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PRN Medications Ordering Practice at a Large Intensive Care Unit in Saudi Arabia

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Abstract

Background: One of the most common medications, that their ordering is associated with many medication errors, is PRN medications. In order to explore the types of medication errors that are associated with ordering PRN medications, and to test the correlation between these medication errors with many factors, we conducted this study.

Methods: A comparative cross-sectional study design was used. All medical records for critically ill patients were screened for PRN medications orders. All medication errors that occurred in the ordering stage of the medication process were documented. The study was conducted in March 2015.

Results: 114 patients were found on PRN medication order. Among those patients, 130 PRN orders were detected; 116 orders had medication errors and 14 orders did not. The number of medication errors was 216. The percentage of PRN ordering errors at the different intensive care units was: 14.8% in the Medical ICU, 13.9% in the Surgical ICU, 21.3% in the Trauma ICU, 9.3% in the ICU for chronic patients, 39.8% in the Cardiac ICU and 0.9% in Maternity ICU. There was significant difference in the percentage of PRN ordering medication errors between different ICU sections (Cardiac ICU, Medical, Surgical, Trauma, and Chronic), P value was 0.03.

We also found statistical significant difference when we compared the percentage of PRN ordering medication errors in all ICUs except Cardiac ICU and percentage of PRN ordering medication errors in Cardiac ICU (P value was 0.03). The most common PRN ordering error was not writing the indication; 106 errors of total 216 errors (49%). The most common PRN medication was acetaminophen; 39.2% of PRN orders (51 of 130 orders).

Conclusion: Our hospital has inadequacy in PRN ordering practice. We proposed some interventions to solve the inadequacy in our practice.

Keywords: PRN orders; Medication errors; Intensive care unit; Ordering stage; Medication process

Abbreviations: CPOE: Computerized Hysician Order Entry; DNR: Do Not Resuscitate; GCS: Glasgow Coma Scale; ICU: Intensive Care Unit; IOM: Institute of Medicine; IV: Intravenous; LOS: Length of Stay; KSMC: King Saud Medical City; PRN: Pro Re Nata

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Introduction

A medication error is defined as any failure in the treatment process that leads to, or has the potential to lead to harm to the patient [1]. Medication errors can be source of significant morbidity and mortality in the health care setting [2-6]. From 1983 to 1998, U.S. fatalities from acknowledged prescription errors increased by 243%, from 2,876 to 9,856 [7]. The Institute of Medicine (IOM) report highlights that 44,000 to 98,000 patients die every year because of medical errors, a large portion of these are medication-related [8].

In the intensive care units, on average, patients experience 1.7 errors per day [9]. In Saudi Arabia, one study explored the

rate of medication errors in one university teaching hospital in Riyadh, medication error reports were reviewed and reported at quarterly intervals over a one year period, the medication error rate over the 1-year study period was 0.4% (949 medication errors for 240,000 prescriptions). During this period 14 (1.5%) errors were considered harmful to patients [10].

King Saud Medical City (KSMC) is a large public hospital in Riyadh/Saudi Arabia. In order to improve the quality of the health care that we provide, we document medication errors. Medication errors can occur in any stage in the medication process: Ordering, transcription, dispensing, and administration, and discharge summaries [11]. One study related to medication errors was conducted in our hospital, the research was a cross-sectional study that evaluated consecutively collected near miss report forms over a period of 6 months [12]. Near miss is a drug prescription error that happened but without affecting the patient. The total number of near miss report forms was 1,025 and each form contained one or more near misses. The medication errors that were reported are: Wrong frequency (n=266, 25.95%), followed by improper doses (n=250, 24.39%), wrong drug prescribed (n=126, 12.29%), wrong duration (n=97, 9.46%), wrong concentration (n=92, 8.98%), and wrong dosage form (n=57, 5.56%). Stages where most near misses were identified included transcription and entering (n=676, 55.32%), physician ordering (n=397, 32.49%) and dispensing and delivery (n=115, 9.41%). As can be seen, one third of medication errors occurred in the ordering process.

One of the most common medications, that their ordering is associated with many medication errors, is PRN medication. PRN is an abbreviation that means when necessary (from the latin Pro Re Nata). In medicine it means that the medication must be administered to the patient when needed as soon as possible. In order to explore the types of medication errors that are associated with ordering PRN medications, and to test the correlation between these medication errors with many factors, we conducted this study.

Methodology

This comparative cross sectional study was conducted in KSMC (Riyadh/Saudi Arabia). All medical records for critically ill patients were screened for PRN medications orders. All patients were screened without any exclusion criteria like: the comorbid conditions, age, gender and presence or absence of mechanical ventilation. We conducted this study in the Intensive Care Unit sections that include: Medical ICU, Surgical ICU, Trauma ICU, Maternity ICU, ICU for chronic patients and Cardiac ICU. Neonatal and pediatric ICUs were excluded in this study.

According to KSMC PRN medication order policy, the PRN order should contain the medication name (without using a prohibited abbreviation), the dose, frequency, route of administration and the indication of PRN medication. In addition, the order date along with the physician's stamp and signature must be present. Any PRN order that did not comply with these criteria was considered to have medication error.

Data collection

In addition to medication errors, other variables were collected. The variables that were collected in this study included: patient's age, gender, length of stay (LOS), Glasgow coma scale (GCS) and do not resuscitate (DNR) status. Three clinical pharmacists and one clinical research associate were responsible to collect the data. Screening the patient's medical records was done at three different dates in March 2015 (01/03/2015, 15/03/2015 and 31/3/2015). Since this study was conducted over one month period, we made sure that no medication error was repeated for any patient by double checking data entry. Only ordering errors were documented since this study was about ordering errors. Approval to collect and publish the data has been taken from KSMC.

Data analysis

The data were entered and analyzed using Statistical Package for Social Sciences (SPSS) version 20 software. Frequencies of PRN medication errors were described in tables in relation to some selected parameters (patient's age, GCS, LOS and unit). Comparison of the rate of medication errors between the different intensive care units, age groups, GCS and LOS was made using the (Chi Square) χ^2 test. Statistical significance was defined at a level of 0.05.

Results

The number of patients who had PRN order in this study was 114. In the 114 patients, we found 130 PRN orders; 116 orders contained medication errors and 14 orders did not. The number of medication errors was 216. Some patients received many PRN medications, and many PRN orders contained many medication errors. The most common PRN medication was acetaminophen in all the intensive care units; 39.2% of PRN orders (51 of 130 orders). The second common PRN medication was isosorbide dinitrate that was prescribed mainly in the Cardiac ICU; 26.2% of PRN orders (34 of 130 orders). PRN Medications that were prescribed during our study are summarized in **(Table 1)**. The table contains the frequency of prescribing of these medications during the study period and their indication.

Three of the patients that were prescribed PRN medications had positive DNR status. The mean age in all the ICUs was 51.1 years, two patients were of unknown age. The average length of stay at the time of assessment was 5.4 days. The included patients consisted of 85 men (74.6%) and 29 women (25.4%). Frequency of PRN ordering errors varied between the different intensive care unit sections. The frequency and percentage of PRN ordering errors in the different intensive care units are summarized in **(Table 2)**. The most common PRN ordering error was not writing the indication; 106 errors of total 216 errors (49%). The second common error was not writing the frequency; 77 errors of total 216 errors (35.6%). **Table 3** summarizes the ordering errors that were detected during our study with their frequency and percentage **(Table 3)**. The only prohibited abbreviation that was used in PRN ordering was PCM, which was used for acetaminophen.

Table 1 Commonly prescribed PRN medications in our unit with their indication.

Medication	Frequency of prescribing (total is 130 orders)	Indication
Acetaminophen	51	Pain or fever
Isosorbide dinitrate	34	Relief of acute anginal attacks
Haloperidol	10	Agitation
Tramadol	7	Pain
Metoclopramide	5	Vomiting
Pethidine	4	Severe pain
Fleet enema	4	Constipation
Labetalol	3	High Blood pressure (>160/100 mm Hg)
Hydralazine	3	High Blood pressure (>160/100 mm Hg)
Desmopressin	2	Diabetes insipidus
Atrovent	1	Bronchospasm
Lactulose	1	Constipation
Ventoline	1	Bronchospasm
Furosemide	1	Fluid overload
Mannitol	1	Increased intracranial pressure
Atracurium	1	To facilitate mechanical ventilation
Atropine	1	Bradycardia

Table 2 Frequency of medication errors in the different ICU sections.

Section	Frequency of medication errors (total number of medication errors is 216) per unit with their percentage.
Cardiac ICU	86 (39.8%)
Trauma ICU	46 (21.3%)
Medical ICU	32 (14.8%)
Surgical ICU	30 (13.9%)
ICU for chronic patients	20 (9.3%)
Maternity ICU	2 (0.9%)

Table 3 Types of ordering medication errors in our study with their frequency and percentage.

Ordering medication error	Frequency (total is 216 errors)	Percentage
No specified indication	106	49%
No specified frequency	77	35.6%
No ordering date	21	9.8%
Use of prohibited abbreviation	7	3.2%
No physician stamp	4	1.9%
No physician signature	1	0.5%

When we compared the percentage of PRN medication errors between different ICU sections, P value was 0.03 (there was significant difference). Also we found statistically significant difference when we compared the percentage of PRN ordering medication errors in all ICUs except Cardiac ICU and percentage of PRN ordering medication errors in Cardiac ICU, P value was 0.03. No statistical difference in percentage of PRN ordering medication errors was found between Medical, Surgical, Trauma, and Chronic ICUs, P value was 0.69. We did not find an association between the score of GCS and percentage of PRN ordering medication errors; patients were divided into two groups; one group with GCS less than 9 and the second group contained patients with GCS score 9 or above, P value was 0.85. Also no association was found between LOS and percentage of PRN ordering medication errors, patients were divided into two groups; one group with LOS less than 6 days and the second group contained patients with LOS of 6 days or more, P value was 0.88. Finally, when four different age groups and unknown patients were compared regarding the percentage of PRN ordering medication errors, there was no significant difference, P value was 0.17. Age groups are summarized in **(Table 4)**.

Discussion

The PRN medication ordering is a common practice for hospitalized patients. If appropriate, a PRN order can help in the treatment of the patient's disease and alleviate the patient's symptoms.

89.3% (114 of 130) of PRN orders had medication errors; this high percentage of identified errors indicates a need for an intervention in order to improve our PRN ordering practice. The most common medication errors were not writing the indication and not writing the frequency, which is similar to the results of a study that was conducted in one psychiatric unit [13]. Although none of the medication errors that we noticed were considered fatal, the wrong PRN orders especially orders without indications and/or frequency may cause bad clinical consequences. For example, a PRN order that contains acetaminophen to be given 1 g IV for pain without writing the frequency, can lead to acute fulminant hepatic failure by exceeding the maximum daily dose of acetaminophen which is 4 g daily, in this case the nurse will give acetaminophen without consulting the physician. The nursing practice of administering the PRN medications without consulting the physician was noticed in one study at 5 hospitals located in South Korea [14].

The present study has certain limitations; the first limitation is that some patients were admitted to the ICU during the study period without being screened for PRN orders, since data collection was done in three dates in March 2015. Usually our patients stay in the ICU for at least 10 days; many of them have conditions that take time for improvement, and many patients stay in the ICU until transfer because there is no bed available in the ward. So only few patients were missed in our study, and this will unlikely affect the study results. The second limitation is that only adult patients were screened while pediatric and neonatal patients were excluded. The workload on the clinical pharmacists in the pediatric hospital was the major obstacle for them to participate in our study.

Table 4 Age intervals and number of medication errors.

Age	Number of medication errors (total is 216 errors)	Percentage of medication errors
<20 years	8	3.7%
20 to <40 years	38	17.6%
40 to <60 years	105	48.6%
>60 years	59	27.3%
Unknown	6	2.8%

Many interventions can be done in order to improve our PRN ordering practice; one of the interventions is by creating a separate medication administration record, to be used only for PRN medications. In this medication administration record, the most commonly used PRN medications will be written appropriately, what the physician has to do is only to sign, stamp and tick on the indication which is printed already on the medical administration record. This intervention will save the physician's time and will make it easier for them to prescribe a PRN medication. A similar intervention was done to improve the practice of prescribing antibiotics in medical and surgical intensive care unit (ICU) of a university hospital; formatting of the order sheet markedly increased security of antibiotics prescription [15]. The second intervention that can reduce our PRN ordering errors is by educational activities for both physicians and nurses about the complete PRN orders. The educational activities will reduce all medication errors including errors associated with PRN ordering [16]. The third intervention is modifying our CPOE system. In one study, the authors examined the impact of a clinical decision support system for high-alert medications to prevent prescription errors [17]. The clinical decision support system was created to give three kinds of interventions for five high-alert medications: clinical knowledge support, pop-ups for erroneous orders that block the order or provide a warning, and order recommendations. The impact of this clinical decision support system on prescription order was evaluated by comparing the orders in 6 month periods before and after using the program. Some medication errors have been reduced after implementing this program like omitted dilution fluids and exceeded the maximum dose. Finally, the presence of clinical pharmacists is very important to prevent all types of medication errors. The role of clinical pharmacy service is proved in the literature in preventing medication errors and the costs associated with their consequences [18-22]. The four risk mitigation strategies that were mentioned differ in their leverage and effectiveness, the best effectiveness and the highest leverage mitigation strategy is adjusting our CPOE system [23].

Conclusion

KSMC has inadequacy in its PRN prescribing practice. The occurrence of PRN ordering errors can cause other types of medication errors, and can negatively influence the treatment of the patients. Many interventions can be implemented to solve the defects in the PRN ordering practice; the use of separate medication administration record for PRN medications that contain the most commonly prescribed PRN medications printed on it, educational activities, modifying our CPOE system and finally the presence of clinical pharmacists are proposed solutions.

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