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Research Article

Prescribing Errors in an Ambulatory Care Setting: Mitigating Risks in Outpatient Medication Orders, Cross-Sectional Review

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ABSTRACT

Introduction: Prescribing errors (PEs) are the most common type of medication error, which may occur by prescribing the wrong medication, improper dose, dosage, and/or even prescribing a drug to the wrong patient. The present study aims to compile PEs that were generated in an ambulatory care setting at a tertiary-care hospital in Saudi Arabia. **Methods:** A retrospective cross-sectional review was conducted for all reported PEs in ambulatory care clinics for 3 years. The potential hazardous outcomes of these PEs were classified according to the medication error index. **Results:** A total of 897 records containing 1199 PEs were retrieved. More than a third of prescribers had frequently committed PEs—ranging from 2 to 39 times. The most encountered errors were prescribing incorrect doses, medication duplication, incorrect dosing frequency, and inappropriate duration (34.5%, 14.1%, 11.6%, and 9.8%, respectively). The most frequent mistakes were when prescribing antibiotics (22.9%) and drugs for cardiovascular conditions (18.5%). Most errors were of mild to moderate severity, mostly type-B near-miss errors and did not reach patients. Only two prescription events (0.17%) had severe consequences that required intervention to avoid any subsequent harm or damage. **Conclusion:** The current investigation has revealed a substantial percentage of PEs, mostly in internal medicine and cardiology departments. Although PEs are undoubtedly not easy to avoid, monitoring and recognizing these inaccuracies is pivotal to preventing potential harm and promoting patient safety.

Keywords: prescribing errors, ambulatory care, outpatient, medication reconciliation, adverse drug events (ADEs), patient safety

INTRODUCTION

"To err is human." However, medication errors are implicitly condemned as they can deleteriously impact the sacred life of patients. Prescribing errors (PEs) are the most common type of medication error, which may occur by prescribing the wrong medication, improper dose/dosage, or even prescribing a drug to the wrong patient.[1] The most apparent example of such misconduct practice is prescribing a drug to a patient with a known allergy. Several reports claim that medical errors are ranked among the top three causes of death in the United States.[2] Moreover, failing to identify drug interactions or contraindications is another serious problem in healthcare, resulting in evident harm to patients and increased healthcare costs. According to the World Health Organization report published in 2017, the global annual cost associated with medication errors was estimated at approximately 42 billion US dollars.[3]

Estimating the overall prevalence of PEs in any healthcare setting can be difficult, since most go unreported. However, studies have found that PEs occur in at least 2–10% of all items prescribed depending on the clinical setting and method of measurement.[4,5] A fairly

recent cross-sectional observational study reported PE rates as high as 36% in patients' prescription charts, with significantly higher error rates in teaching hospitals.[6] These drug-related errors are of significant concern in the healthcare system, which potentially affect patient safety and disrepute the quality of healthcare services.[7]

Although prevention is better than cure, it is not easy to attain. Thus, to provide the utmost high-quality healthcare services, healthcare institutions should always be keen to recognize such inaccuracies toward preventing potential harm and promoting patient safety. The present study summarizes events involving PEs that were generated at the ambulatory care setting in the National Guard Affairs tertiary-care hospital in Riyadh, Saudi Arabia, between the years 2019 and 2021.

METHODS

This study was approved by the institutional review board at King Abdullah International Medical Research Center (KAIMRC), Riyadh, Saudi Arabia (No. IRBC/104/06/22). Consent to participate was waived since the data were collected from the patients' electronic medical records without disclosing any identifiers of the patients and prescribers.

Study Design and Setting

A retrospective cross-sectional review was conducted for all reported PEs from Jan 1, 2019, through Dec 31, 2021, at the central hospital pharmacy, satellite pharmacies, and outpatient pharmacy associated with ambulatory care. This qualitative cross-sectional article was prepared following the STROBE reporting guidelines checklist.

Data Collection

Data were collected by using a structured data collection format, which includes the chief complaint or diagnosis, patient's age and sex, prescriber specialties/department, and prescription details including drug(s) names, doses, dosing frequencies, dosage forms, route of administration, duration, and instructions of use. To maintain anonymity and avoid prejudice, prescribers' names were replaced with random codes. Medication error reporting is voluntary and performed by healthcare practitioners that include but are not limited to physicians, nurses, and pharmacists through an electronic hospital reporting system.

The medication safety unit, which is part of the quality and patient safety department, maintains all reports for review and evaluation in their retrievable database. All records containing PEs were retrieved through the computerized physician order entry (CPOE) information system from the ambulatory care clinics. The records with general complaints and comments on the PEs that were not related to a specific prescription event and/or not from ambulatory care settings were excluded.

The potentially clinically hazardous outcome of the retrieved PEs was classified according to the revised medication error index by the National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP),[8] which was initially adopted from Hartwig et al.[9] All retrieved PEs were categorized on the basis of specific event types, including prescribing incorrect or unauthorized medication, improper dosage strength or dosage form, medication duplicates, and administration errors including incorrect route, giving the drug to the wrong patient, extra dose, or wrong rate and time.

The following standardized categories were realized: type A (event has potential to cause harm/damage); type B (near-miss event did not reach the patient); type C (event reached the patient but did not cause harm/damage); and type D (event reached the patient and required monitoring to confirm no harm/damage or intervention to preclude harm).

Data Analysis

At least two expert pharmacists scrutinized PEs and their classifications. The patient's electronic medical record was reviewed for diagnostic accuracy and thus appropriateness of the prescribed medications. No patients were contacted, or biological samples taken from them. No names or other confidential information was recorded. Results were expressed as frequencies or proportions of the total number of variables. Descriptive and statistical data analyses were performed with GraphPad Prism Version 9.0 Software Package (San Diego, CA). When appropriate, the unpaired *t* test or Kruskal-Wallis one-way ANOVA test was used to estimate the significant difference between various variables and the frequency of reported PEs. Statistical significance was considered at *p*-values less than 0.05.

RESULTS

A total of 897 records containing PEs were retrieved through the CPOE information system from the ambulatory care clinics. Three records were excluded as they were general complaints and comments on the PEs and were not related to a specific prescription event. Of the 894 records containing 1199 errors, merely 73 prescriptions (8.2%) belonged to patients younger than 18 years. Table 1 displays the general characteristics of patients and physicians involved in the retrieved prescription errors. In all, 498 prescribers were responsible for these errors. Most PEs were committed by prescribers at the departments of internal medicine and cardiology (44.7% and 30.4%, respectively). Among the participating medical departments and units, the ones with the lowest rates of PEs were Organ Transplant, Oncology, Pediatrics, Critical Care, Medical Imaging, and Anesthesia with 4, 2, 2, 1, 1, and 1 error(s), respectively.

On average, prescribers were responsible for 2.4 ± 3.3 PEs (mean ± SD). According to hospital policies and procedures, resident physicians are prohibited from

Table 1. General characteristics of patients and physicians involved in the retrieved prescription errors, $n = 894$

	Values
Patient's sex, *n* (%)	
Male	407 (45.5)
Female	487 (54.5)
Patient's age, y	
Mean ± SD	49.8 ± 22.5
Median (range)	53.0 (3 d–103 y)
Patient's age group, *n* (%)	
Neonates or newborns	8 (0.9)
Infants (1-12 mo)	26 (2.9)
Children (1-12 y)	24 (2.7)
Adolescents (13-17 y)	15 (1.7)
Adults (18-64 y)	564 (63.1)
Older adults (65 y and older)	257 (28.7)
Medical department/unit, *n* (%)[†]	
Internal Medicine	400 (44.7)
Cardiac Sciences	272 (30.4)
Surgery Adult/Pediatric	78 (8.7)
Obstetrics and Gynecology	71 (7.9)
Family and Community Medicine	35 (3.9)
Dentistry	16 (1.8)
Emergency Adult/Pediatric	11 (1.2)
Others [‡]	11 (1.2)
Prescribing error per prescriber, mean ± SD	2.41 ± 3.3
Frequency of errors per prescriber, *n* (%)	
Once	320 (64.3)
Repeatedly (ranging from 2 to 39 errors)	178 (35.7)
Resident involved, *n* (%)	
No	659 (73.3)
Yes	180 (20.1)
Unsure	55 (6.2)

[†]Calculated out of n = 894 prescriptions.
[‡]Includes the following departments/units: organ transplant, oncology, pediatrics, critical care, medical imaging, and anesthesia.

Table 2. Characteristics of the retrieved prescription errors, $n = 1199$

Variable	Values
Types of prescribing errors, *n* (%)	
Allergy[†]	69 (5.8)
Contraindicated drug	40 (3.3)
Incorrect dose or dosage form	415 (34.6)
Incorrect duration	118 (9.8%)
Incorrect frequency	139 (11.6)
Incomplete order	59 (4.9)
Incorrect route/infusion rate	8 (0.7)
Medication discontinued	18 (1.5)
Medication duplicate	169 (14.1)
Wrong medication	106 (8.8)
Policy violation[‡]	26 (2.2)
Wrong patient or diagnosis	12 (1.0)
Improper or lack of documentation[¶]	20 (1.7)
Medication classifications, *n* (%)	
Analgesics	58 (4.8)
Alimentary tract and metabolism[#]	77 (6.4)
Gastric acid–related disorders	48 (4.0)
Anti-infective agents	274 (22.9)
Immunomodulating agents	67 (5.6)
Anticoagulants and antiplatelet	73 (6.1)
Cardiovascular system drugs	222 (18.5)
Dermatologic agents	9 (0.8)
Antidiabetics and insulin analogs[$]	83 (6.9)
Nervous system drugs	79 (6.6)
Endocrine and sex hormones	41 (3.4)
Respiratory system drugs	21 (1.8)
Antihistamines	16 (1.3)
Vitamins	47 (3.9)
Others	84 (7.0)
Is high-alert medication involved? *n* (%)	
No	1091 (91.0)
Yes	108 (9.0)
Medication error-harm category, *n* (%)	
A-Potential to cause harm/damage	197 (16.4)
B-Near-miss, error did not reach the individual	988 (82.4)
c-Event reached individual, no harm/damage	12 (1.0)
D-Required monitoring to confirm no harm/damage	2 (0.2)
Event date, *n* (%)	
2019	374 (31.2)
2020	338 (28.2)
2021	487 (40.6)

[†]Five of which were not documented.
[‡]Violation of the hospital policy and procedure for prescribing and dispensing, when prescribing a medication beyond the specialty knowledge of the prescriber.
[¶]Including wrong instructions.
[#]Sixty-four of which were antihyperlipidemic drugs.
[$]Thirty of which were insulin products.

prescribing medications to patients without prior endorsement from their senior consultant supervisors. However, data show that residents engaged in at least 20% of the reported cases. Peculiarly, more than a third of prescribers (178, 35.7%) had frequently committed PEs—ranging from 2 to 39 times. Of the 498 prescribers, 45 physicians (9.8%) in the departments of internal medicine, cardiology, and surgery were responsible for more than 5 PEs (60.0%, 31.1%, and 8.9%, respectively). Residents were blamed for at least 13.3% of those PEs in the above-mentioned departments.

Table 2 shows the characteristics of the retrieved PEs. The most encountered error was prescribing incorrect doses of drugs or dosage forms ($n = 414$, 34.5%). Followed by medication duplication, incorrect dosing frequency, and inappropriate duration of usage (169 [14.1%], 139 [11.6%], and 118 [9.8%]), respectively). Remarkably, 148 PEs (12.3%) occurred by prescribing a wrong drug, 40 instances were for contraindicated drugs or there was a drug-disease interaction. Prescribing medications to patients with allergies was found in 69 cases (5.8%), 5 of which were unknown or not documented in the system. The most frequently committed errors were prescribing anti-infectives and cardiovascular-related medications (274 [22.9%] and 222 [18.5%], respectively). Further information is provided in Table 2. Almost half of the 108 recognized high-alert drugs (50, 46.3%) were medications affecting blood coagulation (e.g., apixaban, enoxaparin, and warfarin sodium).

Outstandingly, most of the reported errors (82.4%) were type-B errors (i.e., "near-miss," where the error did not reach patients). Figure 1 displays the distribution of

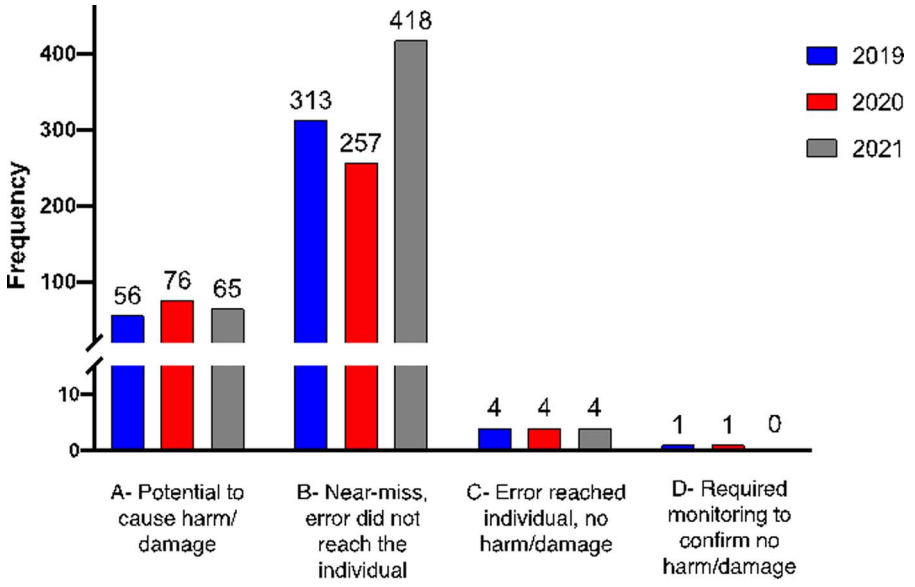

Figure 1. Distribution of the prescription errors and near-miss harm category between Jan 2019 and Dec 2021. Total number = 1199.

PEs and the harm categories by the event year. Fortunately, most errors were of mild to moderate severity. Only two prescription events (0.17%) had severe consequences that required monitoring or intervention to avoid any subsequent harm or damage. Table 3 shows analyses of factors associated with an increased risk of PEs among prescribers. Although the average number of errors reported at different departments/units shows noticeable variances, the differences were not statistically significant ($p = 0.089$). However, the standard deviations show a significant difference ($p < 0.0001$). Similarly, no statistical difference was found between various medication classes ($p = 0.269$); however, the Bartlett test reveals a significant difference among standard deviations ($p < 0.0001$). Moreover, neither high-alert medications nor event-date results display any significant difference with $p = 0.673$ and 0.723, respectively. Interestingly, significantly fewer errors were committed by residents than by other physicians ($p = 0.006$).

The following are three randomly selected examples of PEs from the retrieved samples.

Case 395: On Dec 15, 2019, the physician prescribed apixaban 2.5 mg orally twice daily to a 53-year-old female patient with a history of nonvalvular atrial fibrillation. The error was identified by a pharmacist in the central hospital pharmacy and after discussion with the treating physician, the order was adjusted to 5 mg twice daily.

Case 752: On Aug 6, 2021, nifedipine was ordered as 60 mg bid for a 65-year-old male patient with a history of hypertension. The incorrect frequency was identified by a pharmacist-in-charge at an outpatient pharmacy and after informing the treating physician, the order was corrected to once daily. The patient had been using this medication twice daily for a long time, but it was corrected upon the pharmacist's recommendation.

Case 860: On Feb 18, 2020, the physician prescribed varenicline for a 47-year-old male patient with a long history of smoking, as follows: 0.5 mg orally once daily for 3 days followed by 0.5 mg twice daily for 3 months. The inaccuracy was identified by the pharmacist-in-charge at an outpatient pharmacy and after consultation with the treating physician, the order was changed to the standard packet for the smoking cessation regimen as follows: 0.5 mg orally once daily for 3 days, then 0.5 mg orally twice daily for 4 days, then 1 mg orally twice daily for 4 weeks.

DISCUSSION

PEs are well-recognized, serious problems that account for the greatest portion of all medication errors.[10] In addition to the potential harm to patients, PEs increase health expenses and can damage the reputation and trust of the healthcare system. The current study discusses the prevalence, type, and severity of PEs that were electronically retrieved from an ambulatory care setting in a tertiary-care hospital in Riyadh, Saudi Arabia.

This tertiary-care hospital uses an in-house CPOE information system, which is available for all entitled healthcare providers. This system allows eligible treating physicians, according to their specialties, to access patients' medical history and to prescribe medications from a unified drug formulary database. Whenever a new prescription order is placed in the system, the prescriber must include all specific details pertaining to the patient's identity, prescribed medication(s), and instructions for use, to be deemed valid. Once the "electronic" prescription order has been issued, the pharmacist must review it for any missing information or inaccuracy. In case of ambiguity, imprecision, or incompleteness, the pharmacist should contact the treating physician for clarification or correction prior to dispensing. However, it is

Table 3. Analysis of factors associated with prescribing errors among prescribers, $n = 498$

Factor	Number of Errors (%)	Mean ± SD	*p*-value
Physician department			0.089
Internal Medicine ($n = 218$)	533 (44.5)	2.86 ± 4.3	
Cardiac Sciences ($n = 124$)	400 (33.4)	2.40 ± 2.9	
Surgery Adult/Pediatric ($n = 61$)	99 (8.3)	2.03 ± 2.1	
Obstetrics and Gynecology ($n = 41$)	80 (6.7)	1.96 ± 1.4	
Family and Community Medicine ($n = 22$)	45 (3.8)	1.42 ± 0.8	
Dentistry ($n = 15$)	16 (1.3)	1.07 ± 0.3	
Emergency Adult/Pediatric ($n = 9$)[¶]	11 (0.9)	1.00 ± 0.0	
Others ($n = 8$)[¶]	15 (1.3)	1.87 ± 0.8	
High-alert medication			0.673
No ($n = 449$)	1091 (91.0)	2.37 ± 3.3	
Yes ($n = 49$)	108 (9.0)	2.58 ± 3.4	
Medication class			0.269
Anti-infectives ($n = 121$)	274 (22.9)	1.87 ± 2.0	
Cardiovascular system drugs ($n = 71$)	222 (18.5)	3.04 ± 4.8	
Antidiabetics and insulin analogs ($n = 35$)	83 (6.9)	2.28 ± 4.1	
Nervous system drugs ($n = 38$)	79 (6.6)	2.26 ± 1.7	
Alimentary tract and metabolism ($n = 26$)	77 (6.4)	3.43 ± 3.8	
Anticoagulants and antiplatelet ($n = 38$)	73 (6.1)	2.97 ± 3.9	
Immune-modulating agents ($n = 27$)	67 (5.6)	2.71 ± 2.7	
Analgesics ($n = 22$)	58 (4.8)	1.68 ± 1.4	
Gastric acid–related disorders ($n = 17$)	48 (4.0)	1.64 ± 1.9	
Vitamins ($n = 22$)	47 (3.9)	3.19 ± 3.5	
Endocrine and sex hormones ($n = 17$)	41 (3.4)	3.70 ± 6.8	
Respiratory system drugs ($n = 14$)	21 (1.8)	1.62 ± 1.5	
Antihistamines ($n = 5$)	16 (1.3)	2.25 ± 1.4	
Dermatologic agents ($n = 6$)	9 (0.8)	2.17 ± 2.0	
Resident involved? *n* (%)			0.006
No ($n = 329$)	880 (73.4)	2.78 ± 3.9	
Yes ($n = 125$)	242 (20.2)	1.79 ± 1.7	
Event date, *n* (%)			0.723
2019 ($n = 131$)	374 (31.2)	2.37 ± 2.5	
2020 ($n = 141$)	338 (28.2)	2.59 ± 3.8	
2021 ($n = 226$)	487 (40.6)	2.31 ± 3.5	

[¶]Not included in the statistical analysis.

worth noting that this hospital's mechanism (policy and procedure) for reporting medication and prescription errors is voluntary. Hence, the employee who witnesses any medication errors or who has participated in the incident can report and document it in the designated hospital's electronic reporting system within 24 hours of the event.

The results of the current investigation have revealed a substantial percentage of PEs. More than a third of prescribers frequently committed errors, especially in the internal medicine and cardiology departments, which represents almost three-quarters of the identified errors. The most frequent PEs were related to anti-infectives and cardiovascular-related medications. Although the average number of PEs reported at different departments did not show a statistically significant difference, there were some noteworthy variations between them. PEs often involve incorrect dosing or dosage form, medication duplication, incorrect frequency, and inappropriate duration of use. Most of these PEs were mild to moderate, with only a minor fraction having severe consequences that required intervention (e.g., prescribing wrong high-alert medications or to patients with unknown or undocumented allergies). Most of the reported PEs were type-B errors, meaning they were "near-miss" errors that did not reach patients. This is consistent with several studies that reported PEs in a similar healthcare setting. [11–13]

Although resident physicians were not allowed to prescribe medications without approval from their supervisors, they engaged in at least one-fifth of the identified cases. However, significantly fewer errors were committed by residents than by other senior physicians. This may reflect their updated knowledge, as they have just obtained their medical degree and are undergoing further training in a specific medical specialty. It may infer that they had already consulted other medical professionals or their superiors before prescribing medications to patients. Nonetheless, no similar findings have been found in the published literature.

Medication and prescription errors are preventable problems in healthcare that require a multifaceted approach and collaboration of all healthcare professionals to deal with. Healthcare institutions can implement several strategies to reduce errors and improve patient safety. For example, using electronic prescribing systems can help reduce

PEs caused by illegible handwriting, wrong patient, and incorrect instructions.[14] Using medication-related technologies such as barcode-scanning technology and automated dispensing techniques to verify prescription orders will verify the correctness of the prescribed medication and dosage being administered.[15] Medication reconciliation can also be effectively implemented to identify discrepancies and to ensure the accuracy of prescribed medications, which can eventually help in avoiding PEs such as medication omissions, duplications, incorrect dosing, and even drug interactions.[16] Expert pharmacists have an indispensable role in the successful implementation of these strategies, which aid in the detection of PEs and thus undoubtedly can prevent or at least minimize the incidence of adverse drug events.[17]

Moreover, most well-recognized reputable medical institutes known for their exceptional quality of care and advanced medical services require healthcare professionals to be regularly engaged in continuing education and professional development programs. These programs usually focus on diverse topics, including clinical competencies,[18] communication skills,[19] leadership,[20] and patient safety.[21] Such programs have a significant impact on improving the knowledge and skills of healthcare professionals and thus optimizing the quality of healthcare clinical practice provided. For example, the antimicrobial stewardship program promotes the responsible prescription of antimicrobial agents, which ultimately improves therapeutic outcomes and reduces microbial resistance by optimizing the selection, dosing, and usage of antimicrobial therapy.[22]

Encouraging open communication between healthcare providers, patients, and families warrants that everyone is aware of the current medication list and any potential side effects or interactions.[23] This of course requires the active participation of everyone in asking and answering questions about prescribed medications and reporting any adverse effects.

The study is limited by the fact that all retrieved reports are voluntary. This may underscore the prevalence of PE in ambulatory care settings. This qualitative study tried to shed light on the most common error types and their frequency; however, the results cannot be generalized to all ambulatory care settings. The observational type of study will have some inconsistency due to the subjective nature of evaluation, which was reduced by having two reviewers. Finally, it is worth noting that the PEs recognized in the current study were identified and reported voluntarily by pharmacists or other healthcare professionals to their respective departments before being formally documented in the hospital medication safety system. Hence, the presented data may represent the tip of the iceberg and the results shown could underestimate the actual number of PEs committed. Nonetheless, awareness is still a pivotal tool in preventing PEs. Thus, sharing lessons learned with other healthcare professionals and employees can help identify errors and causes of failure.

CONCLUSION

The current investigation results have revealed a substantial percentage of PEs mostly in the internal medicine and cardiology departments. The outstandingly low-potential clinically hazardous outcome of the retrieved PEs, which were mostly type-B near-miss errors, could be attributed to the use of an "electronic" prescription order via the CPOE information system and the use of automation in monitoring and retrieving PEs. Although PEs are undoubtedly not easy to avoid, monitoring and recognizing these inaccuracies is pivotal to preventing potential harm and promoting patient safety.

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Data Availability

The datasets analyzed during the current study are available from the corresponding author upon request.

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