

INPATIENT PHARMACIST INTERVENTIONS IN REDUCING PRESCRIPTION-RELATED MEDICATION ERRORS IN INTENSIVE-CARE UNIT (ICU) IN RIYADH, SAUDI ARABIA

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Abstract

The present study was carried out to evaluate the effectiveness and impact of having inpatient pharmacist interventions in reducing prescription-related medication errors in Intensive Care Units (ICUs). The study also evaluates the occurrence and incidence to identify therapeutic categories and types of prescription-related medication errors. The observational and retrospective study was carried out in an Intensive Care Units (ICUs) of 6 tertiary care hospitals in Riyadh, Saudi Arabia, including 4 private health sector hospitals, one governmental hospital and one university teaching hospital. All prescription-related medication error reports were filled electronically by inpatient pharmacists using Computerized Physician's Order Entry (CPOE). The study reported drug errors in the Intensive Care Units (ICUs) that were detected and addressed by clinical pharmacists. A number of 9215 medication orders were collected and prescribing errors were detected. The most commonly reported prescribing errors were incomplete orders (21%), followed by drug information 16%, errors in dosing schedule (14%), duplicate drug class (10%), wrong dose (7%), wrong unit of measurement (6%), drug-drug interaction (4%), re-order requested and others (4%), wrong frequency (4%), no indication for prescription (PRN) 3%, conflicting information 3%, wrong route (2%), incomplete patient information (1%), oral and intravenous (IV) same drug order (0.1%). The most common location where the errors occurred was in the ICU (42.5%), followed by neonatal intensive care unit (NICU; 34.8%), critical care unit (CCU; 14.5%) and paediatric intensive care unit (PICU; 8.5%). The findings of our study highlight the importance of the inpatient pharmacists' role in detecting, reporting and reducing prescription-related errors, as well as the incidence of these errors among Riyadh hospitals' ICU departments.

Rezumat

Studiul a fost realizat pentru a evalua eficacitatea și impactul intervențiilor farmaciștilor clinicieni asupra reducerii erorilor de prescriere în Unitatea de Terapie Intensivă (UTI). Studiul evaluează, de asemenea, prevalența și incidența erorilor medicale de prescriere. Studiul observațional și retrospectiv a fost realizat în unități de terapie intensivă (ICU) din 6 spitale de îngrijire terțiară din Riad, Arabia Saudită: 4 spitale private, un spital guvernamental și un spital universitar. Toate rapoartele de erori medicale de prescriere au fost completate electronic de farmaciștii din spital în programul de Introducere Computerizată a Prescripției Medicului (ICPM). Au fost colectate un număr de 9215 prescrieri de medicamente. Cele mai frecvent raportate erori de prescriere au fost tratamente incomplete 21%, informații insuficiente despre medicamente 16%, erori privind perioada de administrare a tratamentului 14%, prescriere de medicamente din aceleași clase 10%, doze greșite 7%, unitatea de măsură greșită 6%, interacțiuni medicament-medicament 4%, recomandări suplimentare și altele 4%, frecvență greșită 4%, fără diagnostic 3%, informații contradictorii 3%, cale de administrare greșită 2%, informații incomplete pentru pacient 1%, același medicament administrat atât oral cât și i.v. 0,1%. Cel mai frecvent erorile au fost sesizate în UTI 42,5%, apoi 34,8% în unitate de terapie intensivă neonatală (UTIN), 14,5% în unitatea de stare critică (USC), 8,5% în unitatea de terapie intensivă pediatrică (UTIP). Rezultatele studiului nostru evidențiază importanța rolului farmaciștilor clinicieni în detectarea, raportarea și reducerea erorilor de prescriere, precum și în reducerea incidenței acestor erori în departamentele de terapie intensivă ale spitalelor din Riad.

Keywords: medication errors, inpatient pharmacist, ICU departments

Introduction

Medication error is any unwanted and preventable event that occurs in any point of medication processes, either resulting to adverse consequences to the patient or not, while the medication is under the control of

health-care professionals [1]. Medication errors related to prescriptions viz (incorrect indication, dose, frequency and route) occur when the wrong drug is being prescribed or given to a patient [2]. Medication errors can be categorized according to the stage of medication process sequence into five main categories including:

prescribing, compounding, dispensing, distribution and administration [3]. According to Food and Drug Administration (FDA) statistics, around 1.3 million people each year in the United States lose their lives as a result of drug-related complications. Preventability is implicit in the concept of medication error, and one of the primary responsibilities of a pharmacist is to prevent the possibility of medication errors occurring in either the outpatient or inpatient clinical settings [4]. The occurrence and prevalence of drug errors in ICU vary significantly between populations and clinical settings [5]. One study analysed 5299 prescriptions from public and private clinics in primary care in Riyadh found a prescription error rate of 18.7% [6]. Another study conducted in a university teaching hospital in Saudi Arabia affiliated with King Saud University reported a total of 949 medication errors over a period of one year, with almost equal numbers of inpatients (49%) and outpatients (50%) recording errors. Physicians were responsible for the majority of errors (87.5%), while pharmacists primarily identified them (83.0%) [7]. Additionally, a study conducted in a paediatric inpatient tertiary care setting in Saudi Arabia examined 2380 orders, with an overall error rate of (54.2%) [8].

The aim of this study was to measure and identify the impact of inpatient pharmacist role in reducing prescription-related medication errors in Intensive-Care Units (ICUs) in Riyadh, Saudi Arabia. Also, another goal was to measure prevalence and incidence and to identify therapeutic categories and types of prescription-related medication errors. Finally, the purpose of analysing reports of medication errors is to determine the rate of occurrence, and the commonly reported medication errors involving prescriptions.

Materials and Methods

Study settings

This study was conducted in Intensive Care Units (ICUs) of 6 tertiary care hospitals in Riyadh, Saudi Arabia, including 4 private health sector hospitals, one governmental hospital and one university teaching hospital.

Ethical approval

This study was approved prior to data collection by the research ethical committee of King Khalid University hospital (KKUH) affiliated with King Saud University in Riyadh, Saudi Arabia.

Study design and population

The retrospective study analysed the prescription-related medication error reports of Intensive Care Units (ICUs) belonging to 6 tertiary care hospitals over an interval period of (January 2015 - January 2018) in Riyadh, Saudi Arabia. All the prescription-related medication error reports were reported in Intensive-Care Units including Adult Intensive-Care Unit (ICU), Paediatric Intensive-Care unit (PICU) and

Neonatal Intensive-Care Unit (NICU). The following units were not included: Surgical Intensive-Care Units (SICU), Cardiac Care Unit (CCU) and Ambulatory Care Unit (ACU). Other types of medication errors, verbal orders and reports are excluded in this study.

Measurement

All prescription-related medication error reports were filled electronically by inpatient pharmacists. Electronic reporting systems were used to report prescription-related medication errors at the time of ordering a prescription by physicians using Computerized Physician's Order Entry (CPOE). The inpatient pharmacists reviewed all the prescriptions before dispensing it and report any prescription-related medication errors such as incorrect indication, dose, frequency and route of administration, and also verbally notified the physicians about the medication errors. The data was collected from medication errors reporting systems in all included hospitals and matched with the same medication error domains to avoid duplications or discrepancies.

All prescription-related medication errors included in our study were categorized into: 1) Harmful event occurred; 2) Non-harmful event occurred. Data were obtained and the following parameters were examined and analysed: (A) Types and reasons of prescription-related medication errors (incorrect indication, dose, frequency and route of administration); (B) The therapeutic category associated with prescription-related medication error; and (C) Most frequent medication associated with prescription-related medication error.

Statistical analysis

Data were analysed and results were presented as percentage and numerically coded for the ease of expressive statistics using SPSS software (SPSS Inc, Chicago, IL, USA).

Results and Discussion

Inpatient pharmacists from a number of private and government hospitals are highlighted in this study about their role in identifying and correcting medication errors in intensive care units (ICUs). A number of 9215 reports were collected on ordering and prescribing errors on an interval period of (January 2015 - January 2018) in Riyadh, Saudi Arabia. As represented in Table I, the most common prescribing errors were incomplete orders 21% (n = 1928), and drug information related errors 16% (n = 1503) most common errors detected by pharmacists. In addition, errors in dosing schedule, duplicate drug class and wrong dose were also commonly reported at 14%, 10% and 7%, respectively. Furthermore, wrong unit of measurement and repeating a wrong order came less common at 6% (n = 562), and 4% (n = 376), respectively. On the other hand, serious errors like wrong frequency 4% (n = 348), wrong route 2% (n =

150), incomplete patient information 1% (n = 83), and ordered oral and IV same drug 0.1% (n =10) were also relatively highly reported. The distribution of the inpatient pharmacist’s interventions according to intervention category is shown in Figure 1. The

most common location where the errors occurred was in the ICU 42.5% (n = 3919), followed by NICU 34.8% (n = 3207), CCU 14.5% (n = 1336) and PICU 8.5% (n = 790) (Figure 2).

Table I

Types and reasons of prescription-related medication error

Type	Inpatient Reports	Reason	No. of Reports	(%)
Ordering and prescribing	(n = 9215)	Conflicting information	313	3%
		Drug Class Duplicate	914	10%
		Drug Information	1503	16%
		Drug-Drug interaction	395	4%
		Error In Dosing Regimen	1290	14%
		Incomplete Patient Information	83	1%
		Incomplete IV order	1928	21%
		No indication for prescription	317	3%
		Ordered oral & IV same drug	10	0.1%
		Re-Order Requested	376	4%
		Wrong dose	647	7%
		Wrong frequency	348	4%
		Wrong route	150	2%
		Wrong unit of measurement	562	6%
Other: Missing Date, Time etc.	376	4%		

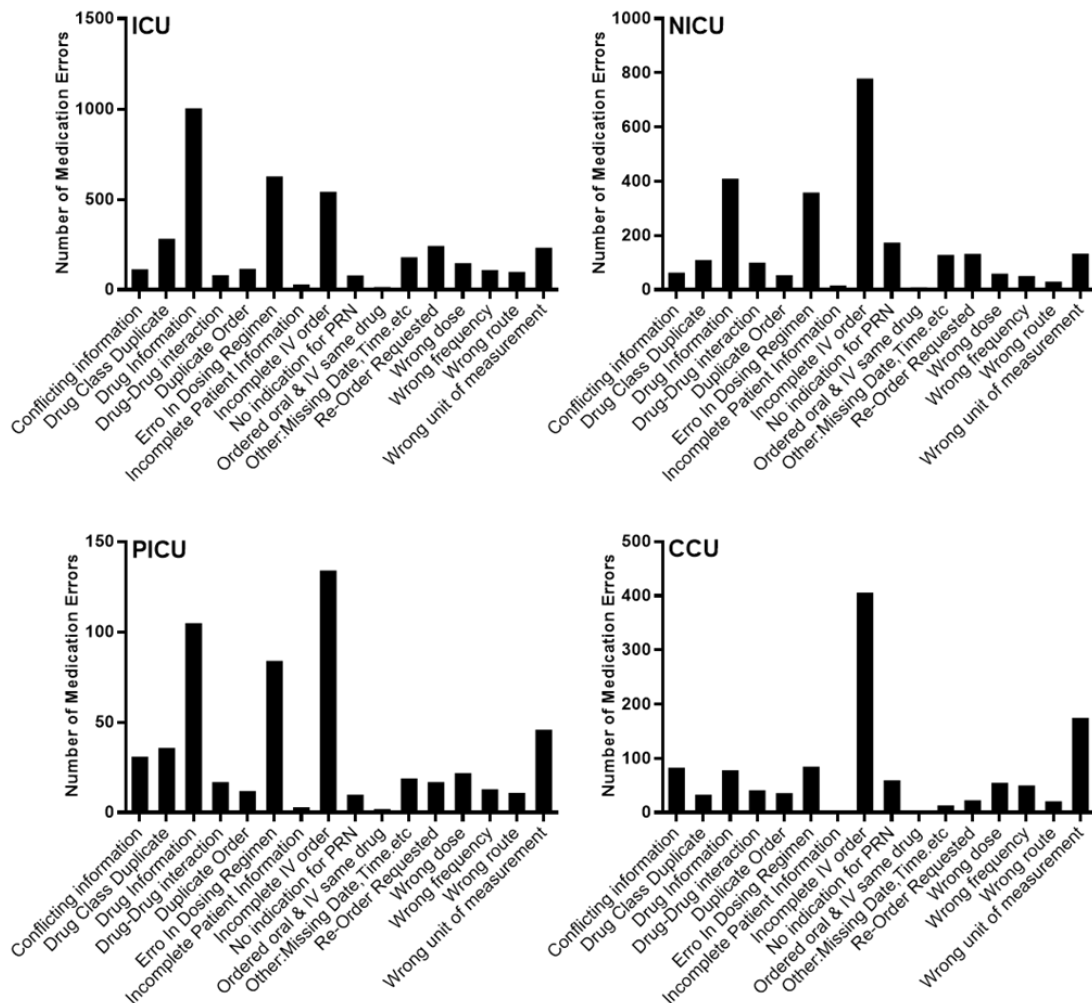


Figure 1.

Number of medication error in various critical care departments

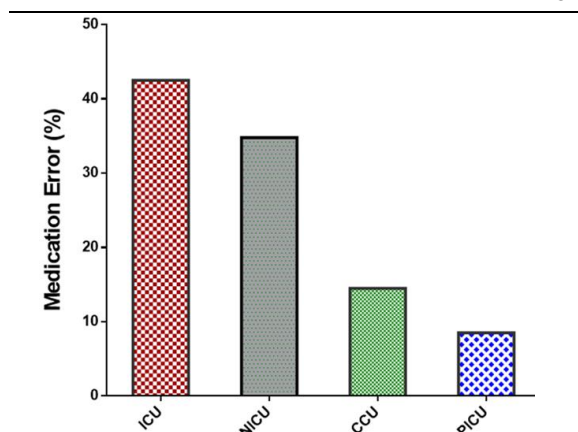


Figure 2.

Location of Error in various critical care departments: ICU (42.5%); NICU (34.8%); CCU (14.5%) and PICU (8.5%)

Statement of principal findings

Therapeutically active compounds used in the treatment and diagnosis of disease and illness are called drugs. Incorrect usage of these substances can cause health problems and even death [9]. A critical aspect in quality of pharmacy services given to needed patients is the ability to identify medication errors [10]. Inpatient pharmacists in the various critical care departments are part of the health care team working towards the improvement of patient care and related needs [11]. Inpatient pharmacists play a key role in safeguarding all patient related needs that are being addressed, developing care plans, clarifying tasks, and communicating plans among other health care professionals [11]. The integration of the inpatient pharmacist in a multidisciplinary healthcare team in the ICU is associated with a lessening in avoidable adverse drug reactions, patient length of stay and costs [12]. Pharmacist intervention has been shown to reduce prescribing errors by over 15% in multiple clinical settings [13]. A study showed that delivering a rigorous education and informational programme to doctors that is tailored specifically to pharmacists improves prescription accuracy by more than 4.5% [14]. There is a significant reduction in prescribing errors when pharmacists are given training compared to prior pharmacist interventions. But, since making an error when prescribing medication in a clinical context has a bigger influence on patient safety, and hence can result in poor outcomes, reducing the occurrence of such errors is important. In this retrospective study, we aimed to identify the inpatient pharmacists' role in detecting prescription-related medication errors in the ICU, to assess the incidence of different types of prescription-related medication errors and to identify the most common ICU department where these errors occur. There were 9,215 drug errors of all kinds associated with prescriptions during the study period. They ranged from 0.1% to 21%.

The number of reported errors in our findings were similar to the findings of other reports [15, 16], even though only pharmacist reported errors in the prescriptions were included. A previous study that was conducted in a tertiary academic hospital in Riyadh found that medication error incidences were higher in the ICUs compared to other medical and surgical departments [15]. Further, a pooled analysis of eight studies in a systematic review and meta-analysis highlighted the key role of pharmacists in reducing errors in prescriptions [16]. Moreover, in the present study we found that the majority of the prescription-related errors occurred in general ICUs and NICUs, and to less extent in CCUs and PICUs. Therefore, more special attention should be needed towards the ICU and NICU departments. Out of these errors, more than one third occurred in NICUs, which justifies further attention to this patient population in intensive care among other factors.

Interpretation within the context of the wider literature

Prescription errors were found to be reduced as a result of pharmacist interventions in the current investigation. In addition to this, data gathered from a previous study demonstrate that pharmacist interventions lead to a lower rate of preventable events, which indicates that pharmacists are essential in making health care better. In Mecca, Saudi Arabia, researchers examined the impact of a pharmacist intervention on medication errors and how the prevalence of high-risk abbreviations (HRAs) among professionals contributes to these errors [17]. It has been found that the use of HRAs was especially high in prescriptions and dispensing records with more than 70%. However, after pharmacists implemented a post-intervention program, the overall prevalence of HRAs was reduced by 52% [17]. Despite a relatively high acceptance rate in this study, the use of medication errors decreased by more than 75% as a result of the increased number of pharmacist interventions that were acknowledged by doctors and patients. The study published by Molino *et al.* also discovered that changes in medication therapy generally occurred as a result of physician acceptance of pharmacist involvement [18]. According to these findings, it appears that healthcare providers recognize the value of pharmacists in their practice, as well as the critical importance of pharmacy practices in clinical situations. In contrast, acceptance rates among various physicians for certain units were under 50%. There are several factors which may serve as hurdles to doctor's acceptance of these inpatient pharmacist involvements, including subject, gender of the pharmacist and patient [19]. The lack of clinical procedures mandating physicians' responses to pharmacist compliments was a major factor in the low level of physician acceptance of pharmacy interventions [19]. In our study, incomplete IV orders were the most recurrently found medication error,

followed by drug information, regimen error and drug class duplicate. By contrast, these findings vary slightly from those found in an earlier report, which identified that 31.4% of errors were associated with drug reactions, non-compliance, drug interactions, followed by untreated indications (10.7%), inappropriate drug choice (5.4%) and use of medication without a symptom (1.8%). Researchers investigated the effect of clinical pharmacist practices in critical care units by conducting another study at a private hospital in Riyadh City, Saudi Arabia. These findings showed that improper dosage was the most common medication error, occurring in 20.05% of cases, followed by medication duplication (11.29%), inadequate route (6.87%) and drug-drug interactions (DDIs) (1.96%) [18]. Although drug-drug interactions have been found in numerous other studies [20], our study demonstrates that a pharmacist-led intervention prevents them. An explanation for why drug-drug interactions were not observed in our study could be that each patient did not have a high number of prescriptions and that the prescriber, patient and pharmacist had a good relationship. Drug-drug interactions may be reduced by limiting the total number of drugs given to an individual patient [18]. It has been found that more than 50% of medication errors are avoidable [18]. Current investigations have found that fewer medication errors have occurred as a result of pharmacists' involvement in the treatment process, suggesting that pharmacists contribute significantly more to medication error identification compared to normal care [21]. Medical errors can be reduced if multi-disciplinary teams work together with the pharmacist to improve adherence to therapy and rational drug use [21, 22].

Nonetheless, the information from different countries on medication errors in ICUs shows a great disparity in the frequency of medication errors. Prevalence rate as follows: Two ICUs in the North-eastern (USA) are treating 276 patients *per* 1,000 patients. In the Netherlands, there is a 62 - 190 *per* 1,000-patient ICU monitored in one tertiary-care teaching hospital, and 65 *per* 1,000 with two paediatric ICUs in two tertiary-care teaching hospitals in Japan [23-25]. These studies found that intervention programmes had to be designed and implemented proactively, since patient care is extremely complex and medication use is error-prone. Another study done in Ethiopia found the primary reasons for pharmaceutical errors to be incorrect timing (20.3%), unavailability (29%) and missing doses (18.3%) [24]. This might be because ICUs in different countries are run in different ways, the way ICUs are set up, the procedures used to identify medication errors, and other human variables influence the results (including stress, high workload and knowledge deficits) [26]. The incidence of medication errors in paediatric intensive care units (PICU) in Saudi Arabia was found to be 33.9% in a

study done in both paediatric general ward and paediatric ICU (PICU) at King Abdulaziz Medical City [27]. A study conducted in a single centre NICU by Pawluk *et al.*, in 2016 found that the prescribing process was associated with most of the medication errors reported by pharmacists [28]. The most common drugs utilized in the NICU were the ones where errors were found. An essential aspect of reducing medication errors in different phases of the prescribing process is a multi-disciplinary team, including a pharmacist. Actually, the Society of Critical Care Medicine (SCCM) in the U.S. considers the presence of a pharmacist in the medical team as to be best practice, as well as essential. There are different methods to reduce prescribing errors in the ICU like used by pharmacists. Medication reconciliation at admission and discharge, development and implementation of medication related guidelines, as well as medication education for the care team among other duties [29]. Nonetheless, the direct pharmaceutical care of patients is a major responsibility of the ICU pharmacist [30]. In the present study the most common location where the errors occurred was in the ICU 42.5%, followed by 34.8% NICU, CCU 14.5% and PICU 8.5% and pharmacist led interventions proved to be effective in minimizing the prescription errors in ICUs which are consistent with previous reports [8]. These findings will further help to better understand medication errors typically found in an ICU and serve the needs of Hospitals in the Kingdom.

Implications for policy, practice and research

In order to prevent medication errors, it is necessary to provide education programs on medication safety and appropriateness. Programmes and workshops that enable patients to take better care of themselves should be made widely available to all clinicians, and must especially equip pharmacists to recognise and correct medication errors in a collaborative inter-professional healthcare environment. Additionally, it is also recommended that a formal policy that encompasses not only pharmacists' roles in the detection and correction of medication errors, but also includes the involvement of prescribers to allow pharmacists to carry out their profession as experts in assuring patient safety be in place [31].

Strengths and limitations

The present study has some limitations due to the nature of the retrospective descriptive design and lack of available data. We included medication errors in prescriptions only. Other areas where medication errors may occur, *e.g.* dispensing, administration, etc., were not covered. In addition, we did not include the severity of the detected medication errors nor the accompanied therapeutic classes. Further details of the reported errors would have added more to our findings. For example, patients' characteristics, their hospitalization duration etc. However, our study goals were specific to the incidence, types and location of

errors. Hereafter, our data were obtained from 6 different hospitals in Riyadh, our findings cannot be generalized to other hospitals in Saudi Arabia. Small town and rural hospitals may have a larger, however, unreported rate of prescription errors. Since we included only the prescription-related errors that were detected by inpatient pharmacists, it can be safely concluded that the actual incidence of medication errors is greatly larger than perceived. In fact, including other departments of the hospitals, other types of medication errors, recruiting an ICU pharmacist, and involving other team members would provide a bigger picture. This will improve patient care by significantly reducing medication errors and ensuring a safety culture. Moreover, focus on medication safety in the ICU and encouraging reporting errors may reduce medication errors further. Finally, our findings shed the light on the importance of the inpatient pharmacists' role in detecting, reporting and reducing prescription-related errors, as well as the incidence of these errors among Riyadh hospitals' ICU departments. Nevertheless, a larger study that includes detailed data from different types of hospitals and several regions is needed to reflect significant findings of the ICU medication errors in Saudi Arabia.

Conclusions

Inpatient pharmacist's intervention led to a substantially decrease in medication errors in ICU departments of many government and private hospitals, contributing to a safer prescription process which in turn prevents the drug interactions, medication errors and drug inconsistencies. Inpatient pharmacists are indispensable to improve patient care and outcomes. Our study's results strongly suggest that inpatient pharmacists play a vital role in preventing medication or prescription errors across different ICU departments. Evaluations conducted in critical care services have shown that inpatient pharmacists have a significant impact on outcomes and can prevent life-threatening situations. In order to reduce the frequency of medication errors and improve existing drug distribution services, this study recommends better documentation and constant observation. In order to completely eliminate this issue, effective and frequent communication among members of the healthcare team is required. As inpatient pharmacist role expands, the prerequisite for well-planned studies is needed.

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Conflict of interest

The authors declare no conflict of interest.

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