polypharmacy, extended hospital stays, perioperative drug changes, and numerous care transitions. Studies on drug usage and prescription audits in orthopaedic settings have shown how important it is to continuously monitor prescribing procedures in order to encourage rational drug use and enhance patient safety.[9,10]

The national accreditation board for hospitals and healthcare providers (NABH) has established comprehensive medication management and use requirements to ensure that drugs are prescribed, dispensed, administered, and monitored safely. The recently released sixth iteration of NABH guidelines emphasizes prescription auditing, pharmaceutical safety, generic prescribing, medication reconciliation, and continuous quality-improvement initiatives.[11] Recent prescription-audit investigations conducted in conformance with NABH rules have revealed significant gaps in prescription completeness and compliance, highlighting the need for continuous monitoring and preventive and corrective measures.[12]

Studies on drug use and prescription audits carried out in teaching hospitals in India have shown how beneficial regular prescription reviews are for spotting illogical drug prescribing practices and enhancing medication safety.[13] René Therefore, discovering system flaws and creating focused interventions to enhance patient safety and quality of life need ongoing medication mistakes and the evolution of prescribing trends.

The present study was undertaken to assess medication errors and prescribing patterns among orthopaedic inpatients at a tertiary care teaching hospital and to evaluate compliance with NABH medication safety standards across prescription, transcribing, dispensing, and administration processes.

METHODS

Study design and setting

This cross-sectional observational study was conducted in the orthopaedics inpatient department of a tertiary care teaching hospital at Integral Institute of Medical Sciences and Research, Integral University, Lucknow, India.

This study was designed as a cross-sectional observational study conducted in the orthopaedic department of a tertiary care teaching hospital. The study was reported in accordance with the strengthening the reporting of observational studies in epidemiology (STROBE) guidelines.

Study duration

The study was carried out over six months (October 2024 to March 2025).

Study population and sample size

A total of 110 patients were included. Sample size was calculated using the formula.

$$n = (Z^2pq)/d^2$$

At 95% confidence level and 5% margin of error, the calculated sample size was 382. After finite population correction (N=150), it was reduced to 108 and rounded to 110.

Selection criteria

Inclusion criteria

Patients of all age groups and both genders admitted during the study period.

Exclusion criteria

Non-consenting/non-cooperative patients, history of drug abuse, and incomplete case records.

Source of data

Patient IPD case records and patient/attendant interviews.

Data collection procedure

Data were collected using a structured form including demographic details, clinical history, and medication-related information (prescriptions, indent slips, pharmacy bills).

Medication chart review (NABH-based)

Medication charts were reviewed using a structured checklist based on NABH medication safety standards.[9] Errors were categorized as doctor-related errors: incorrect drug selection; missing/incorrect dose, frequency, route; illegible handwriting; non-standard abbreviations; non-use of generic names; drug interaction oversight, transcription errors (doctor/nurse): incorrect drug, strength, or

formulation during order transfer, pharmacist-related errors: wrong drug/strength/formulation; expired drugs; labeling errors; delay or unauthorized substitution, nurse-related errors: wrong patient, dose omission, incorrect dose, route, timing, rate, or documentation errors, medication error categorization and, medication errors were classified as: no harm: category A–D, harm: category E–H and death: category I.

Types of medication errors

Prescription errors (opportunities 1–13)

Prescription errors are failures in the prescribing process leading to inappropriate or incomplete medication orders, such as incorrect drug selection or omission of dose, frequency, or route.[11]

$$Prescription\ error\ (\%) = number\ of\ prescription\ errors / total\ prescription\ opportunities \times 100$$

Transcription errors (opportunities 14–16)

Transcription errors occur during the transfer or interpretation of medication orders and may result in incorrect drug name, dose, formulation, or frequency.[11]

$$Transcription\ error\ (\%) = number\ of\ transcription\ errors / total\ transcription\ opportunities \times 100$$

Dispensing errors (opportunities 17–23)

Dispensing errors arise when there is a discrepancy between the prescribed and dispensed medication, including wrong drug, dose, formulation, or labeling.[11]

$$Dispensing\ error\ (\%) = number\ of\ dispensing\ errors / total\ dispensing\ opportunities \times 100$$

Administration errors (opportunities 24–35)

Administration errors occur when the medication administered differs from the prescribed regimen, such as incorrect dose, route, timing, or rate.[11]

$$Administration\ error\ (\%) = number\ of\ administration\ errors / total\ administration\ opportunities \times 100$$

Overall medication error rate

The overall medication error rate represents the total burden of errors across all stages of medication use.[11]

$$Overall\ error\ rate\ (\%) = total\ number\ of\ errors / total\ opportunities \times 100$$

Opportunities for error

Each prescribed drug was assessed against 36 NABH-based criteria.[10]

Total drugs reviewed: 592, opportunities per drug: 36, and total opportunities: 21,312.

$$Errors\ per\ prescription = total\ errors / total\ prescriptions$$

Multiple errors per prescription were possible. Percentages for error types were calculated using total opportunities as the denominator, while commonly encountered errors were calculated using total errors (n=750).

Statistical analysis

Data were analyzed using Microsoft Excel and statistical package for the social sciences (SPSS) software. Results were expressed as percentages and mean±standard deviation (SD) or standard error of mean (SEM), along with the number of observations (n).

Correlation between number of drugs prescribed and medication error rates, as well as WHO prescribing indicators, was assessed using Pearson's correlation coefficient. A $p<0.05$ was considered statistically significant, and $p<0.01$ was considered highly significant.

RESULTS

A total of 110 patients were included in the study.

Demographic distribution

The majority of patients (46.36%) were aged >40 years, followed by 21–40 years (41.8%) and 1–20 years (11.8%).

Out of 110 patients, 72(65.45%) were males and 38(34.55%) were females (Table 1).

Table 1: Demographic characteristics of the study population (n=110).

Variable		Number of patients (n)	%
Age group (years)	1–20	13	11.82
	21–40	46	41.82
	>40	51	46.36
Gender	Male	72	65.45
	Female	38	34.55
	Total	110	100.00

Types of medication errors

Prescription errors were the most common type of medication error (599 errors; 7.78%), followed by transcription errors (122; 6.87%), dispensing errors (23; 0.55%), and administration errors (6; 0.08%). The overall medication error rate was 3.52%, calculated from 750 errors out of 21,312 opportunities (Table 2).

Commonly encountered medication errors

The most frequent error was non-usage of generic names (387; 51.6%), followed by omission of dose (101; 13.5%) and non-usage of capital letters in drug names (60; 8.0%). Other errors included wrong formulation transcribed or indented (22; 2.9%) and wrong drug (13; 1.7%). All percentages were calculated based on the total number of errors (n=750) (Table 3).

Distribution of medication error categories

The majority of observed events were classified as type A errors (94.4%), with a mean of 3.24±1.77 per prescription. Among actual errors, type C errors were most common (4.4%; 0.14±0.38 per prescription), followed by type B errors (0.4%; 0.01±0.08 per prescription). Other categories accounted for 0.8% (0.03±0.15 per prescription). Excluding type A events, the proportion of actual medication errors was 5.6%.

The overall mean number of events per prescription was 3.42±2.38. Error percentages are calculated based on the total number of medication errors (n=750). Values for "errors per prescription" are expressed as mean±standard deviation (Table 4).

Correlation analysis

A statistically significant positive correlation was observed between the total number of drugs prescribed and the percentage of medication errors ($r=0.516$, $p<0.001$). Significant positive correlations were also observed between overall medication errors and type A errors ($r=0.663$, $p<0.001$), and between overall medication errors and type C errors ($r=0.367$, $p<0.001$).

No statistically significant correlation was observed between the number of drugs prescribed and other categories of medication errors (Table 5). Correlation between WHO prescribing indicators and medication errors.

A significant positive correlation was found between the number of antibiotics prescribed and prescription errors ($r=0.313$, $p=0.001$). A significant negative correlation was observed between drugs prescribed from the essential medicines list (EML) and dispensing errors ($r=–0.256$, $p=0.007$).

A significant positive correlation was observed between EML prescribing and prescription errors ($r=0.426$, $p<0.001$), injection use ($r=0.490$, $p<0.001$), and antibiotic prescribing ($r=0.619$, $p<0.001$) (Table 6).

Correlation between WHO prescribing indicators and error categories

Significant positive correlations were observed between EML prescribing and type A errors ($r=0.369$, $p<0.001$), and between the total number of drugs prescribed and type A errors ($r=0.519$, $p<0.001$). Antibiotic prescribing showed significant positive correlations with type A ($r=0.319$, $p=0.001$) and type B errors ($r=0.203$, $p=0.033$).

Injection prescribing showed weak but significant positive correlations with type A ($r=0.191$, $p=0.046$) and type B errors ($r=0.203$, $p=0.033$).

A weak positive correlation was observed between type A and type C errors ($r=0.199$, $p=0.037$). No statistically significant correlations were observed between prescribing indicators and other error categories (Table 7).

Table 2: Types of medication errors (n=110; total opportunities=21,312).

S. no.	Type of medication error	Error opportunities (range)	Number of errors (N)	Total opportunities	Percentage (%)
1	Prescription error	1–13	599	7,696	7.78
2	Transcription error	14–16	122	1,776	6.87
3	Dispensing error	17–23	23	4,144	0.55
4	Administration error	24–35	6	7,696	0.08
5	Other	36	0	592	0.00
6	Overall error	—	750	21,312	3.52

Table 3: Commonly encountered medication errors (n=750).

S. no.	Type of medication error	Number of errors (N)	%
1	No dose mentioned	101	13.47
2	Non-usage of capital letters for drug name	60	8.00
3	Non-usage of generic name	387	51.60

Continued.

S. no.	Type of medication error	Number of errors (N)	%
4	Wrong formulation transcribed/indented	22	2.93
5	Wrong drug	13	1.73
6	Other	167	22.27
7	Total errors	750	100.00

Table 4: Percentage distribution of errors by category.

Type of error	Error percentage (%)	Errors per prescription (mean±SD)
Type A error	94.40	3.24±1.77
Type B error	0.40	0.01±0.08
Type C error	4.40	0.14±0.38
Other error	0.80	0.03±0.15
Overall	100.00	3.42±2.38

Table 5: Correlation between total number of drugs prescribed and error percent (n=110).

Correlation		Total number of drugs	Medication error×100/ opportunity	Medication error a×100/ opportunity	Medication error b×100/ opportunity	Medication error c×100/ opportunity	Medication error other×100/ opportunity
Total number of drugs	Pearson correlation	1	0.516**	-0.179	0.101	0.054	0.017
	Sig. (2-tailed)		0.000	0.061	0.292	0.576	0.858
	N	110	110	110	110	110	110
Medication error ×100/opportunity	Pearson correlation	0.516**	1	0.663**	0.047	0.367**	0.017
	Sig. (2-tailed)	0.000		0.000	0.623	0.000	0.862
	N	110	110	110	110	110	110
Medication error a×100/ opportunity	Pearson correlation	-0.179	0.663**	1	-0.054	0.143	-0.061
	Sig. (2-tailed)	0.061	0.000		0.575	0.135	0.524
	N	110	110	110	110	110	110
Medication error b×100/ opportunity	Pearson correlation	0.101	0.047	-0.054	1	-0.047	-0.022
	Sig. (2-tailed)	0.292	0.623	0.575		0.625	0.823
	N	110	110	110	110	110	110
Medication error c×100/ opportunity	Pearson correlation	0.054	0.367**	0.143	-0.047	1	-0.061
	Sig. (2-tailed)	0.576	0.000	0.135	0.625		0.528
	N	110	110	110	110	110	110
Medication error other×100 /opportunity	Pearson correlation	0.017	0.017	-0.061	-0.022	-0.061	1
	Sig. (2-tailed)	0.858	0.862	0.524	0.823	0.528	
	N	110	110	110	110	110	110

Table 6: Correlation between WHO prescribing indicators and types of error (n=110).

Variable	Prescription error	Transcription error	Dispensing error	Administration error	Essential medicines list	Injection prescribed	Total no. of drugs
Prescription error	1	0.017 (p=0.858)	-0.083 (p=0.390)	-0.004 (p=0.968)	0.426** (p<0.001)	0.158 (p=0.099)	0.589** (p<0.001)

Continued.

Variable	Prescription error	Transcription error	Dispensing error	Administration error	Essential medicines list	Injection prescribed	Total no. of drugs
Transcription error	0.017 (p=0.858)	1	0.066 (p=0.490)	0.037 (p=0.702)	0.021 (p=0.827)	-0.097 (p=0.315)	0.154 (p=0.107)
Dispensing error	-0.083 (p=0.390)	0.066 (p=0.490)	1	0.315** (p=0.001)	-0.256** (p=0.007)	-0.079 (p=0.411)	-0.169 (p=0.078)
Administration error	-0.004 (p=0.968)	0.037 (p=0.702)	0.315** (p=0.001)	1	0.094 (p=0.330)	0.082 (p=0.395)	0.081 (p=0.403)
Essential medicines list	0.426** (p<0.001)	0.021 (p=0.827)	-0.256** (p=0.007)	0.094 (p=0.330)	1	0.490** (p<0.001)	0.774** (p<0.001)
Injection prescribed	0.158 (p=0.099)	-0.097 (p=0.315)	-0.079 (p=0.411)	0.082 (p=0.395)	0.490** (p<0.001)	1	0.475** (p<0.001)
Total no. of drugs	0.589** (p<0.001)	0.154 (p=0.107)	-0.169 (p=0.078)	0.081 (p=0.403)	0.774** (p<0.001)	0.475** (p<0.001)	1

*- Data are presented as correlation coefficients (r) with corresponding p values. Positive values indicate a direct relationship, while negative values indicate an inverse relationship between variables. **Correlation is significant at the 0.01 level (two-tailed). Statistical significance was set at p<0.05.

Table 7: Correlation between WHO prescribing indicators and categories of medication errors.

Variables	EML	Injection	Total drugs	Generic	Antibiotics	Error A (%)	Error B (%)	Error C (%)	Other error (%)
Essential medication list (EML)	1	0.490** (p=0.000)	0.774** (p=0.000)	0.542** (p=0.000)	0.619** (p=0.000)	0.369** (p=0.000)	0.064 (p=0.505)	0.112 (p=0.245)	0.049 (p=0.615)
Injection prescribed	0.490** (p=0.000)	1	0.475** (p=0.000)	0.704** (p=0.000)	0.602** (p=0.000)	0.191* (p=0.046)	0.203* (p=0.033)	-0.143 (p=0.135)	-0.010 (p=0.920)
Total no. of drugs	0.774** (p=0.000)	0.475** (p=0.000)	1	0.429** (p=0.000)	0.560** (p=0.000)	0.519** (p=0.000)	0.101 (p=0.293)	0.109 (p=0.258)	0.021 (p=0.830)
Generic name	0.542** (p=0.000)	0.704** (p=0.000)	0.429** (p=0.000)	1	0.525** (p=0.000)	0.137 (p=0.155)	0.171 (p=0.073)	-0.050 (p=0.601)	0.159 (p=0.097)
Antibiotics prescribed	0.619** (p=0.000)	0.602** (p=0.000)	0.560** (p=0.000)	0.525** (p=0.000)	1	0.319** (p=0.001)	0.203* (p=0.033)	0.051 (p=0.600)	-0.104 (p=0.279)
Error type A (%)	0.369** (p=0.000)	0.191* (p=0.046)	0.519** (p=0.000)	0.137 (p=0.155)	0.319** (p=0.001)	1	0.008 (p=0.937)	0.199* (p=0.037)	-0.062 (p=0.519)
Error type B (%)	0.064 (p=0.505)	0.203* (p=0.033)	0.101 (p=0.293)	0.171 (p=0.073)	0.203* (p=0.033)	0.008 (p=0.937)	1	-0.044 (p=0.648)	-0.022 (p=0.823)
Error type C (%)	0.112 (p=0.245)	-0.143 (p=0.135)	0.109 (p=0.258)	-0.050 (p=0.601)	0.051 (p=0.600)	0.199* (p=0.037)	-0.044 (p=0.648)	1	-0.057 (p=0.553)
Other error (%)	0.049 (p=0.615)	-0.010 (p=0.920)	0.021 (p=0.830)	0.159 (p=0.097)	-0.104 (p=0.279)	-0.062 (p=0.519)	-0.022 (p=0.823)	-0.057 (p=0.553)	1

EML=Essential medicines list, significant at p<0.05, **significant at p<0.01, all values represent Pearson correlation coefficient (r) with corresponding p in parentheses

DISCUSSION

The present study demonstrates that prescribing errors constitute the largest proportion of medication errors, followed by transcription errors, indicating that the prescribing phase is the most error-prone step in the medication-use process. This observation is consistent with earlier hospital-based studies that have identified prescribing as a major point of vulnerability in medication safety.[14,15]

The proportion of prescriptions containing generic drugs (15.26%) was markedly lower than that reported in comparable studies, indicating suboptimal adherence to rational prescribing practices. Similarly, the proportion of drugs prescribed from the WHO essential medicines list (EML) was lower than that reported previously.[10,16,17]

These variations may be attributed to differences in institutional prescribing patterns, drug availability, and clinician preferences. Limited use of generic names and essential medicines may increase treatment costs and reduce accessibility, particularly in resource-constrained settings. The high frequency of errors related to non-use of generic names (51.6%) is consistent with the low rate of

generic prescribing, although these measures are based on different denominators.[18]

The burden of medication errors observed in the present study is comparable to findings from recent hospital-based studies reporting a high prevalence of such errors.[19]

Differences between healthcare settings may be explained by the availability of electronic prescribing systems, standardized protocols, and robust medication safety frameworks in developed systems, whereas handwritten prescriptions and time constraints remain challenges in many Indian healthcare settings. In agreement with prior research, prescription-related errors frequently involved the use of brand names and poor legibility.[20,21]

Only a small proportion of prescriptions were written in capital letters, increasing the risk of misinterpretation, particularly for look-alike and sound-alike medications. Similar concerns have been highlighted in earlier studies emphasizing the importance of standardized prescription writing practices.[22]

Although dosage details were documented in most prescriptions, the overall error rate remained considerable, suggesting that completeness of individual components does not ensure overall prescription accuracy. This finding is consistent with previous audits indicating that multiple elements of prescription writing must be optimized simultaneously to reduce errors.[23] The majority of administration errors were associated with omissions, unsuitable duration, or incorrect dose frequency, which may have resulted from inefficient workflow and communication gaps.[24] In line with research indicating that technological interventions like barcode-assisted distribution can lower such errors, dispensing errors were comparatively rare and mostly related to improper dosage forms.[24] Medication errors may be caused by system-related factors such as high patient loads, staff shortages, and frequent shift changes, according to research that links higher error rates to healthcare professional workload.[25] Pantoprazole, ceftriaxone, amikacin, and piperacillin-tazobactam are among the drugs most frequently linked to errors in this study. These drugs are regularly used in empirical therapy. Previous research has shown that routinely given medications, especially antibiotics, are more likely to cause errors because of their extensive use and frequent dose modifications.[25]

NCC MERP category A, which denotes possible errors that did not reach the patient, was used to classify the majority of pharmaceutical errors. A lower percentage of mistakes reached the patient without causing any harm. These results are in line with research showing a preponderance of lower-severity errors while pointing out underlying system flaws that, if left unchecked, might have more detrimental effects.[22,27] The results of this study are in line with reports of medication mistake rates in Indian hospital settings, which vary from 2% to 10%. Overall, these observations support the validity of the study results.

A complex strategy is needed to strengthen pharmaceutical safety, including frequent prescription audits, encouraging the prescription of generic drugs, adhering to essential medicine recommendations, and ongoing training for medical personnel. Reducing prescription errors and enhancing patient safety may be further aided by the use of computerized prescribing systems and the integration of clinical pharmacists.[27]

CONCLUSION

Prescription errors were the most prevalent kind of pharmaceutical error, followed by transcription problems, according to an analysis of 110 case records. Most of the mistakes were categorized as type A. The most common problems were incorrect use of capitalization in drug names, lack of dosage, and non-use of generic medicine names. The results show that specific interventions are required to enhance prescribing habits. Medication errors may be decreased and patient safety enhanced by actions like supporting generic prescriptions, making sure prescriptions are clear and comprehensive, and promoting sensible drug usage, which includes reducing polypharmacy and adhering to the essential medicines list. Patient care may be further improved by tightening drug delivery procedures and training nursing personnel in precise documentation. Clinical pharmacists' participation in prescription auditing, medication review, and patient counselling may also help identify and avoid pharmaceutical errors early on, enhancing overall medication safety.

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