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Impact of Electronic Prescription on Prescribing Errors

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aims: There are series of medical errors that can be prevented by taking precautions. Therefore, the study evaluates the impact of the electronic prescribing system on prescription errors.
Study Design: A pre-post study design was conducted.
Place and Duration of Study: The study was conducted at outpatient pharmacy services of a teaching hospital in Jeddah city.
Methodology: Prescriptions were evaluated for the presence of the essential prescription elements such as patient information, drug name, dose, frequency, strength, and other prescription completeness parameters.
Results: In the pre-intervention study, 1182 handwritten prescriptions were evaluated, and 6627 errors were detected from these prescriptions. The length of the pre-and post-intervention period was two weeks each. The most prevalent prescribing errors were that of medications written without defined dosage forms were recorded 1653 (55.90%) time followed by prescriptions written by trade names 1493 (22.5%), without route of administration 1266 (19.1%), and without specified duration 1009 (15.2%). However, 1512 prescriptions were evaluated in the post-intervention study,

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among which 339 errors were detected. The errors included prescriptions written without diagnosis (5.09%), or without doctor's name or stamp (1.52%), written by trade names (4.49%), without defined dosage forms (4.29%), and without specified duration (2.84%).
Conclusion: The study concluded that E-prescribing eliminated prescription errors that resulted from handwritten prescriptions.

Keywords: Healthcare providers; patient information; pharmacists; safety.

1. INTRODUCTION

Series of medical errors have been revealed recently, medication errors which can be prevented before causing any harm to the patient [1]. This motivates health care professionals and governmental bodies to avoid such errors before occurrence [2]. Errors may result from the medication process during prescribing, transcribing, dispensing, or administering [2,3]. Administration and prescribing errors are the most common types of medication errors in hospitals [4]. It is expected that patients may anticipate exposure to medication errors daily, with these types of errors [4]. Therefore, as part of their routine duties, hospital pharmacists are responsible for reviewing and checking prescriptions to detect any errors or incompleteness. Thus, it helps in improving prescription quality and patient care [4]. They try to draw many plans to reduce prescription errors that occur with manual prescriptions and improved patient outcomes. Pharmacist training and education play an important role in identifying the prescribing errors and prevent them before reaching the patient [5].

Pharmacists, especially in the developed countries, are educated to check and verify all the received prescriptions. They also need to communicate with the prescribers if necessary to clarify or correct any inappropriate element before filling prescriptions, reconciling them for their medications, and providing medication reviews upon discharge [5]. The standard features of prescription include diagnosis, name of the recipient and drugs, dosage form, dose frequency, route of administration, duration, and physician identity [6]. Any errors resulting from these elements are considered as prescribing errors [6]. Prescribing error is defined as wrong instruction about one or more of the standard features of a prescription [7]. In addition, prescribing errors may involve uncompleted patient or drug information, incorrect doses, illegible prescription, and prescription with most or all words impossible to identify [8,9]. Prevention of prescription errors has received considerable attention that presents a major challenge to health care, especially pharmacists [10].

Recently, electronic prescribing has reduced medication errors and improved compliance with the hospitals' system [11]. This system has improved patient safety by ensuring the five important rights of medication management, including; right patient, right drugs, right dosage form, right route, and right frequency [12]. Electronic prescribing allows physicians and other medical practitioners to electronically fill and send prescriptions to participating pharmacies, rather than using handwritten or faxed notes or calling in prescriptions [13]. Consequently, the prescriber's ability to send an accurate and eligible prescription electronically to a pharmacy is an important quality element to improve patient care [14]. A previous study has identified the causes of prescribing errors that are a poor prescription structure and formulated through handwritten technique [15]. Among geriatric patients, fatal medication errors occurred because they take multiple medications simultaneously [16,17]. Children are also a population at risk because the concentration or strengths of the drug are written according to their weight; therefore, errors in the calculation may lead to fatal effects in children [18].

The hospitals recently resort to Computerized Provider Order Entry (CPOE), which refers to different computer-based systems that automate the medication ordering process. This approach is likely to standardize and make legible complete orders [19]. It also enables early detection and plays an additional role in the management of patients. There is rapid acceptance of this technology among radiologists and clinicians to review and process digital radiographic images and prescribe medicines accordingly. Electronic prescribing is considered a requisite measure for the prevention and reduction of prescription errors [20]. Therefore, the present study aims to assess the impact of the electronic prescribing system on prescription errors at King Abdul-Aziz University Hospital (KAUH) in Jeddah city.

2. MATERIALS AND METHODS

A pre and post-design study was employed to compare the impact of the electronic prescribing system on prescription errors with the traditional handwritten prescription. The data was collected at KAUH outpatient pharmacy services daily during the normal duties over two weeks in each stage. The Units approved the study of the Biomedical Ethics Research Committee at the Faculty of Medicine (approval number is D/37/25420). Then it was approved for the evaluation of the prescriptions included at the times of study from King Abdulaziz University Hospital and Director of pharmaceutical care Jeddah Saudi Arabia. The intervention was the introduction of electronic prescribing instead of handwritten prescriptions. The entire procedure was carried on by a team that included ambulatory physicians working with the hospital information technology (IT) team and the director of the pharmacy. Two research assistants were trained to monitor the traditional and E-prescriptions and enter them into a Microsoft Excel database. CPOE enables healthcare providers to transmit orders electronically, which improves efficiency while submitting medication orders to their respective departments.

The study was undertaken in two stages. In the first stage, the data of all handwritten prescription was evaluated and collected, that took two weeks from 2nd December to 15th December 2015. The second stage was performed after enforcement from a pharmacy that will dispense only E-prescription, all electronic prescriptions for two weeks from 11th December 2016 to 24th December 2016 were evaluated, and data collected after the intervention. Prescriptions were considered about the presence of the following criteria that include; file number, patient's name, drug names, strength, dosage forms, route of administration, frequency, duration, doctor's name or stamp, the total number of medications, and prescriptions. All the personal data of patients, including their names and file numbers, were kept confidential. Data were extracted to chart review form without mentioning in any part, name of prescribing physicians or patients. Table 1 summarizes all types of errors presented during the analysis.

3. RESULTS AND DISCUSSION

3.1 Pre-Intervention

A total of 1182 prescriptions were included during the pre-intervention study period, with a capacity of 2957 items been prescribed, with an average of 2.5 items per prescription (Fig. 1). A total of 6627 errors were detected from these prescriptions (Table 2 and Fig. 2). The most detected errors were medications written without defined dosage forms, which were recorded 1653 (55.90%) times (Fig. 3). Followed by those medications written by trade names 1493 (50.49%) (Fig. 4), without route of administration 1266 (42.81%), without specified duration 1009 (34.12%), without doctor's name or stamp 294 (24.87%), without date 290 (24.53%), without strength 602 (20.36%), illegible prescription 75 (6.35%), without frequency 155 (5.24%), without file number 52 (4.40%), without patient's name 32 (2.71%), and without diagnosis 1102 (93.23%).

Table 1. Reported errors

Errors (Pre-Intervention)
Medications written without defined dosage forms
Medications written by trade names
Medications without route of administration
Medications without a specified duration
Medications without doctor’s name or stamp
Medications without date
Medications without strength
Illegible prescription
Medications without frequency
Medications without file number
Medications without patient’s name
Medications without diagnosis

Table 2. Number and percentage of prescribing errors occurrence in handwritten prescriptions during pre and post-intervention period

Type of errors	Pre-intervention	Post-intervention
No file number	(52) 4.40%	(9) 0.60%
No patient name	(32) 2.71%	(24) 1.59%
No date	(290) 24.53%	(32) 2.12%
Items written by trade names	(1493) 50.49%	(87) 4.49%
Items are written without strength	(602) 20.36%	(11) 0.57%
No dosage form defined	(1653) 55.90%	(83) 4.29%
No route of administration	(1266) 42.81%	(32) 1.65%
No frequency	(155) 5.24%	(5) 0.26%
Duration not specified	(1009) 34.12%	(55) 2.84%
Illegible prescription	(75) 6.35%	(1) 0.07%
No doctor's name or stamp	(294) 24.87%	(23) 1.52%
Total	6627	339

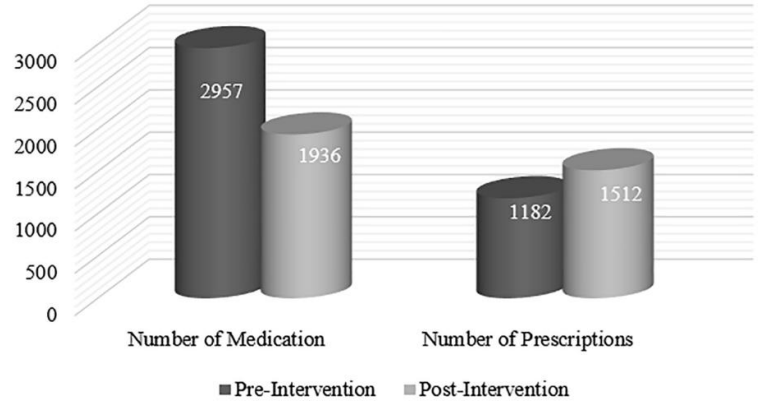

Fig. 1. Number of prescriptions and prescribed medications in pre and post-intervention

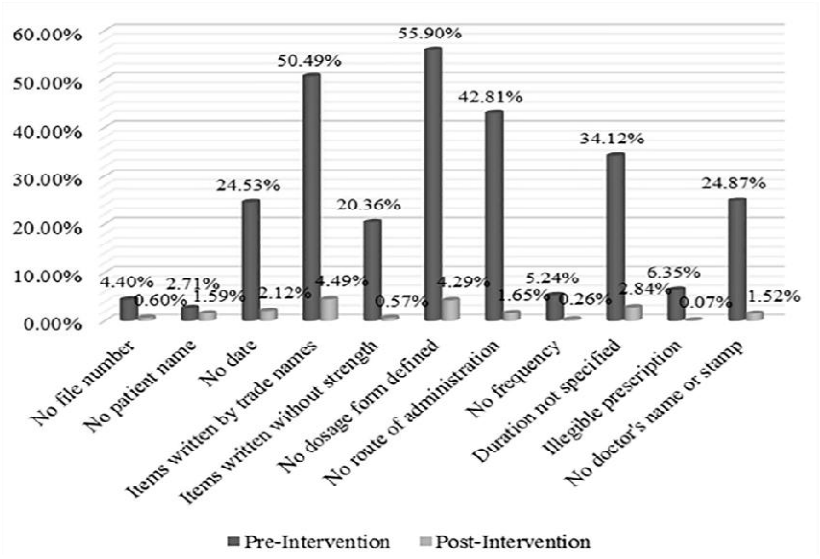

Fig. 2. Percentage of prescribing errors in handwritten prescriptions during pre and post-intervention period

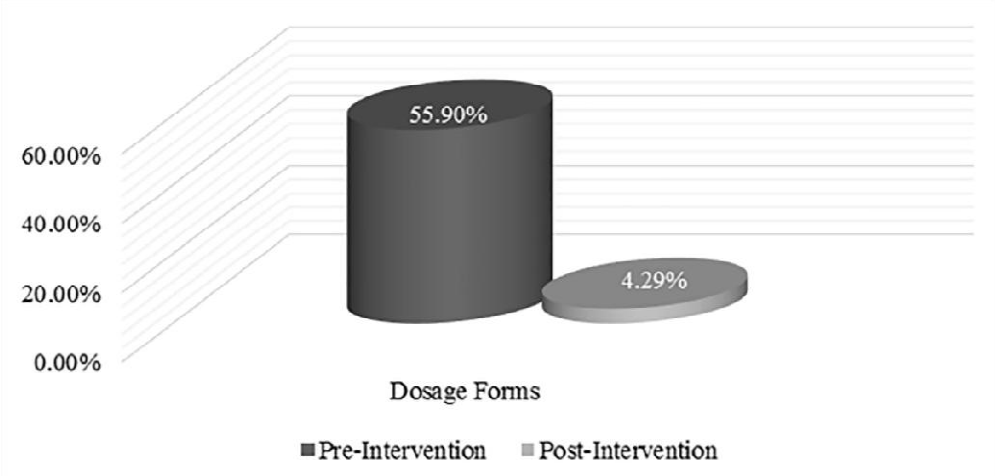

Fig. 3. Percentage of prescribed medications without dosage forms in handwritten prescriptions

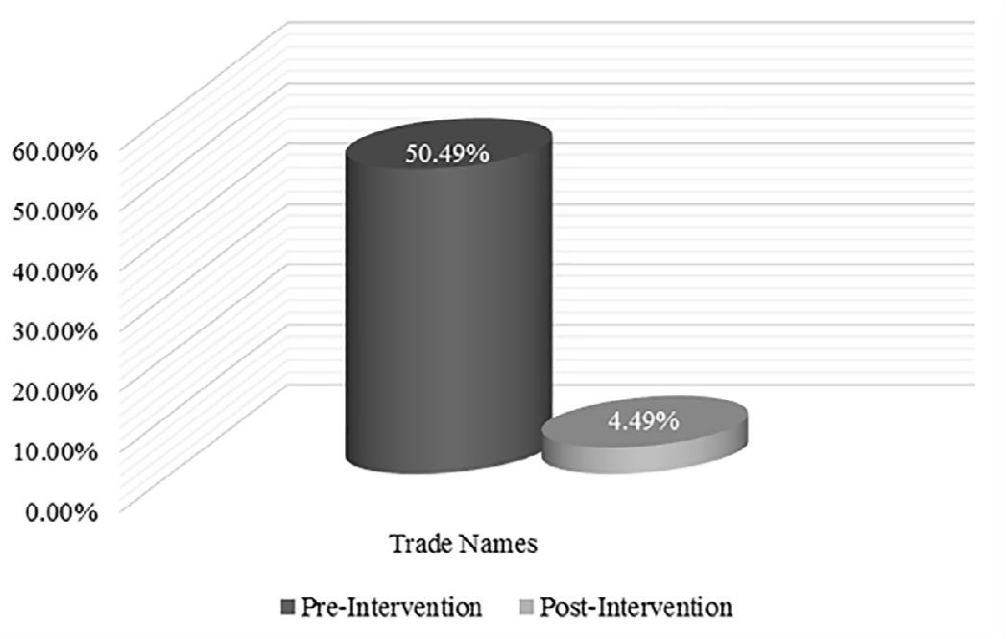

Fig. 4. Percentage of prescribed medications with trade names in handwritten prescriptions

3.2 Post-Intervention (Use of E-prescribing)

A total of 1512 prescriptions were included during the post-intervention study period, with 1936 total items having an average of 1.28 items per prescription. Eighty-two were handwritten prescriptions with 118 items, while 1430 E-prescriptions with 1818 items. A total of 339 errors were detected in this phase, all from handwritten prescriptions with no errors were obtained from E- prescriptions (Fig. 4). Errors were mainly of the 77 prescriptions written without diagnosis (5.09%), 23 without doctor's name or stamp (1.52%), 87 items written by trade names (4.49%), 83 items without defined dosage forms (4.29%), and 55 items without specified duration (2.84%). Moreover, 32 prescriptions were without date (2.12%), 32 written without route of administration (1.65%), 24 without patient's name (1.59%), 9 prescriptions without file number (0.60%), 11

without item's strength (0.57%), 5 items without frequency (0.26 %), and one illegible prescription (0.07%). All E-prescriptions were generated with the option to display the patient's diagnosis. Moreover, the doctor's name and contact numbers were available on screen, and they were eligible to prescribe through the computer system by entering username and password.

The present study results had shown a substantial reduction in prescribing errors when the system was changed to an electronic one. Fortunately, the electronic prescribing system has reduced all writing errors associated with handwritten prescriptions. There were no writing errors in prescriptions after the introduction of electronic prescribing. In contrast, these errors were very prevalent when the prescribing system depends on the physician's handwriting. However, about 5.42% of prescriptions are still issued by handwritten. This still produces a considerable number of errors during the post-intervention study period, such as missing the patient's name (1.59%) and file number (0.60%). E-prescribing showed zero percentage compared to results at pre-intervention study, where the result was 2.71% for missed patient's name and 4.40% for missed file number.

In the pre-intervention of the present study, 5.24% of handwritten prescriptions were not reported; whereas, other previous studies record 3% and 18% of prescriptions with omitted frequency [21]. While in a post-intervention survey, 0.26% of prescriptions written were reported with missed frequency. It is important to mention the frequency to maintain the plasma level of the drug to get the optimal effect and enhance both efficacy and safety. Still, 2.84% of drugs written by hand in the post-intervention study were without duration. Specifying duration is very important to strengthen the drug's effectiveness and improve the outcomes of the patient. Little errors still occur as 0.07% of prescriptions in the post-intervention study were not eligible.

In contrast, 6.35% of prescriptions in the pre-intervention period showed 20.2% of medication orders were illegible or readable with the effort that may cause wrong dispensing of medication by a pharmacist. Previous studies have shown that electronic prescriptions reduced such errors. Interestingly, this study showed a lower percentage of illegibility as compared to other studies.

A previous study has shown the significant importance of mentioning the correct name of the patient and file number as it ensures that the patient receives his medications [22]. It is also important when the pharmacists need to address the patient by their name or when they need to discuss any intervention regarding the prescription with prescribing physician [23]. However, previous studies have found that the missed patients' demographic rate varies between 5% and 14.5% of the prescriptions [24, 25-26].

Drug strengths and dosage forms were omitted in many prescriptions (20.36% and 55.90%, respectively) in the pre-intervention study. This result was similar to findings of previous studies with a percentage of 22.11% for the prescriptions written by hand [21,26]. However, errors still may happen because 0.57% of prescribed items were written by hand without strength and 4.29% without dosage forms. After all, there is a variety of strengths and dosage forms available for the same drug. Route of administration was not specified in 42.81% of prescriptions in the pre-intervention phase of the study. Other studies have reported percentages ranging from 13% to 22.38% prescriptions with the unspecified route of administration [21]. About 1.65% of handwritten drugs are issued without route administration, affecting the therapy plan, especially the bioavailability, as it differs according to the administered route.

The majority of the handwritten prescriptions were issued without mentioning the diagnosis. This was consistent with a previous study, which showed that most of the diagnosis in prescriptions was missing [21]. Electronic prescriptions enable the pharmacist and other concerned health team members to view a patient's diagnosis that plays an important role in helping the pharmacist check the suitability of medications prescribed. A similar study conducted in Oman showed that 24.90% of prescriptions in pre-intervention study; while, 4.6% of the prescriptions in the post-intervention survey had no prescriber signature [27]. Still, in handwritten prescriptions, 1.52% of prescriptions written by the physicians did not comply with their name or signature. E-prescribing is done by physician username and official login; however, emphasis is needed to complete the medical prescription so that the pharmacist and another team member can have full information about the patient and prescribed drugs [21]. The introduction of electronic prescribing can

decrease all the errors mentioned above, which may lead to harmful situations and affect the outcome of patients [28]. Encouragingly, the introduction of automation alleviated all prescribing errors prevalent in the past and decreased the manual processing of prescriptions by a physician [29]. It is expected that the percentage of reduction in prescribing errors will decrease largely through the access of automation process. Moreover, this E-prescribing is helpful to the healthcare providers for the safe management of patients' medications and helps them focus more on patient compliance issues. A decrease in the prescribing error accompanies the increase in the number of prescriptions dispensed daily with a reduction in the number of items prescribed during the pre-intervention phase of the study.

The study results are limited as it has no control group. The absence of control poses alternate explanations about the apparent causal relationship between the variables that threaten study results. Moreover, it also fails to analyze errors and missing information as dosing errors and drug-drug interactions. Therefore, retrospective audits are required for collecting the information needed to apply this taxonomy.

4. CONCLUSION

The present study has evaluated the impact of the electronic prescribing system on prescription errors. The results revealed that the entry of a computer-dependent system to prescribe patient's medications had shown a complete elimination of prescriptions errors resulting from handwritten prescriptions. In the post-intervention period, several prescriptions were written by hand, which produced a small percentage of errors that improve the quality of prescribing process. Pharmacy departments should make recommendations to stress about E-prescribing to prevent errors in patients' prescribed medications and completely abolish handwritten prescriptions.

CONSENT

As per international standard or university standard, patients' written consent has been collected and preserved by the author.

ETHICAL APPROVAL

The study was approved by units of the biomedical ethics research committee at the faculty of medicine and byt King Abdul-Aziz University Hospital, Jeddah, Saudi Arabia.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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