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Original Article

INCIDENCE AND PREVALENCE OF PRESCRIBING ERRORS IN SAUDI ARABIA: A SYSTEMATIC STUDY

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ABSTRACT

Objective: The increased incidence of prescribing errors has become a major health problem and is a concern for healthcare authorities across the world due to its serious medical consequences for patients. However, very little is known about prescribing errors in Saudi Arabia. Therefore, this review aims to systematically review the studies that have assessed the incidence and prevalence of prescribing errors in Saudi Arabia.

Methods: A systematic review of the literature related to prescribing errors among adults in Saudi Arabia was limited by the period from January 2005 up to April 2016, using the following databases: PubMed, Scopus and ISI Web of Science. The search strategy included studies conducted among adults 18 or over; in primary or secondary care in Saudi Arabia; that assessed handwritten prescriptions by junior or senior doctors; and that were published in the English language only. The quality of the included studies was assessed using a 13-item quality assessment tool adopted from two previous studies.

Results: Six studies met the inclusion criteria. The overall quality of the included studies was variable. Error rates varied from 7.1% to 94% for prescribing. The median error rate interquartile range (IQR) was as high as 32% (7.1-49%). Duration of the studies ranged from one day to two years. The studies included data on 259,055 prescription orders, with a number of prescription orders assessed in the studies ranging from 1582 to 240,000. The most common types of prescribing errors reported were attributed to incorrect dosage followed by incorrect strength and incorrect duration of treatment.

Conclusion: This review suggests the need to improve the prescribing skills and knowledge of prescribers in Saudi Arabia through the introduction of educational and training programmes with the aim of reducing prescribing errors.

Keywords: Medication errors, Drug prescriptions, Inappropriate prescribing, Middle East, Saudi Arabia

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INTRODUCTION

Medication errors are common [1], and are a leading cause of patient morbidity and mortality in all healthcare settings [2, 3]. This can cause unnecessary pain and harm to patients and can even lead to death [4, 5]. The Agency for Healthcare Research and Quality (AHRQ) defines a medication error (ME) as "an error (of commission or omission) at any step along the pathway that begins when a clinician prescribes a medication and ends when the patient actually receives the medication" [6]. In the United States, MEs have been reported to be responsible for 7,000 injuries to patients per year, with a similar incidence and consequences reported in the United Kingdom and worldwide [7, 8].

Although MEs can occur at any stage of the medication use pathway [4], prescribing errors are the most common subtype of MEs in all healthcare settings [9-11]. Evidence from a systematic review that included 65 studies suggested that prescribing errors accounted for 7% of medication orders, 50% of hospital admissions and 2% of inpatients [12]. The percentage of prescribing errors ranged from 29% to 56% of all reported MEs in adults [9, 13].

Many definitions have been used for the term 'prescribing error' in previous studies. However, one of the most validated definitions was developed by Dean *et al.* (2000), as follows: "a prescribing error occurs when, as a result of a prescribing decision or prescription-writing process, there is an unintentional, significant reduction in the probability of treatment being timely and effective; or increase in the risk of harm when compared to generally accepted practice" [14]. It can also be further defined as "a failure in the prescription writing process by a physician that results in a wrong instruction about one or more of the normal features of a prescription" [15]. The "normal features" include the identity of the recipient, the identity of the drug, the formulation, and dose, and the route, timing, frequency and duration of administration [15].

The National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP), which includes 27 national organizations, suggests that MEs are preventable [16]. However, prevention of MEs can be challenging, particularly in inpatient settings where prescription orders are more prone to errors [17]. These errors may result in increased patient care costs due to prolonged length of hospital stay and an increase in the patient mortality rate [18].

MEs have become a universal problem; however, most of the evidence on MEs has been collected from developed countries such as the US and Europe [19], whereas MEs are still under-reported in the developing countries, including Saudi Arabia. Medication errors can cause serious consequences for patients such as adverse drug events (ADEs), which represent a major cause of harm. However, the overall incidence of ADEs and the implications of MEs in Saudi Arabia are still unknown [11]. However, only one study was found in the literature suggested that MEs were a contributory factor to the 26 deaths reported by Aldhawailie *et al.*, study.

A study conducted in a large tertiary university teaching hospital in Riyadh, Saudi Arabia, identified 113 (7.1%) prescribing errors out of the total 1582 medication orders assessed [20]. Incorrect drug strength and incorrect drug administration frequency were the two most common types of errors identified during the study [20]. However, no study has systematically assessed the incidence and prevalence of prescribing errors in both primary and secondary care in Saudi Arabia. Furthermore, considering the important

implications of prescribing errors for patient safety, there is a need to investigate the nature and extent of such errors in Saudi Arabia as well as to establish their overall incidence and prevalence in the country. Therefore, this review aims to systematically review the studies that have assessed the incidence and prevalence of prescribing errors in Saudi Arabia.

MATERIALS AND METHODS

Search strategy for identification of studies

Three major electronic databases–PubMed, Scopus and ISI Web of Science–were searched in April 2016 using the following MeSH terms: [Medication Errors] OR [Potentially Inappropriate Medication List] OR [Prescription Drug Misuse] OR [Drug Prescriptions] OR [Inappropriate Prescribing] AND [Middle East]. Saudi Arabia is not a MeSH term. Therefore, Middle East was used and then studies conducted in Saudi Arabia were manually selected. Searches were restricted to the English language only and were limited by the period from January 2005 up to April 2016. Although Arabic is the national language of the studied country, medical studies in the Middle East are always reported in English. Reference lists of all included articles were also manually searched to identify any other relevant studies.

Study selection

All types of quantitative studies were included if they: (1) reported incidence or prevalence of prescribing errors among adults 18 or over; (2) were conducted in primary or secondary care in Saudi Arabia; (3) assessed handwritten prescriptions by junior or senior doctors and (4) were published in the English language only. Research on patient safety and MEs started in 2005 [19]; therefore, studies published between 2005 and 2016 were included in the review. Abstracts and conference proceedings were also included. Exclusion criteria included studies conducted outside Saudi Arabia. Similarly, studies reporting prescribing errors in children and neonates, studies not reporting incidence or prevalence of prescribing errors, review studies, and intervention studies were also excluded from the review. Furthermore, studies reporting prescribing errors that occurred during the use of computerized physician order entry (CPOE) were excluded as they are different to the errors reported with handwritten prescriptions [21]. In addition, handwritten prescriptions still dominate as the main method of prescribing in hospitals worldwide [21].

Data extraction and quality assessment

Two reviewers independently reviewed the titles and abstracts of all potentially relevant articles. Duplicate articles were removed. Articles that met the inclusion criteria were retrieved as full papers and two reviewers checked each paper either electronically or as a hard copy for inclusion. Furthermore, reference lists of the retrieved articles were manually screened to identify any further relevant studies. Any disagreements between the reviewers were agreed through discussion or resolved through a third reviewer. A standardized data extraction form was used, based on the Cochrane checklist for systematic reviews [22], and the third edition of the NHS Centre for Reviews and Dissemination (CRD) guidance produced for undertaking systematic reviews [23]. One reviewer independently extracted data onto a proforma that included: author name, study settings, the location of the study, year of publication, study type, duration of the study, the total number of prescription orders assessed and results (rate of prescribing errors). The second reviewer checked the extraction sheets.

The quality of the included studies was assessed using the 12-item quality assessment tool adopted from two previously published studies [8, 24]. In addition, ethical approval reported in the studies was also assessed. As a result, all included studies were assessed by two reviewers based on the 13-item quality assessment tool shown in Table 1.

Statistical analysis

A narrative overview and analysis of included studies were undertaken. Percentage frequencies of prescribing errors were reported.

RESULTS

A total of 112 studies were identified through initial searches (fig. 1), 107 from electronic databases and five from reference lists of included studies. Six duplicates were removed. One hundred and six records were screened at the title and abstract level, with 69 irrelevant titles removed. Thirty-seven full-text studies were assessed for eligibility; 31 studies did not meet inclusion criteria (fig. 1). Reasons for exclusion included the following: studies with no data on prescribing errors, studies reporting errors with electronic prescribing, studies including children and neonates, studies conducted outside Saudi Arabia, studies not reporting incidence or prevalence of prescribing errors and intervention studies. Six studies contributed to the systematic review [20, 25-29].

Table 1: 13 item criteria used for quality assessment of included studies

1.	Aims/objectives of the study clearly stated.
2.	Definition of what constitutes an ME.
3.	Error categories specified.
4.	Error categories defined.
5.	The presence of a clearly defined denominator.
6.	Data collection method described clearly.
7.	Setting in which study conducted described.
8.	Sampling and calculation of sample size described.
9.	Reliability measures.
10.	Measures in place to ensure that results are valid.
11.	Limitations of study listed.
12.	Mention of any assumptions made.
13.	Ethical approval

Study characteristics

Four studies were conducted in the capital of Saudi Arabia, Riyadh [20, 27-29], one in Makkah [26], and one in the Asir region [25] (see table 2 for characteristics of studies included in the review). Four studies were performed in secondary care [20, 26, 28, 29], and the remaining two studies were conducted in primary care settings, either in a single outpatient clinic [25], or multiple clinics [27]. Studies were conducted in various ward settings, including surgery [26, 28], medical [20, 26, 28], intensive unit [26, 28], cardiology [28], and emergency department [28, 29]. Duration of the studies ranged from one day [27] to two years [26]. The studies included data on a total of 259,055 prescription orders, with individual study numbers ranging from 1582 [20], to 240,000 prescription orders assessed [28].

Three studies were carried out retrospectively [25, 26, 29], and two prospectively [20, 27]. One study did not specify whether the data was reviewed prospectively or retrospectively [28].

Five studies included patients who were prescribed multiple classes of medications (i.e. antibiotics, antacids, proton-pump inhibitors, corticosteroids and anti-inflammatory medicines, antidiabetic and cardiovascular medicines) [20, 25-28], while the remaining one study focused only on antibiotics [21]. In three studies, pharmacists collected the prescription data [20, 25, 29], while a multidisciplinary team was involved in the data collection in one study [28]. In the remaining study, there was no involvement of healthcare professionals in the data collection and data was collected by research assistants only [27].

Half of the included studies (n=3) used the prescription review method [25, 27, 28], whereas the medical record review method was used in two studies [26, 29]. Only one study used a combination of both prescription review and medical record review methods [20].

Three studies did not validate the reported prescribing errors [25, 26, 28], while one study conducted partial validation of the reported errors, where one independent pharmacist randomly checked reported data [27]. The remaining two studies validated all reported errors by contacting the prescribers [20] or accessing the electronic medical record system (QuadraMed) [29].

Study quality

The overall quality of the included studies was variable. None of the six studies met the complete 13-item quality assessment tool. Only one study met nine of the quality tool items [29]. The remaining five studies met fewer than seven of the tool items [20, 25-28].

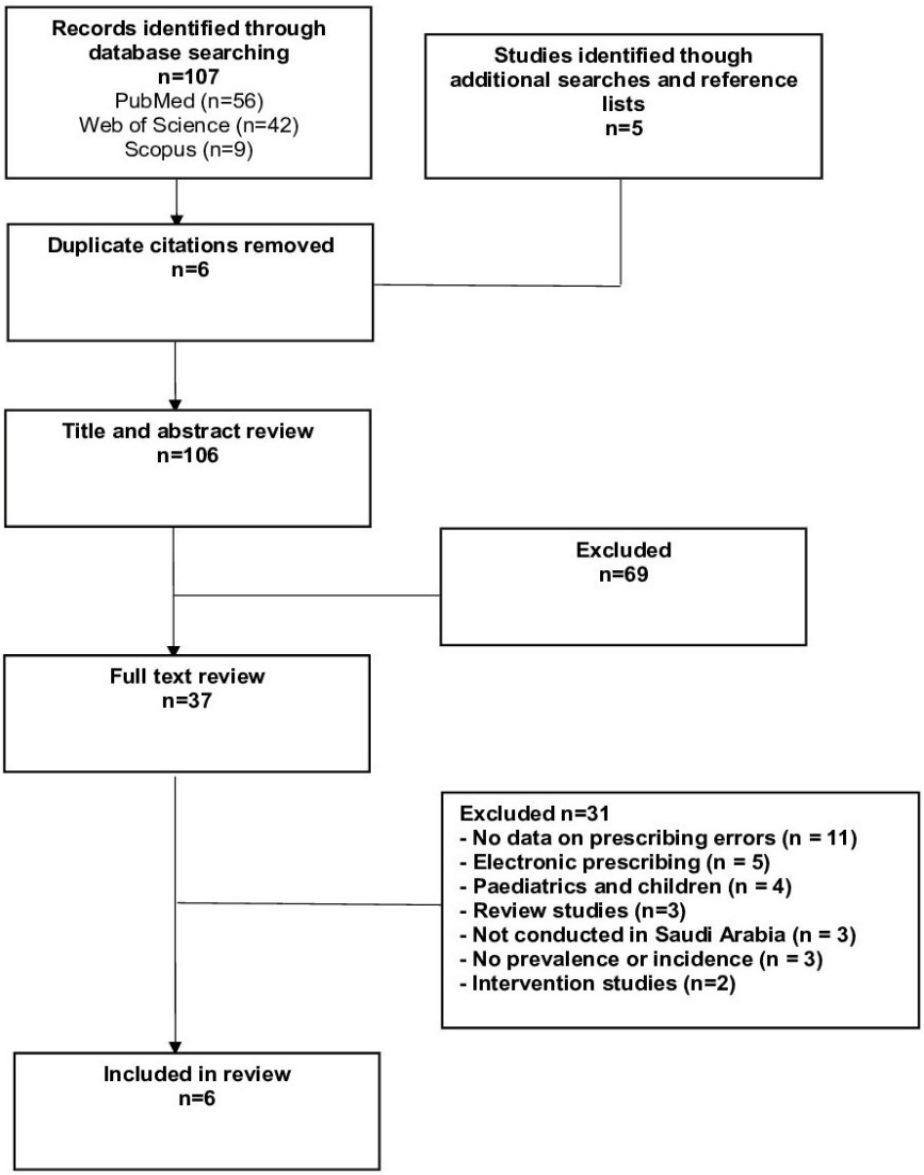

Fig. 1: Prisma flow diagram

Table 2: Characteristics of studies included in the review

Author name, year of publication, study settings, study location	Type of study	Duration	Total order/ prescriptions	Results (rate of prescribing errors)
Irshaid *et al.* (2005), Primary care, Asir	Retrospective data review	1 y	3795 prescriptions	94% of prescriptions had no quantity indicated; 90.7% of prescriptions had incomplete instructions for patients.
Dibbi *et al.* (2006), Secondary care, Makkah	Retrospective data review	2 y	2627 patient files	60% of patient files contained one error; 30% of patient files contained two errors, and 3 errors or more were found in 10% of patient files. Wrong strength was reported in 914 patients (35 %).
Aldhawailie *et al.* (2011), Secondary care, Riyadh	Prospective data review	1 mo	1582 Medication orders	7.1% prescribing errors were detected; wrong strength 39 (35%) followed by wrong dosage 26 (23%).
Khoja *et al.* (2011), Primary care, Riyadh	Prospective data review	1 d	5299 prescriptions	18.7% prescribing errors identified; 8 (0.15%) prescribing errors had a serious effect on the patients.
Alshaikh *et al.* (2013), (Secondary care, Riyadh	Not specified	1 y	240,000 prescriptions	0.4% of medication error rate was detected. Medication errors were reported predominantly at the prescribing stage of the medication process (89%). The most common types of errors were prescribing (44%) and improper dose/quantity (31%).
Alanazi *et al.* (2015), Secondary care, Riyadh	Retrospective data review	3 mo	5,752 patients' charts	46.2% of prescribing errors were detected with at least one type of error with antibiotics (ATB). Errors were lowest in selection of ATB class (2%), followed by dosage (21.7%), and duration (28.6%).

Definition of prescribing errors used in the included studies

Regarding the definitions used, none of the studies used a standard and validated definition. None of the studies (n=6) that investigated prescribing errors in Saudi Arabia clearly stated a definition of the term but instead conceived their own definitions based on the commonly known types of prescribing errors [20, 25-29].

Rate of prescribing errors

The rate of prescribing errors reported in the included studies ranged from 7.1% [20] to 94%[25] (table 2). In one study, 94% of the prescriptions assessed had no quantity indicated and 90.7% of prescriptions had incomplete instructions for patients [25]. Measures used to calculate the rate of prescribing errors were: medication orders (prescriptions) [20, 25-28], and patients' charts [29]. Of the prescribing errors reports, three studies declared that antibiotics were the most frequent class associated with prescribing errors [26, 28, 29].

Types of prescribing errors

Incorrect medication dosage was the most frequent type of prescribing error, with three studies reporting such errors [20, 28, 29] (table 2). Incorrect strength was the second most common type, with two studies reporting such errors [20, 26], followed by incorrect duration of treatment, with one study reporting such errors [29]. Furthermore, unclear handwriting and incomplete patient instructions were another type of error reported in one study [25].

Severity of reported prescribing errors

Half of the studies (n=3) did not report the severity or potential severity of the prescribing errors, while three studies did do so [20, 26, 28]. One of these three studies reported 26 deaths and suggested that MEs were a contributory factor to these deaths [26]. Two studies classified the severity of the prescribing errors into actual or potential errors [20, 26]. However, each study used a different scale. These scales were developed by each study's authors. One study adopted a scale from a validated system to classify the type of prescribing error [27]. It is noteworthy that reported severity in the studies varied between different classes of medicines used. For instance, severe errors were associated with the use of antacids, antidiabetic and cardiovascular medicines [25, 28]. On the other hand, major and minor errors were associated with antibiotics, proton-pump inhibitors, corticosteroids and anti-inflammatory medicines [20, 27, 29].

DISCUSSION

To the best of our knowledge, this is the first systematic review that has assessed the prevalence, incidence and types of prescribing errors among adults in Saudi Arabia. The findings of this study confirm a higher incidence of prescribing errors in the country, with errors ranging from trivial to serious. These errors had a variable impact on patient healthcare that depended on the medicine class, route of administration and dose. Previous studies also suggest that increased incidence of prescribing errors has become a major problem and is a concern for healthcare authorities across the world [12, 30]. For example, a systematic review conducted in the UK by Lewis and colleagues to determine the incidence, prevalence, and nature of prescribing errors reported that prescribing errors were a common practice in secondary care [12].

In this particular study, the median error rate (interquartile range [IQR]) was 7% (2-14%) of the total medication orders. However, in our review, the median error rate (IQR) was found to be as high as 32% (7.1-49%) of medication orders. The wide range of prescribing errors reported in this study could have been influenced by the study setting, methodology, and definitions used for error identification. For example, the highest prescribing error rates reported in this study were identified through a retrospective prescription review method. This method is considered to identify the largest proportion of errors (70-80% of all prescribing errors). Furthermore, it identifies errors that result in patient harm [31]. In contrast, a prospective review of medication prescriptions reported the least number of prescribing errors. This method is known to detect only about 30% of all prescribing errors, and it is unlikely to identify errors that result in patient harm as errors [31].

In Lewis *et al.*'s 2009 review, errors were identified and reported before they caused harm and were most common with antimicrobials, which is consistent with the findings of this review. However, the severity of the detected errors was evaluated in only two studies, which used different methods to measure the severity of prescribing errors [20, 26]. The difference in the method of evaluation made it difficult to draw any conclusions about the severity of reported errors.

The most common types of prescribing errors reported in this review were attributed to incorrect dosage, strength, and duration of treatment. These findings were in line with the findings of previous studies conducted in the US and UK [8, 12, 32, 33]. Similarly, the UK National Patient Safety Agency [4] also reported that the most common type of medication error reported in the National Health Service (NHS) was incorrect dosage or frequency of medication [4].

It is noteworthy that the definitions used in the studies included in this review were inconsistent, and the majority of these definitions were produced either by the study authors or were a combination of different authors' definitions. The use of a pre-validated definition is highly recommended to ensure the generalisability of the findings and to compare these findings with the finding of studies conducted internationally.

This study has some limitations. Firstly, a limited number of studies were included in this review. Secondly, most of the studies included in this review were conducted in a single hospital, and their findings may therefore not be generalisable to the wider population. Furthermore, some of the included studies had a study period as short as one day [27]. Therefore, the results obtained from such a study should not be perceived as definitive; the study should be considered as being preliminary and indicative. Finally, this review only included studies that were published in English, which may have resulted in the exclusion of relevant studies published in other languages.

Based on the findings of this review, the authors would suggest some recommendations improve medication safety by reducing prescribing error in Saudi Arabia. To begin with, there is a need to raise awareness among prescribers about prescribing errors. Prescribers would need to focus on the most common types of prescribing errors such as medication dosage and make every effort to identify these errors before they reach the patients. Secondly, the prescribing error reporting system needs to be improved in Saudi Arabia by removing the barriers attached to reporting and by encouraging healthcare professionals including prescribers to promptly report such errors. Thirdly, clinical pharmacist-led educational programmes should be introduced at the undergraduate and postgraduate level for medical and other allied healthcare students. Finally, work is required to evaluate the effectiveness and policy implications of interventions aimed at reducing prescribing errors in Saudi Arabia.

CONCLUSION

A high incidence of prescribing errors was reported in Saudi Arabia. However, there was a wide variation between the rate of prescribing errors reported in the included studies. This variation could have been explained by the differences in the study settings, methodologies, and definitions used to report prescribing errors. The common types of error reported in this study were attributed to incorrect medication dosage and strength, and unclear handwriting of prescribers. These findings, therefore, suggest the need to improve the prescribing skills and knowledge of prescribers in Saudi Arabia through the introduction of educational and training programmes with the aim of reducing prescribing errors.

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CONFLICTS OF INTERESTS

All authors have none to declare.

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