International Journal of Religion
2024
Volume: 5| Number 12 | pp. 1773 – 1780
ISSN: 2633-352X (Print) | ISSN: 2633-3538 (Online)
ijor.co.uk
DOI: https://doi.org/10.61707/g6pky360

Medication Errors among Pharmacists in Hospitals and Health Care Centers Affiliated with the Ministry of Health: A Systematic Review

Ahmed Abdulrahman Alzahrani[1], Faiz Fahd Mubarak[2], Abdulrahman Abdu Judayba[3], Dhafer Ghannam ALQahtani[4], Othayman Ghannam Alqahtani[5], Bader Abdullah Alqahtani[6], Mesfer Abdullah Alqahtani[7], Fay abdulaziz ALJumaah[8], Fadhel Ali Sahla Alanaz[9] and Faisal Mohammed Almasoud[10]

Abstract

Medication errors (MEs) present a significant issue in health care area, as they pose a threat to patient safety and could occur at any stage of the medication use process. The objective of this systematic review was to review studies reporting the rates, prevalence, and/or incidence of various MEs in different hospitals and health care centers, searched PubMed, HINARI, Google, and SCOPUS for relevant published studies. We included observational, cross sectional or cohort studies on MEs targeting adults in different health care settings, a total of number records were identified through searching different databases. Following the removal of duplicates, screening of title, abstract and full text screening, 24 papers were included for the final review step. Prescribing errors was the most common error reported in the included studies, where it was reported in 15 studies. The prevalence of prescribing errors ranged from 0.1% to 96%. Two studies reported unintentional discrepancies and documentation errors as other types of MEs, where the prevalence of unintentional discrepancies ranged from 47% to 67.9%, and the prevalence of documentation errors ranged from 33.7% to 65%. In conclusion, a wide variation was found between the reviewed studies in the error prevalence rates. This variation may be due to the variation in the clinical settings, targeted populations, methodologies employed. There is an imperative need for addressing the issue of MEs and improving drug therapy practice among Pharmacists or health care professionals by introducing education and training.

Keywords: *Medication Errors, Pharmacists, Hospitals, Health care centers. Ministry of Health.*

INTRODUCTION

Medication errors (MEs) are under-reported in all countries, particularly in developing countries. MEs present a universal problem and can cause serious consequences for patients, especially those with acute complex medical conditions. The National Patient Safety Agency revealed that MEs in all care settings in the UK occurred in each stage of the medication treatment process, with 16 % in prescribing, 18 % in dispensing and 50 % in administration of drugs [Keers, et al, 2013].

To explore and highlight the problem of MEs in this region, there are a variety of reasons why MEs may be different in this region. These include the training of health professionals in clinical pharmacology, differences in relation to the role of clinical pharmacists, and the types of medicines prescribed.

This systematic literature review therefore aimed to identify and review studies of the incidence and types of MEs and identify the main contributing factors, errors, documentation errors, transcribing errors, medication

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mistakes drug mistakes, prescribing mistakes, dispensing mistakes, administration mistakes, transcribing mistakes wrong medication, wrong drugs, wrong doses, wrong route of administration, wrong calculations, physicians, pharmacists and nurses [Ogunleye, et al, 2016].

Medication errors (MEs) have been defined by The National Coordinating Council for ME Reporting and Prevention 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 health-care professional, patient, or consumer (National Coordinating Council for ME Reporting and Prevention).[1] These errors pose a threat to patient safety, and may lead to many adverse consequences, such as patient harm (injury or disability), admission to hospital, increasing the duration of hospital stay, the cost of health care, and occasionally death [Asensi-Vicente, et al, 2018].

MEs could occur at any stage of the medication use process, such as prescribing, transcribing, dispensing, and administration. The stages that are associated with the most common errors are prescribing and drug administration.[5,6] The worldwide incidence of MEs ranges from 2% to 14% [Kavanagh, et al, 2017]. The causes of MEs were identified and may include illegible handwriting, heavy workload, labeling errors, interruptions, and distractions that health care professionals face during drug prescription and administration, and wrong drug calculations.

Organizational policies and procedures to prevent MEs should be established, and these procedures should be implemented in the every step of drug delivery [Lavan, et al, 2016]. Moreover, prompt reporting of any occurred MEs should be encouraged. Furthermore, electronic prescribing as a tool helps against some errors that occur as a result of illegible handwriting and incompleteness of prescriptions, as using the mandatory fields in electronic prescribing ensures the completeness of the prescription [Tully, et al, 2012]. Another type of technology that could be used to prevent MEs is bar coding, in which using this technology in dispensing phase had led to a reduction in wrong MEs, a reduction in wrong dose errors, and a total elimination of incorrect dosage form errors [Shamseer, et al, 2015].

Recently, the research concerning MEs in Saudi Arabia is expanding. However, no previous comprehensive review of literature regarding MEs has been undertaken. This review aimed to report the rates, prevalence, and/or incidence of various MEs in different hospitals health-care centers settings. Papers, abstracts, unpublished theses, editorial reports, or letters to the editors with limited information have been excluded. Moreover, the exclusion criteria include studies focused on illegal substance abuse, herbal products, pediatric population (<18 years), MEs during pregnancy or published in other languages than English. The randomized controlled trials were excluded since these could not be used to reliably assess the incidence and/or prevalence of the outcomes of interest. Finally, we excluded studies describing and predicting the types and causes of adverse drug reactions [Stefanacci, et al, 2015].

Study Objective

Medication errors that may occur among pharmacists in hospitals or health care centers are a major societal concern and can have serious medical consequences in patients. As little is known about medication errors that may sometimes occur among pharmacists, the study aims to conduct a systematic review of special studies, the occurrence of medication errors and their types in some countries of the world, including Saudi Arabia, and identifying their causes and the factors contributing to this occurrence using the following databases: Embase, Med line, and PubMed inclusion criteria were the studies evaluated or discussed the incidence of medication errors and factors contributing to the occurrence of medication errors during treatment the process of drug treatment for patients with various diseases, criteria have been applied in selection process of the current study.

Study Selection

The study focused at the Studies that dealt with errors in medication prescriptions for patients by some pharmacists or doctors, whether in inpatient departments or outpatient clinics**,** and studies conducted in community or emergency departments. Furthermore, we included studies that described prescription and/or

over-the-counter medications, observational studies, and cross-sectional analysis which are suitable for estimating the incidence of medication errors.

Review articles, conference papers, abstracts, unpublished theses, editorial reports, or letters to the editors with limited information have been excluded. Moreover, the exclusion criteria include studies focused on illegal substance abuse, herbal products, pediatric population (<18 years), MEs during pregnancy or published in other languages than English. The randomized controlled trials were excluded since these could not be used to reliably assess the incidence and/or prevalence of the outcomes of interest. Finally, we excluded studies describing and predicting the types and causes of adverse drug reactions.

Study Design

A systematic review is the design of this study, and the protocol used was developed based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [Hammour, et al, 2016]. The following databases were used as sources of data: PubMed, HINARI, Google, and SCOPUS. These databases were searched for relevant published studies and reviewed based on predefined inclusion and exclusion criteria. The current systematic review was designed to include articles written only in English.

Data Extraction

Once we finished the searching for studies in the databases, the process of study selection was started. At first, duplicates were removed manually by AM. Second, the title and abstracts of the remaining studies were screened following the above eligibility criteria. This initial screening was performed by three researchers (AR, AM, and MA), and resulted in excluding many studies that fit with a certain exclusion criterion. RAYYAN software (http://rayyan.qcri.org/; Qatar Foundation Headquarter, Qatar) was used to filter the search and to facilitate the automated initial screening of the suggested abstracts and titles. Third, the remaining studies were assessed based on a full text screening to ensure eligibility following the above inclusion and exclusion criteria. In both screening stages, the reason of exclusion for the excluded studies was explained. In the current study, we used specific preidentified mesh terms, keywords, and Boolean operators to keep the search reproducible. Some Boolean operators ("AND" and "OR") were used to combine between the search terms. All search results were downloaded as full text, and then after screening, the included studies were exported into the Endnote referencing software. The flow diagram of the whole process of study selection is shown in Figure 1.

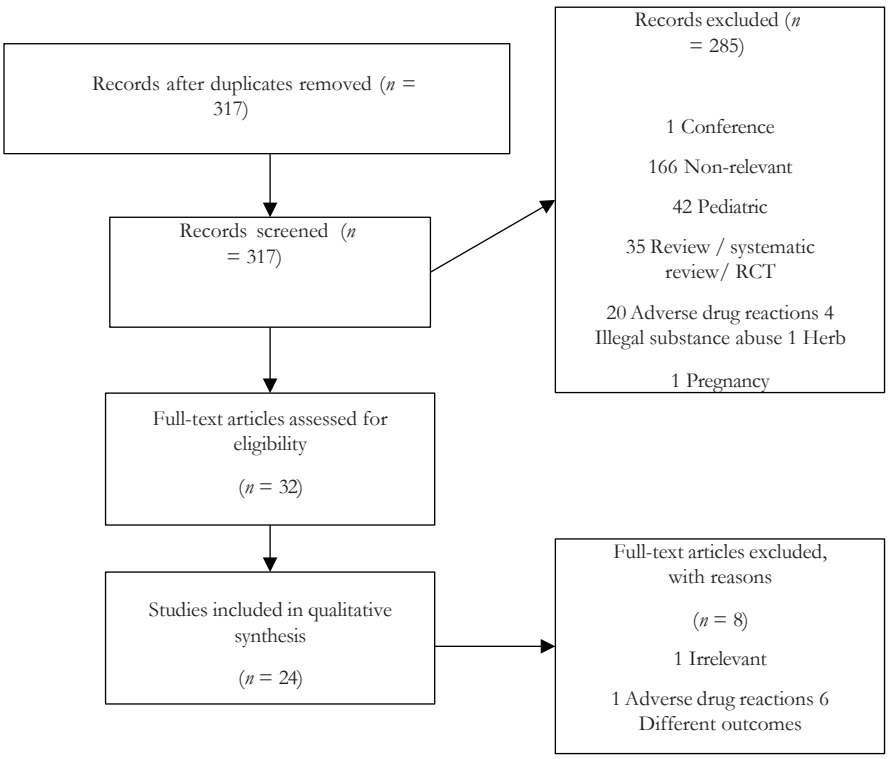

Figure 1: PRISMA flow diagram illustrating articles selection method. RCT: Randomized controlled trial

Certain key information was extracted from the included studies and was recorded on separate sheets for organization. These are the general characteristics of the included study's author, study setting, study design, study population, sample size, number of study settings, the rates, prevalence and/or incidence of certain types of MEs, and the prevalence of selected types of prescription errors, assessment For this study, we assessed the risk of bias using National Heart, Lung, and Blood Institute quality assessment tools (NHLBI) (https://www. nhlbi.nih.gov/health-topics/ study-quality-assessment-tools).

The quality for all included studies was evaluated using one checklist, which is Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies. That is because the design of these studies was cross-sectional. The grey literature was excluded from the current study such as conference.

Proceedings, unpublished theses, information that is not published in clearly comprehensible databases or journals, and studies that include the abstracts of research presented at conferences. To minimize publication bias, the present study was depending on high-quality search thorough literature reviews; hence, included all studies (that met the inclusion criteria) regardless their results, included articles that required a peer reviewer to acknowledge conflicts of interest, and excluded information that is not published in clearly comprehensible databases or journals. The studies were meticulously assessed based on a full text screening to ensure eligibility following the above inclusion and exclusion criteria. In both screening stages, the reason of exclusion for the excluded studies was explained. In the process of identifying the inclusion/exclusion criteria, we mainly utilized the Topic Refinement (Key Questions) process to minimize ambiguity. The criteria were set based on the analytic framework using NHLBI quality assessment tools.

Because all the studies were cross-sectional in their nature, measuring the exposures of interest prior to the outcomes and loss of follow-up were not applicable. Four papers [Moghli, et al, 2021]. out of 24 did not study the causes or risk factors (exposures) of MEs (outcomes), therefore evaluating the relationship between exposures and outcomes was not applicable as well as the exposures themselves. Only two studies measured the confounding variables, and five studies [Mrayyan, et al, 2017]. blinded the outcome assessors [Salameh, et al, 2018]. Clearly stated that the researcher (the person measuring the exposure) is one of the authors and therefore could also be an outcome assessor. In this case, it is most likely that the outcome assessor is not blinded. Further details.

Data Analysis

Given the likelihood of a wide range of study types, the planned data analysis involved a narrative synthesis to identify common themes and trends in the types of errors, their causes, and prevention and improvement strategies. Descriptive analysis was conducted to organize and code the data, utilizing Minitab 17 for statistical analysis. This approach allowed for a comprehensive understanding of medication errors in Saudi Arabian hospitals and the effectiveness of prevention and improvement strategies.

RESULTS

Searches returned articles from Embassy (n = 4), PubMed (n = 10), and Web of Science (n = 8), giving a total of 22 articles which, after duplicates (n = 9) were removed, reduced to 13 studies. One study was removed as it was a review article. Hand-searching the reference lists of each of the 12 provided an additional 13 articles for inclusion, yielding 25 articles for inclusion in this review. The 28 studies included in this review comprised retrospective observational studies (n = 17, 60.7%), cross-sectional studies (n = 6, 21.4%), qualitative studies (n = 2, 7.1%), prospective observational studies (n = 2, 7.1%), and quality improvement projects (n = 1, 3.6%) [Al-Azayzih, et al, 2019]. Of the 28 included studies, 20 (71.4%) reported the types of medication errors observed, wrong dose and improper dose errors were among the most frequently reported across multiple studies, while prescribing errors remained consistently high, indicating a critical area for intervention, although less frequent, omission errors still held significance. Errors related to in complete orders and administration errors are still noteworthy, though they are less commonly reported than prescribing errors [Aburuz, et al, 2018].

Specific issues such as therapeutic duplication and incorrect dilution highlight potential areas for focused improvements [Alrabadia, et al, 2020]. Additionally, frequency and dosing schedule errors emphasize the importance of accurate scheduling in medication and dosing scheduling errors. Prescribing errors have been defined as MEs initiated during the prescribing process. These include the incorrect selection of medication, wrong dose, and wrong strength, wrong frequency, incorrect route of administration, inadequate instruction for use of a medication and wrong dosage form. Twenty-one (46 %) of the studies reported MEs that occurred during the prescribing stage of the medication, eight studies identified in this review used the above definition [Alqudah, et al, 2016].while the remaining studies did not clearly state a definition of prescribing errors. Thirteen were prospective studies and were conducted in six countries [Al-Shara, et al, 2018]. Five were retrospective studies

Comprehensive Review of The Selected Studies

Included studies encountered 21,100 participants from different clinical settings. The clinical settings represented by the included studies were unaccented| two centers and multicenter settings covering most parts of Saudi. Most of the included studies applied cross-sectional design, four studies used retrospective, and one represented their outcomes via applying descriptive correlational study design. Moreover, [Sulaiman, et al, 2017]. and Ababneh et al. employed prospective observational study design with direct observation and chart review methods. On the other hand, [Aseeri, et al, 2020]. Used mixed design approach to study the incidence and causes of medication dispensing errors; combining prospective veiled observation and direct health-care providers interviewing. On the other hand [Walid Al-Qerem, et al, 2018]. Utilized prescriptions review and direct interview methods to study the prevalence of potential drug-drug interaction in geriatric patients. Most of the papers evaluated were conducted for hospitalized patients (n = 8), patients attending outpatient settings (n = 10) and emergency department (n = 1). Moreover, seven of the included papers either described Saadian nurses' perceptions about different aspects of medications errors, or recorded observation incorporated the nurses who formulated and administered the medications [Wittich , et al, 2024]. in their prospective study showed that almost all participated patients (98.3%) experienced at least one treatment related problems. The prevalence of prescribing errors presented by [Ababneh, et al, 2020]. Abdel-Qader *et al.* Abu Hammour *et al.* Al-azayzih *et al.*, Alqudah *et al.*, Arabyat *et al.* Zalloum *et al.*, and Sulaiman *et al.* are 36.6%, 11.5%, 10.5%, 62.5%, 86%, 27.6%, 72.5% and 0.1% respectively. [Al Khawaldeh, et al, 2018].

The rate, prevalence, or incidence of medication errors shows the rates, prevalence, or incidence of MEs reported in the included papers classified according to the type of MEs. In this review, most of the included papers assessed prescribing, administration, and dispensing errors. For example, Al-Taani *et al.*(2018) reported that 81.2% of total recruited patients within the outpatient settings have at least one medication related errors (represented as untreated indication, unnecessary drug, and efficacy issues). Moreover, Aburuz Another example for MEs, the cross-sectional study conducted by Haddadin *et al.* (2020) indicated that almost one third (30.2%) of the dispensed antibiotics in Saudian community pharmacies were without prescriptions. Alrabadi *et al.* [2020] described that ~83.4% of the nurses conveyed <1 error/year. Moreover, Alkhawaldeh *et al.* (2016) indicated that 27.3% administration errors appeared among registered nurses working at the hematology and oncology departments at King Hussein Cancer Center and Saadian Royal Medical Services. Alshara *et al.*[19] declared via their questionnaire-based study that the nurses administration.

Errors represented the highest level of MEs, reported as giving the drug in a wrong time (8.7%), inappropriate dose (22.2%), to the wrong patient (26.2%) or by giving the incorrect medications (9.5%) . Additionally, two studies in this systematic review reported the presence of potential drug-drug interaction, which is considered a type of MEs (91%. and 96%.

Abu Moghli, et al, [2017] anticipated other types of MEs reported as unintentional discrepancies (drug omissions, additions, wrong drug, or dose) and intentional undocumented discrepancies (documentation errors). They reported that 67.9% of participants experienced at least one unintentional discrepancy with 65.1% of them being omissions.[16] Moreover, 33.7% documentation errors were also recognized. On the other hand, Salameh *et al*, [2018] identified 65% of the study participants having documentation errors, and 47% were retrieved to have at least one unintentional discrepancy.

In this systematic review, the prevalence of prescription errors ranged from 0.3% to 89.8%. Frequently identified prescription errors types were efficacy and indication related errors (89.8% and 74.63%, respectively), inappropriate dosage regimen (68.5% and 50.3%, untreated conditions (68.3%), ineffective or incomplete drug therapy (74.9%[32]) and a need for additional or more frequent monitoring (41.73%)[36]. Most of the included studies reported at least one drug without an indication or unnecessary drug therapy (34.7%, 27.6%, 26.1% and 2.47%.

Further, two studies reported the presence of actual or potential drug interaction 17.7% and 10.2% respectively. Consistent with previous studies, transcribing errors were the least frequently reported MEs since the transcribing stage was not as important as prescribing and dispensing stages in medication treatment process. However considered the medication transcription as the stage where most MEs could occur. In the present systematic review, only two studies evaluated transcribing errors with no further information mentioned about what types of those transcribing errors were. The limited evidence in the literature about transcribing stage may mislead the real statistics about the prevalence and incidence rates of transcribing errors.

This systematic review had several limitations. First, both prospective and retrospective studies are combined in this review although there would be differences in the prevalence of MEs identified using different methods of chart review; either retrospective or prospective. Second, not all reviewed studies reported the rates of MEs as percentages. Basheti *et al*.,(2019) reported MEs rates as a mean and standard deviation. The representativeness of the reviewed studies is limited, and the generalizability of the present review findings should be discussed with caution since approximately one-half of the studies were conducted in single hospitals. This review was designed to include articles written only in English, which may introduce a selection bias. Some articles written in Arabic, which is the original language in Saudi, might be missed.

Future research is recommended to increase healthcare professionals' and students' awareness of MEs. Hence, we encourage the development of educational and training programs discussing pharmacotherapy and examine their effectiveness in promoting the knowledge, attitude, and practice of medication prescribing, administration, and dispensing. Further exploring of barriers and facilitators to MEs reporting among health care professionals is warranted.

DISCUSSION

This systematic review aimed at reporting the rates, prevalence, and/or incidence of various MEs in different health care clinical settings in Saudi. Reporting MEs is crucial for patient safety and optimal health outcomes. This review found a relatively few numbers of MEs studies conducted in Saudi compared to the number from other Middle Eastern countries. To best of our knowledge, this is the first systematic review appraising MEs in Saudi. This systematic review has demonstrated limited evidence regarding MEs in Saudi. For example, no information was reported on the sample size of one of the selected national studies that targeted 350 community pharmacies across the country. In addition, many studies focused on outpatients with only one study reported the incidence rates of MEs. The present study highlighted several types of MEs such as prescribing, administration transcribing, dispensing.

This is the first systematic review to report on MEs in Saudi. Despite the relatively small number of reviewed studies related to MEs in Saudi, a wide variation was found between those studies in the error prevalence rates. This variation may be due to the variation in the clinical settings, targeted populations, methodologies employed. Most of the studies targeted inpatients and outpatients, while very few studies were conducted on healthcare professionals. Most studies reported on prescribing errors. There is an imperative need for addressing the issue of MEs and improving drug therapy practice among health-care professionals by introducing education and training.

CONCLUSIONS

This analysis of 28 studies on medication errors conducted in Saudi Arabia highlights wrong doses, improper doses, and prescribing errors as the most frequent, underscoring a critical need for intervention. Strategies to reduce these errors include awareness campaigns, closed-loop medication systems, independent double-checks,

and electronic order sets. Effective communication among healthcare professionals, automated dispensing systems, continuous education, and regular pharmacist reviews are essential. Addressing potentially inappropriate medications through regular reviews and stewardship initiatives is also crucial. Implementing technology like electronic prescribing and optimizing pharmacist–patient ratios in critical care are vital strategies. Practical training for new doctors and incorporating pediatric-specific information into systems further help reduce medication errors. The study showed the most common errors are prescribing and drug administration. The worldwide incidence of causes of MEs were identified and may include illegible handwriting, heavy workload, labeling errors, interruptions, and distractions that health care professionals face during drug prescription and administration, and wrong drug calculations.

Recommendations

The need to improve patient safety by reducing prescribing errors and adverse drugs events (ADEs) has been increasingly recognized by the medical community. This concern was highlighted after the publication of recommendations from the Institute of Medicine [46] which were supported by other investigators [47,48]. These focused on enhancing the knowledge base about safety; identifying and learning from errors; raising standards and expectations for improvements in safety; and creating safety systems inside health care organizations. Besides the domains of patient safety and organization assessment tools, the Institute rightly identified the roles of the public, the media and stakeholders from different discip.

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