Medication errors in outpatient pharmacies: comparison of an electronic and a paper-based prescription system

Mera A. Ababneh [ID], Sayer I. Al-Azzam, Karem H. Alzoubi [ID] and Abeer M. Rababa'h

Department of Clinical Pharmacy, Faculty of Pharmacy, Jordan University of Science and Technology, Irbid, Jordan

Abstract

Objectives Medication errors are among the most common medical errors. They can result in mortality, morbidity and additional healthcare costs. Surveillance of medication errors is encouraged to identify gaps in the healthcare system and work on them. This study aimed to compare medication errors in outpatient prescriptions in two hospitals in Jordan: one with a paper-based and one with an electronic prescription system.

Methods This was a cross-sectional observational study in two large hospitals in Jordan over a three-month period. Prescribing and dispensing of medicines were screened for medication errors in both centres: 2500 prescriptions were screened in each hospital.

Key findings In the hospital with electronic prescriptions, of the 2500 prescriptions screened, 631 medication errors were detected: 231 (36.6%) prescription errors and 400 (63.4%) dispensing errors. In the hospital with paper-based prescriptions, 3714 medication errors were found: 288 (7.8%) prescription errors and 3426 (92.2%) dispensing errors. The most common prescription and dispensing errors in electronic prescriptions were, respectively, prescription of drugs that could have a drug–drug interaction, and omitting to dispense a drug on the prescription. In the paper prescriptions, the most common prescription and dispensing errors were, respectively, inappropriate dose/quantity/frequency or route of administration, and inappropriate and/or inadequate labelling of medication when dispensed, of which there were a large number (2496 (67.2%)).

Conclusion This study highlights the effect of the prescription system used by hospitals. Fewer medication errors were found in the electronic system. Healthcare policymakers, professionals and administrators are encouraged to invest in electronic systems to minimize medication errors.

Keywords electronic prescribing; Jordan; medication errors; outpatients; pharmacists

Introduction

A medication error is defined as 'any preventable event that may cause or lead to inappropriate medication use or patient harm, while the medication is in the control of the healthcare professional, patient or consumer'.[1] Medication errors can lead to serious adverse outcomes, threaten patient's trust in the healthcare system and increase healthcare costs.[2–4] Medication errors can occur at any level of patient care and may be caused by staff members at different levels including doctors, pharmacists, nurses and pharmacy technicians.[2,5]

Inadequate working environment, undefined policies, complex procedures, heavy workload and inadequate or unclear communication between members of the healthcare team can lead to medication errors. Therefore, systems need to be in place that can help prevent, detect and resolve medication errors.[6,7] Medication safety is a critical component of patient care competency, and thus, the development of new approaches to reduce medication error is a multinational priority.[8]

The Joint Commission on Accreditation of Health Care Organization reinforced the value of reviewing error records to prevent potential future errors while introducing additional patient safety requirements that reflect the advancement of safety culture. Furthermore, recording errors helps to identify why errors occur, to determine strategies for error control and prevention, and also to drive long-term progress in patient safety.

Correspondence: Mera A. Ababneh, Department of Clinical Pharmacy, Faculty of Pharmacy, Jordan University of Science and Technology, P.O. Box 3030, Irbid 22110 Jordan.
E-mail: mababneh@just.edu.jo

Active management and accurate monitoring system should detect errors before they reach or cause any harm to patients.[9]

Detection and monitoring of medication errors is important to prevent their future occurrence and to develop and implement improvements in prescribing to provide better healthcare outcomes for patients. Medication errors are often under-reported and probably only errors that result in an adverse drug reaction are reported, whereas those that do not, go unnoticed.[10,11]

The aim of this study was to assess the provenance of medication errors in outpatient's setting and compare types of medication errors in outpatient pharmacies in two different hospital settings in Jordan: one with an electronic pharmacy system and one with a paper-based pharmacy system.

Methods

Study design and setting

This cross-sectional study was conducted in the outpatient pharmacies at two hospitals with different prescription systems over three-month period (March through June 2016). One hospital is utilizing an electronic pharmacy system, while the other uses paper prescription forms. Both hospitals are comparable in workload.

Data collection

Two trained clinical pharmacists at each site conducted data collection over three months. During the study period, medication prescriptions and dispensing procedures in the outpatient pharmacies were screened for medication errors in both participating centres by direct observation of the two clinical pharmacists at each site. They had received extensive training on evaluating medication errors from the investigators of this study.

The components of the prescriptions were analysed separately based on the patient's clinical variables. The evaluation items included the appropriateness of drug selection for the indication, contraindications, existing drug therapy, drug–drug interactions, therapeutic duplications and appropriateness of the dose, frequency, concentration, route of administration and instructions.[12,13]

On the dispensing level, the dispensing process was observed and analysed for dispensing quantities, expiry dates, omission of a medication (failure to dispense one of the medications on a prescription), failure to dispense because of unaffordable cost, appropriateness of the labelling, preparation, packaging and appropriateness of dispensed drugs with correct dose, drug, route, dosage form and amount.[12,13]

If a medication error was identified, the clinical pharmacists who were collecting the data immediately reported the error to the pharmacist in charge. This action was taken before the medication was dispensed and it was part of a collaborative practice agreement. All medication errors prevented by the clinical pharmacists were nonetheless considered a medication error.

Ethical approval

The institutional review boards of the participating hospitals approved the study. A written informed consent was obtained from patients for the use and disclosure of their information.

Statistical analysis

Descriptive statistics were used to report data as counts and proportions using *JMP* software, (version 10.0; SAS Institute, Cary, NC, USA).

Results

Of 2500 prescriptions in the hospital with an electronic prescription system, 631 medication errors were detected (Table 1). Prescription errors constituted 36.6% of all errors and dispensing errors were 63.4%. Of the 631 errors, 112 (17.7%) were prescription of drugs that could have a drug–drug interaction, 50 (7.9%) were duplication of drugs on the same prescription, and 31 (4.9%) were prescription of an inappropriate drug for the indication. On the dispensing level, 377 (59.7%) of the errors were omitting to dispense a drug on the prescription, 9 (1.4%) were medications inappropriately prepared or packaged before dispensing, and 8 (1.3%) were dispensing the wrong drug, dose or dosage form.

Table 1 Comparison of medication errors in outpatient pharmacies in two different hospitals

Mediation error	Electronic prescription system No. (%) (n = 631)	Paper prescription system No. (%) (n = 3714)
Prescription error		
Inappropriate drug for indication	31 (4.9)	43 (1.2)
Inappropriate dose, quantity, frequency, or route of administration	35 (5.5)	162 (4.4)
Therapeutic duplication	50 (7.9)	21 (0.6)
Contraindication	3 (0.5)	1 (0.0)
Drug–drug interaction	112 (17.7)	61 (1.6)
Total prescription errors	231 (36.6)	288 (7.8)
Dispensing error		
Expired medications in stock	0 (0)	1 (0.0)
Inappropriate storage conditions (including refrigerated items) in stock	0 (0)	4 (0.1)
Drug omission	377 (59.7)	671 (18.1)
Inappropriate or inadequate labelling of medication	2 (0.3)	2496 (67.2)
Dispensing of inappropriately stored, prepared and/or packaged medication *before* dispensing	9 (1.4)	89 (2.4)
Dispensing wrong drug, wrong dose or wrong dosage form	8 (1.3)	129 (3.5)
Dispensing incorrect amount	4 (0.6)	36 (1.0)
Total dispensing errors	400 (63.4)	3426 (92.2)

In the paper-based pharmacy hospital, of 2500 prescriptions, 3714 medication errors were found. Most were dispensing errors were (92.2%); 7.8% were prescription errors. Of the 3714 errors, 162 (4.4%) were prescription with an inappropriate dose, concentration, quantity, frequency and/ or route of administration, 61 (1.6%) were prescription of drugs that could have a drug–drug interaction, 43 (1.2%) were prescription of an inappropriate drug for the indication, and 21 (0.6%) were duplication of drugs on the same prescription. Regarding dispensing errors, 2496 (67.2%) were for medicines inadequately and/or inappropriately labelled, 671 (18.1%) were omitting to dispense a drug on the prescription, 129 (3.4%) were dispensing the wrong drug, dose or dosage form, 89 (2.4%) were because of inappropriately prepared or packaged medicines before dispensing, and was one because of expired medication stocked in the hospital's pharmacy.

Discussion

This study compared proportions and types of medication errors between two teaching hospitals in Jordan. The two hospitals use different prescribing and dispensing systems: electronic system versus paper-based system. The number of prescriptions analysed in the two healthcare settings was the same (2500 prescriptions each); however, the number of medication errors in the paper-based system was about five times more than electronic prescription system. Errors in the dispensing of medication were more common than errors in prescriptions in both hospitals. Dispensing errors are common in hospital settings around the world. Some of these errors, if undetected by pharmacists, can have life-threatening effects.[14] The underlying causes of dispensing errors are attributable to pharmacist workload, overall pharmacy workload, interruptions during dispensing, shortages of pharmacy staff and fatigue of healthcare providers.[15,16] Preventive strategies to decrease the incidence of dispensing errors should be encouraged (as discussed below).

Prescribing of an ineffective medicine for the indication was lower in paper-based prescription hospital (1.2%) than in electronic prescription system hospital (4.9%). Nonetheless, these percentages are lower than reported in other studies that assessed medication errors in inpatient settings.[3,17]

A large number of medications were inadequately or wrongly labelled in paper-based prescription hospital (67.2%) compared with electronic prescription system (0.3%). This is probably because the labelling process in the paper-based prescription hospital is manual, whereas in electronic prescription system, prescribed medicines are electronically labelled. An electronic prescription record contains all the data required to fill, label and dispense a prescription that allows pharmacists to monitor drug use. The electronic prescription record allows the integration of the patient's entire pharmacy and medical records to improve patient care and reduce medication errors. The problems identified can be solved by creating a good work environment with minimal distractions and by implementing verification, checking, and double-checking of prescriptions and including the drug's indication on the prescription. The

use of checklists and computerized alerts and reminders has been found to beneficial.[18-21]

Albarrak *et al.*[22] reported that electronic prescribing systems allowed health practitioners to deliver medications directly to the pharmacy, which have the direct benefit of increasing readability, completeness and minimizing transcription errors.

Several electronic pharmacy applications are advanced with decision-making tools for monitoring drug–drug and drug–allergy interaction.[23] Previous studies have shown that electronic prescribing could reduce the likelihood of medication errors by more than 50% and improve the quality of prescription, patient safety and reduce healthcare costs.[24-26] Thus, there is an urgent need to address the readability of prescriptions, the right spelling of medications to minimize the incidence of medication errors.[27]

In a previous study, 71 (35.7%) and 5 (2.5%) medication errors were identified in handwritten and electronic prescriptions, respectively. The main types of errors were the incidence of incorrect or missed route of administration (15.1%) and the incorrect or missed dose (12.1%) in handwritten prescriptions.[22] This research showed the need to shift towards electronic prescribing to increase the efficiency of prescribing and patient safety.

A recent study at the American University of Beirut Medical Center reported that electronic prescriptions had fewer medication errors than those associated with handwritten prescriptions. Specifically, electronic prescriptions decreased the missed doses, frequency and strength of medication errors.[28] Further, Bizovzi et al. noticed that the electronic prescription programme was threefold less likely to result in errors and five times less likely requiring pharmacist clarification than handwritten prescriptions within the emergency department.[29]

When comparing electronic prescribing with handwritten prescriptions, no differences were found in the need for our data collectors to intervene to correct prescribing errors (inappropriate or ineffective prescribing, under-prescribing, overprescribing, wrong dose, wrong frequency, wrong duration or wrong route of administration). Another study also suggests that pharmacists have to intervene on e-prescriptions as much as on handwritten prescriptions.[30] Other studies have shown that the implementation of an electronic system to record clinical information decreased medication errors in certain fields and improved therapeutic drug monitoring of narrow therapeutic indices drugs and renal dosing adjustments in patients with renal insufficiency.[31,32]

Our study was part of a collaborative practice agreement where trained pharmacists directly observed medication errors and reported them to the pharmacist in charge or sometimes directly intervened. These interventions were encouraged by the pharmacists in charge and at the end of the study; they recommended educational sessions on the prevention of medication errors. It is vital to work on developing strategies to reduce the risk of medication errors throughout the medication utilization process. One strategy is to evaluate drugs prescription for errors (either prescription errors or dispensing errors) similar to what was done in this study. This type of surveillance of errors needs to be implemented periodically in healthcare settings to identify medication errors and monitor

the success of strategies to minimize them. All healthcare professionals should be responsible for identifying, monitoring, evaluating and preventing medication errors at all levels.

This study had some limitations. This study was only of 3-month duration, longer duration could identify different types of errors. The study was conducted in outpatients setting, and results cannot be generalized to other healthcare settings.

Conclusion

The type of prescription systems used by hospitals can affect the occurrence of medication errors. The use of a paper-based prescription system resulted in a higher number of medication errors compared with an electronic prescription system. Therefore, efforts to establish computerized prescription systems in healthcare settings should be encouraged. Establishing effective systems for reporting and surveillance of medication errors in hospitals is a practical solution to minimize the problem of mistakes in prescribing and dispensing medicines.

Declarations

Conflict of interest

The Author(s) declare(s) that they have no conflicts of interest to disclose.

Funding

Authors' contributions

All authors state that they had complete access to the study data that support the publication. MAA, SIA, KHA, and AMR conceived and designed the study. MAA, SIA, and KHA implemented the study. MAA, SIA, and AMR analysed the data. MAA had primary responsibility for final content. All authors participated in writing, read, and approved the final manuscript.

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