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PRESCRIBING ERRORS IN AN INTENSIVE CARE UNIT AND THE ROLE OF THE PHARMACIST

ERROS DE PRESCRIÇÃO EM UMA UNIDADE DE TRATAMENTO INTENSIVO E O PAPEL DO FARMACÊUTICO

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RESUMO

Objetivos: Avaliar o índice de erros de prescrição nas prescrições médicas dos pacientes admitidos em uma unidade de terapia intensiva (UTI), o grupo de medicamentos mais relacionados aos erros de prescrição e o índice de aceitação das sugestões farmacêuticas.

Métodos: as prescrições médicas dos pacientes admitidos na UTI de um hospital universitário foram analisadas. Os parâmetros considerados foram dose, intervalo de administração, via de administração, velocidade de infusão e diluição dos medicamentos. Os medicamentos mais relacionados aos erros de prescrição também foram avaliados, assim como a aceitação das sugestões farmacêuticas.

Resultados: 741 prescrições foram analisadas e 480 (64,78%) foram incluídas no estudo. 374 erros de prescrição foram encontrados após a análise da prescrição de 5007 medicamentos, o que resultou num índice de erro de 7,47%. 41,67% das prescrições médicas continham pelo menos um erro e o erro no intervalo de administração foi o mais comum (35,56% do total de erros). Os antimicrobianos foram os medicamentos mais relacionados aos erros de prescrição. O farmacêutico realizou 152 sugestões de modificação das prescrições, das quais 98,03% foram aceitas pelos médicos prescritores.

Conclusão: os erros de prescrição são eventos comuns na UTI estudada, trazendo um risco em potencial para os pacientes. O erro no intervalo de administração foi o tipo de erro mais freqüente nesse estudo. Os antimicrobianos foram os medicamentos mais relacionados aos erros. A aceitação às sugestões foi elevada.

Descritores: Erros de Medicação, Terapia Intensiva, Atenção Farmacêutica.

ABSTRACT

Purpose: To evaluate the rate of prescribing errors in the prescribing orders of patients admitted to an intensive care unit (ICU), the medication groups more related to the prescribing errors and the rate of acceptance of pharmacist intervention.

Methods: The prescriptions charts of patients admitted to the ICU of a teaching hospital in Brazil were analyzed. The considered parameters were dose, dosing interval, route of administration, infusion time and dilution of medications. The most common medications related to the errors were also evaluated, as well the acceptance of the interventions made by the pharmacist.

Results: A total of 741 prescriptions charts were analyzed and 480 (64.78%) were included in the study. 374 prescription errors were found after the analysis of 5007 medication orders, which resulted in a error rate of 7.47%. 41.67% of the prescriptions charts had at least one error and the dosing interval error was the most common (35.56% of the errors). The antibiotics were the medications more related to the prescribing errors. The pharmacist made 152 interventions and 98.03% of these were accepted by the physicians.

Conclusion: The prescribing errors are common occurrences in the studied ICU, bringing potential risk to the patients. The dosing interval error was the most frequent type of error found in the study. The systemic antibiotics were the medication group more related to the errors. The acceptance of pharmacist intervention was high.

Keywords: Medication errors, Intensive care, Pharmaceutical care.

RESÚMEN

Objetivos: Evaluar el índice de errores en la prescripción de medicamentos en las recetas de pacientes ingresados en una unidad de cuidados intensivos (UCI), evaluar el grupo de medicamentos más relacionados a los errores de prescripción y el índice de aceptación de las sugerencias realizadas por el profesional farmacéutico al prescriptor.

Metodología: Se analizaron las prescripciones de los ingresados a la UCI de un hospital universitario. Los parámetros considerados fueron: la dosis, el intervalo de administración, la vía de administración, la velocidad de infusión y la dilución de los medicamentos. También se evaluó cuales son los medicamentos más relacionados a los errores de prescripción y la aceptación de las sugerencias farmacéuticas realizadas al prescriptor.

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Resultados: 741 prescripciones fueran analizadas y un total de 480 (64,78%) fueran incluidas en el estudio. Tras analizar la prescripción de 5007 medicamentos, se encontraron 374 errores de prescripción, por ende el índice de error en la prescripción fue de 7,47%. Un 41,67% de las prescripciones contenían por lo menos un error. El error más recurrente se observó en el intervalo de administración (35,56%). Los antimicrobianos fueron los medicamentos más relacionados a los errores de prescripción. El farmacéutico realizó 152 sugerencias de modificación en las prescripciones, de las cuales un 98,03% fueron aceptadas por los prescriptores.

Conclusión: Los errores de prescripción son eventos recurrentes en la UCI estudiada, lo que representa un riesgo potencial en los pacientes hospitalizados en ella. El error en el intervalo de administración fue el error más frecuente en este estudio. Los antimicrobianos fueron los fármacos más relacionados a errores de prescripción. La aceptación de las sugerencias fue elevada.

Descriptores: Errores de Medicación, Cuidados Intensivos, Atención Farmacéutica.

INTRODUCTION

The medication process includes, at least, the prescription, the dispensation and the administration of a medication. It is, therefore, a complex and multidisciplinary activity that involves physicians, pharmacists, nurses and other healthcare professionals⁽¹⁻²⁾.

Medication errors, defined as a failure in the treatment process that leads to, or has the potential to lead to, harm to the patient, are common occurrences in the medication process, affecting especially inpatients⁽³⁾. These errors affect between 4% and 17% of inpatients and are considered the major cause of harm to this population. They bring important clinical and economic implications, endangering patient safety and raising hospital costs⁽⁴⁾.

The ICU is the site of most medication errors in the hospital environment, which can be due the severity of illness of its patients, the prescription of a great number of medications and the stressful work environment⁽⁵⁾. The consequences of the errors are also more serious in critical care patients. Nearly 19% of medication errors in ICU are life-threatening and 42% create the need for additional treatment⁽⁶⁾.

The pharmacist participation in the ICU is one of the strategies that can be adopted to prevent medication errors, as this healthcare professional provides important information that makes the medication use safer⁽⁷⁻⁸⁾.

The main objective of this study was to evaluate the rate of prescribing errors in the prescribing orders of patients admitted to an ICU, the medication groups more related to the prescribing errors and the rate of acceptance of pharmacist interventions.

METHODS

Study design. Cross-sectional, quantitative, descriptive and prospective study that was carried out in the ICU of a Brazilian teaching hospital. The referred ICU has 12 beds and receives patients from clinical and surgical wards.

Ethical considerations. The study was authorized by the ethics committee of the university that manages the hospital. For each patient, a close relative signed an informed consent after explanations about procedures and importance of the research. Only the prescription charts of patients whose relative signed the informed consent were included in the study.

Data collection and statistical analysis. The data was collected during 92 days (May 15th to August 15th) from the 7:00 am to 5:00 pm. During this period, each prescribing order was analyzed and the data was registered. The medications prescribed out of the daily period of collection were evaluated on the next day. The Microsoft Excel 2007 was used to calculate the rate of error.

Inclusion criteria. The prescription charts of patients which a close relative signed the informed consent.

Exclusion criteria. The prescription charts of patients which a close relative did not sign the informed consent were not included. The electrolyte solutions and insulins, as well as, the dermatologic and inhaled medications were also not included in the study.

Parameters and errors. The analyzed parameters on the prescribing orders were dose, dosing interval, route of administration, infusion time and dilution of medications. Any difference between the prescription orders and the literature of reference (MICROMEDEX[®],⁽⁹⁾ UptoDate[®],⁽¹⁰⁾ "Handbook of Injectable Drugs")⁽¹¹⁾ was considered an error. The following types of error were evaluated:

Dose error: the prescription of a medication in a dose not reported in

the literature, in an inappropriate dose for patients with renal or hepatic failure or the lack of the dose in a prescribing order.

Dosing Interval Error: the prescription of a medication in a dosing interval not reported in the literature, in an inappropriate dosing interval for patients with renal or hepatic failure or the lack of the dosing interval in a prescribing order.

Route of administration error: the prescription of a medication in a route of administration not recommended by the literature, the prescription of a medication in an unsafe route or the lack of the route of administration in a prescribing order.

Infusion time error: the prescription of a medication in an infusion time not reported in the literature or the lack of the infusion time in a prescribing order for medications that induce toxicity or therapeutic response according to this parameter.

Dilution error: the prescription of an inappropriate dilution for an injectable medication or the lack of the dilution in the prescribing order of an injectable medication.

Each error rate was calculated using the following equation:

Rate of a type of error = (number of errors per type / total number of errors) x 100.

Medication groups more related to errors. The analyzed medications were divided in groups according the Anatomical Therapeutic Chemical (ATC) classification. This allowed the identification of medication groups more related to the errors. The error rate per medication group was calculated using the following equation:

Rate of error per medication group = (number of group errors / total number of errors) x 100.

Acceptance to pharmacist intervention. The pharmacist made interventions on the errors found from 7:00 am to 5:00 pm. The interventions that resulted in the immediate change of the prescribing order were considered accepted. The rate of acceptance was calculated by the following equation:

Rate of acceptance = (number of accepted interventions / total number of interventions) x 100.

RESULTS

A total of 741 prescriptions charts were analyzed and 480 (64.78%), corresponding 5007 prescribing orders, were included in the study, as they fulfill the inclusion criteria. At least one prescribing error was found in 41.67% (200/480) of the prescription charts. Table 1 shows the rates of the number of errors per prescription.

Table 1 - Total Number and Rates of Errors per Prescription

Number of Errors per Prescription	Number of Prescriptions	Rates
One Error	111	23.13%
Two Errors	46	9.58%
Three Errors	22	4.58%
Four Errors	9	1.88%
Five Errors	6	1.25%
Six Errors	3	0.63%
Seven Errors	3	0.63%
Total number of prescriptions with errors	200	41.67%

The prescribing error rate was 7.47% (374/5007). The dosing interval error had a rate of 35.56% (133/374), while route of administration errors corresponded to 26.74% (100/374) of total number of errors. The dose errors, dilution errors and infusion time errors had a rate of 12.57%, 12.03% and 13.10%, respectively.

A total of 68 medications were related to prescribing errors and they were divided according to the main ATC group. The error distribution by main ATC group can be seen in Table 2, while Table 3 shows the most common medications in each ATC group.

Table 2- Error Distribution by Main ATC Group

Main ATC Group	Number of Errors	Rates of Error
Alimentary Tract and Metabolism (Group A)	34	9.09%
Blood and Blood Forming Organs (Group B)	22	5.88%
Cardiovascular System (Group C)	51	13.64%
Genito Urinary System and Sex Hormones (Group G)	1	0.27%
Systemic Hormonal Preparations, Excl. Sex Hormones and Insulins (Group H)	18	4.81%
Antiinfectives for Systemic Use (Group J)	123	32.89%
Musculo-Skeletal System (Group M)	9	2.41%
Nervous System (Group N)	108	28.88%
Antiparasitic Products, Insecticides and Repellents (Group P)	4	1.07%
Respiratory System (Group R)	4	1.07%
Total Number of Errors	374	100%

Table 3 - Medications More Related to Prescribing Errors in Each ATC Group

Main ATC Group	Medications	ATC Code	Rates of Error*
Alimentary Tract and Metabolism (Group A)	METOCLOPRAMIDE	A03FA01	3.74%
	RANITIDINE	A02BA02	3.74%
Blood and Blood Forming Organs (Group B)	HEPARIN	B01AB01	1.34%
	WARFARIN	B01AA03	2.14%
Cardiovascular System (Group C)	AMLODIPINE	C08CA01	3.48%
	FUROSEMIDE	C03CA01	2.94%
Systemic Hormonal Preparations, Excl. Sex Hormones and Insulins (Group H)	HYDROCORTISONE	H02AB09	3.21%
Antiinfectives for Systemic Use (Group J)	AMIKACIN	J01GB06	3.74%
	CEFEPIME	J01DE01	7.75%
	MEROPENEM	J01DH02	9.36%
	VANCOMYCIN	J01XA01	4.55%
Nervous System (Group N)	FENTANYL	N02AB03	5.88%
	MIDAZOLAM	N05CD08	5.88%
	ACETAMINOPHEN	N02BE01	4.28%
	TRAMADOL	N02AX02	2.94%

*Rates corresponding to the total number of errors (374).

The pharmacist made interventions in 152 prescribing orders, which corresponds to 40.64% (152/374) of the total number of prescribing errors. The rate of acceptance to pharmacist intervention was 98.03%, as only three interventions were not accepted.

DISCUSSION

The comparison between medication errors studies is a difficult task, as definitions and methodologies used are widely variable. Thus, comparison between different institutions can be misinterpreted by confounding variables, as the individual prescribing practices⁽¹²⁻¹³⁾.

Although comparison difficulties, the rate of prescribing errors found in this study (7.47%) is similar to the findings of other studies, including the systematic review of Lewis et al., which reported an error rate of 7%⁽¹⁴⁻¹⁵⁾. Of note, in these studies, the analyzed prescribing orders were handwritten by the physicians, while the orders analyzed on this study were made using an electronic prescribing system. Regarding to this type of prescribing system, the study of Shawahna et al.⁽¹⁶⁾ found an error rate of 8.2% after the introduction of this technological support.

The studies about medication errors in Brazil are still scarce⁽¹⁷⁾. However, the study of Bohomol, Ramos and D'Innocenzo identified 305 medication errors in an ICU, of which 4.6% were prescribing errors. A

study developed in an important hospital in Brazil found an error rate of 9.2%⁽¹⁸⁾. The methodological differences make the comparisons to the present study impossible.

At least one prescribing error was found in 41.67% (200/480) of the prescription charts analyzed in the present study. This finding can be related to the presence of residents in the ICU. In fact, other studies showed that these professionals commit more prescribing errors, especially at the start of the rotations⁽¹⁹⁾.

The dosing interval error was the most common type of error, corresponding to 35.56% (133/374) of the total number of errors. The ICU that hosted this study receives a great number of patients with renal dysfunction, which requires the adjustment of the dosing interval of many medications. However, this procedure was not taken in a great number of prescribing orders and the parameter was adjusted only after the pharmacist intervention.

The route of administration error represented 26.74% (100/374) of total number of errors and was the second most common. A great part of these occurrences was related to the prescription of medications by oral route, while the patient was using a nasogastric tubes for administration of medications and enteral nutrition.

The dosing error was the third more common type of error found

in the study, corresponding to 12.57% (47/374). This finding differs from the data found in the literature, which points to this error as the most common type of prescribing error^(13,16,20). Most of these errors were related to the prescription of conventional doses for patients of renal dysfunction.

The dilution errors represented 12.03% (45/374) of errors. An important example of this type of error was the lack of this parameter on the prescribing orders of some antibiotics, such as amikacin, clindamycin and trimethoprim/sulfamethoxazole (co-trimoxazole). It is known that these medications can produce important adverse reactions if administered without dilution^(9,11).

The infusion time error corresponded to 13.10% (49/374) of errors. The not addition of this parameter on the prescribing orders of antibiotics, such as vancomycin, cefepime and meropenem, was the most common occurrence for this type of error. It is known that the infusion of the glycopeptide in less than one hour can produce the red man syndrome⁽¹¹⁾. Regarding to the two beta-lactams, recent studies have shown a greater probability of treatment success if they are infused in three or four hours⁽²¹⁻²²⁾.

The systemic antibiotics (Group J of ATC classification) were the medication group more related to the prescribing errors, with 32.89% (123/374) of total number of errors. This finding is also shown in other studies, including those in ICU^(13,23). The meropenem and the cefepime were the medications of the group with more prescribing errors, 9.36% (35/374) and 7.75% (29/374), respectively. These are the most used antibiotics in the ICU that hosted this study, which can justify this finding.

The medications that act in the nervous system (Group N of ATC classification) also presented a strong relation with the prescribing errors, with a rate of 28.88% (108/374). In this group, the fentanyl was the medication with more errors, with a rate of 5.88% (22/374). Some studies show a high rate of prescribing errors with opioids⁽¹⁵⁾.

Many prescribing errors occurred after 5:00 pm, making the pharmacist intervention impossible. Nevertheless, the acceptance of pharmacist intervention was high, with a rate of 98.03% (149/152). The studies of Leape et al.⁽²⁴⁾, Zaidi et al.⁽²⁵⁾ and Kopp et al.⁽²⁶⁾ also found a high acceptance, with rates of 99%, 95% and 98%, respectively. These results suggest that the pharmacist integration in the ICU multidisciplinary team reduces the prescribing errors and, therefore, raises the patient safety. The role of this healthcare professional can be even more important, with improvement of clinical and economical outcomes^(14,23).

The electronic prescribing system used in the ICU requires the definition of the dosage form, dose, dosing interval and route of administration. Regarding to intravenous formulations, the dilution is suggested by the system, but can be modified by the physician. The infusion time is an optional parameter that can be added as a complement to the prescribing order. The results found in the present study may have been influenced by this technological resource, as several studies show a reduction of the prescribing errors after its introduction⁽²⁷⁻²⁹⁾.

Although the prescribing orders are made in the electronic system, the handwritten additions still occurs during the day, which generates a new opportunity for error. In fact, many prescribing errors were committed during this practice. This reinforces the evidence that the electronic prescribing systems reduce the errors.

Some limitations must be considered in the present study. The prescribing orders were analyzed by only one pharmacist and previous studies suggest that can be variability in the error detection according to the reviewer pharmacist⁽³⁰⁾. The pharmacist interventions were performed in only 40.64% of the prescribing errors, which may have resulted in an overrated rate of acceptance. The severity of the prescribing errors was not analyzed, which makes the evaluation of actual risk for the patients impossible.

CONCLUSION

The prescribing errors are common occurrences in the ICU of the teaching hospital that hosted this study, bringing potential risk to the

patients. The dosing interval error was the most frequent type of error found in the study. The systemic antibiotics were the medication group more related to the errors. The acceptance of pharmacist intervention was high and the integration of this healthcare professional in the ICU multidisciplinary team can decrease the frequency of the prescribing errors and, therefore, increase the patient safety.

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