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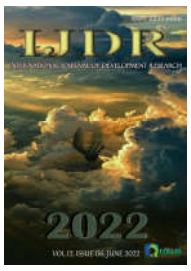

RESEARCH ARTICLE OPEN ACCESS

PRESCRIBING ERRORS FOR HIGH-RISK MEDICATIONS IN A HOSPITAL

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RESUMO

Medication errors are classified into prescription errors, dispensing errors and medication administration errors. Prescription errors are the most frequent and those that most adversely impact clinical outcomes. This study aimed to evaluate the quality and safety in the prescription of high-risk medication in a hospital. It was a cross-sectional study with a quantitative approach, carried out through the evaluation of drug prescriptions. The study followed the rules of the Ethics and Research Committee of the Federal University of Mato Grosso do Sul (CEP/UFMS) and was approved by means of opinion number 3,727,522. The high-risk medications most commonly associated with prescription errors were regular human insulin (40.8%), tramadol (21.53%) and 50% glucose solution (13.82%). The types of prescription errors that were most present were the use of incorrect dose expressions (n=529; 38.47%), use of contraindicated abbreviations (n=520; 37.82%) and the absence of time and speed of infusion (n=184; 13.38%). The results found can guide the construction of indicators related to high-risk medications prescription errors in the institution, in order to contribute to the optimization of internal processes and pharmaceutical interventions with the health team, in order to strengthen patient safety and use rational use of drugs in the hospital environment.

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INTRODUÇÃO

Medication Error (ME) is any avoidable event that, in fact or potentially, may lead to inappropriate or improper use of the medication, when it is being handled by health professionals during and in the field of practice, or in possession of patients and/or clients, when at home, and may or may not cause damage (Pharmacopoeia, 2001). MS are classified as prescribing errors, dispensing errors and medication administration errors (Lima, 2009). Prescription errors are unintentional decision or wording errors that may reduce the probability of the treatment being effective or increase the risk of patient injury, when compared with established and proven effective clinical practices (Brazil, 2013).

Prescription errors are one of the most frequent and have the greatest impact on clinical outcomes (Anacleto *et al.,* 2010; Araújo, 2011) , as they can result in direct and indirect costs to society, such as increased length of hospital stay to suffering and years of life lost (Anacleto, 2010; Néri, 2004). In this context, the evaluation of medication prescription errors is intended to monitor critical steps in the process, highlight the problem, create solutions, seek continuous improvement and evaluate the effectiveness of solutions (Rosa, 2009). Every year, a significant number of patients are harmed or die from a deficiency in health care, resulting in higher rates of morbidity and mortality. However, most damage is preventable (World Health Organization, 2019). In this sense, patient safety is based on the premise that everyone makes mistakes and that specific processes can be implemented to avoid them or minimize their impact. Thus, it is necessary to develop actions to optimize the care provided through

protocols, indicators and accreditation of health services, aiming at patient safety (Carayon, 2006). In the United States of America, MS cause at least one death every day, causing damage to approximately 1.3 million people annually. The annual associated cost is estimated at US$42 billion (World Health Organization, 2017). In some countries, around 6 to 7% of hospital admissions were estimated to be drug-related, so that two-thirds were considered avoidable and, therefore, potentially caused by errors (Pirmohamed, 2004; Alexopoulou *et al.,* 2008). In Brazil, although the number of studies on MS is growing, publications in the area are still scarce (Brazil, 2013). However, based on recent studies available, it is possible to observe that, in general, they are a recurring reality in hospitals, regardless of the stages in which they occur m (de Medeiros, 2020). It is evident that at least 8,000 deaths a year are attributed to EM (Abreu, 2013). Studies also indicate that these tend to be underreported in all countries, especially in developing countries, thus confirming their importance on a global scale (World Health Organization, 2013). In Brazil, in order to minimize the risk of unnecessary harm associated with health care, the Ministry of Health published, in 2013, Ordinance No. (PNSP) (Brazil, 2013) with the objective of contributing to the qualification of health care in all health establishments in the national territory, having as one of its strategies the elaboration and support for the implementation of protocols, guides and patient safety manuals. Another initiative in Brazil was the creation, in 2009, of the Institute for Safe Practices in the Use of Medicines (ISMP) with the objective of disseminating relevant information on medication errors, as a way of preventing adverse events, promoting patient safety and improving the quality of medication use at different levels of health care and (Institute for Safe Drug Use Practices, 2019). Potentially dangerous medicines (PDM), also known as high-alert drugs, are considered high risk, as they can cause significant harm to patients if any type of failure occurs during the use process.

They are responsible for approximately 58% of all drug-related damages (de Melo, 2014). Although errors related to PPM are not frequent, when they occur they can cause permanent or fatal damage (Gomes *et al.,* 2017). These have their relevant use in emergency services and intensive care units, being used more frequently. The most common types of associated damage include hypotension, hemorrhage, hypoglycemia, delirium, lethargy and bradycardia (Reis *et al.,* 2010). As a result, it is recommended that health professionals involved in the drug chain be aware of the risks associated with their use and implement barriers that can prevent the occurrence of errors related to PDM (Institute for Safe Drug Use Practices, 2020). The Institute for Safe Drug Use Practices (ISMP) updated and released, in 2019, a list containing 19 therapeutic classes and 13 specific drugs classified as MPP, including adrenergic agonists and antagonists, antiarrhythmics, antithrombotics, opioid analgesics, sedatives and high concentration electrolytes. Therefore, it is necessary to monitor the use of PDM, as well as the identification of related errors, in order to establish strategies for the continuous improvement of the quality and safety of hospital care and for the reduction of damages and costs (Gomes, 2017). Given the above, the primary contribution of this study to the literature in the area is focused on the evaluation of the quality and safety of prescriptions containing PDM in a hospital institution, since prescribing errors have been associated with a significant risk of permanent damage and, sometimes fatal, which justifies the importance of implementing mechanisms that can identify and intercept them before they reach the patient.

MATERIALS AND METHODS

This was a cross-sectional study with a quantitative approach, carried out through the evaluation of drug prescriptions stored by the institution's Clinical Pharmacy Service. Data collection was carried out from February to April 2020 by pharmacists residing in the institution's Multiprofessional Health Residency Program. In order to be included in the study, the drug prescriptions should have been prepared during the study data collection period and should have been intended for patients assisted by the Infectious and Parasitic Diseases (PID) sector. Data collection was performed daily, using a data collection instrument provided by the Hospital's Clinical Pharmacy Service. The method used to classify drug prescription errors was based on the recommendations of the Institute for Safe Practices in the Use of Medicines and the Protocol on Safety in the Prescription, Use and Administration of Medicines, published by the Ministry of Health of [3]. PDMs were identified based on the provisions of the bulletin of the Institute for Safe Practices in the Use of Medicines: Potentially Hazardous Medicines for Hospital Use – updated list 2019[17]. In view of the above, the variables evaluated in the prescriptions are described in Table 1. Although the Protocol for Safety in the Prescription, Use and Administration of Medicines also recommends the monitoring of errors related to allergies and dose, these errors were excluded from the study due to the impossibility of recording this information in the electronic prescribing system of the institution where the study was conducted.

Table 1. Variables evaluated in the prescriptions of this study

1. Presence of MPP in each prescription evaluated.	*2. Absence of patient identification: patient* 's full name, medical record number or care record, bed, service, ward and floor/ward.	*3. Absence of prescriber identification:* full name and registration number of the professional council and signature.	*4. Absence of identification of the institution:* name, address and telephone number of the hospital.	*5. Absence of date identification: prescription date.*	*6. Illegible drug prescription: in case of handwritten prescription, it must be legible.*	*7. Denomination of drugs: they must be prescribed using the Brazilian Common Denomination (DCB)*
8. Use of contraindicated abbreviations: abbreviations should not appear in the prescriptions.	*9. Incorrect dose expression:* the metric system must be adopted.	*10. Use of vague expressions:* if the prescription contains vague expressions, such as "at the doctor's discretion", "if necessary".	*11. Absence of dilution:* for intravenous, intramuscular, subcutaneous and neuraxial and nervous plexus medication.	*12. Absence of infusion time and speed :* must be presented in the prescription	*13. Route of administration:* they must be clearly prescribed, and the abbreviations standardized by the institution may be used.	

Based on the evaluation of the aforementioned data, the medication prescription error rate was calculated using the following formula: number of drugs prescribed with error/total number of drugs prescribed x 100, where the number of drugs prescribed with error was found according to with guidelines from the form "Criteria for Assessing Prescription Errors". Data were tabulated and interpreted using descriptive statistics, carried out with the help of Excel ®, version 2010. The study complied with the norms of the Ethics and Research Committee of the Federal University of Mato Grosso do Sul (CEP/UFMS) and was approved through opinion no 3.727.522.

RESULTS

From February to April 2020, 784 drug prescriptions from 61 patients admitted to the Infectious and Parasitic Diseases (IPD) sector of the hospital where the study was conducted were evaluated. Of the total number of patients evaluated, 57 (93.44%) used at least one PPM in the evaluated period. Therefore, of the total prescriptions evaluated, 752 (95.92%) were included in the study because they contain at least 01 (one) MPP. The average number of medications per prescription was 15.4 (±5.12), with 01 (one) being the minimum number and 31

(thirty-one) the maximum number. The total number of drugs evaluated in this study was 11,586. Of these, 2,399 (20.71 %) were MPP. The average number of PPM identified by prescription was 3.19 (±1.39), with 01 (one) being the minimum number and 07 (seven) the maximum number, as shown in Table 2. The most commonly prescribed PPMs were: 50% glucose solution (n=675; 28.14%), regular human insulin (n=623; 26.00%) and tramadol (n=247; 10.29%). These classified from the *Anatomical Therapeutic Chemical* (ATC), respectively as irrigation solution (B05), antidiabetic (insulin and analogues – A10) and opioid analgesics (N02), as shown in table 3. The MPP most associated with errors were: regular human insulin (n=561; 40.80%), tramadol (n=296; 21.53%) and glucose 50 % (n=190; 13.82%). Of the total PPM evaluated in this study (n=2,399), 1,221 (46.73%) were prescribed with one or more types of disagreement with the recommendations in the literature established as a method in this study, resulting in a rate of prescription errors of 50.9% described in table 4. In addition, the average number of errors per prescription was 1.8 (±1.18), ranging from a minimum of 1 (one) to a maximum of 8 (eight).

The most commonly identified MPPs were glucose 50%, insulin, and tramadol. Considering the MPPs most associated with errors, insulin was identified, followed by tramadol and 50% glucose. The study by Hicks, Cousins, Williams (Hicks, 2002) (2004), carried out in health institutions in the USA, identified potassium chloride, insulin, morphine, heparin and warfarin as the most common PPM associated with errors. In Brazil, a study carried out by Gomes *et al*. (2017) in a tertiary hospital in the Federal District, identified regular human insulin, 50% glucose solution, enoxaparin and tramadol as the MPPs most involved with writing-type prescription errors, data that also corroborate those found in this study. Insulin-related errors can cause serious damage, progress to coma or even death[30]. Various factors such as dosage complexity, product variety and drug pharmacology contribute to the potential for error and harm associated with insulin. Studies estimate that approximately 100,000 emergency department visits occur annually as a result of of insulin-related hypoglycemia and that severe neurological sequelae occurred in 60.6% of these visits (Geller, 2014).

Table 2. Distribution of potentially dangerous drugs identified in the prescriptions evaluated in this study. Brazil, 2020

Months	Feb /2020		March/2020		April/2020		Total	
MPP number*	n**	%	no	%	No	%	no	%
1-2	95	36.12	92	38.01	58	23.48	245	32.58
3-4	153	58.18	108	44.63	141	57.09	402	53.46
5-7	15	5.70	42	17.36	48	19.43	105	13.96
Total	263	34.97	242	32.18	247	32.85	752	100

*MPP: Potentially Hazardous Drugs.
**n = amount of MPP per prescription per month.

Table 3. Description of potentially dangerous drugs identified in the prescriptions evaluated in this study. Brazil, 2020

ATC*	Potentially dangerous drug	n**	%
Irrigation solution (B05)	50% glucose	675	28.14
Antidiabetics (insulin and analogues – A10)	Human Regular Insulin	623	26
Opioid analgesics (N02)	Tramadol	247	10.29
Antimycotic for systemic use (J02)	Amphotericins B	190	7.92
Antithrombotics (B01)	enoxaparin	189	7.88
High concentration electrolytes (B05)	Potassium chloride	143	5.96
Antithrombotics (B01)	heparin	130	5.42
High concentration electrolytes (B05)	magnesium sulfate	125	5.21
Opioid analgesics (N02)	Morphine	62	2.59
-	Others	15	0.62
	TOTAL	2,399	100

*ATC = *Anatomical Therapeutic Chemical*;
**n = number of potentially dangerous drugs identified.

Table 4. Distribution of the rate of prescription errors of potentially dangerous drugs identified in the prescriptions evaluated in this study, by period. Brazil, 2020

months (n)	Feb /2020	March/2020	April/2020	Total
MPP* totals analyzed	781	766	852	2,399
MPP* prescribed with error	341	388	492	1,221
Prescription error rate (%)	43.66	50.65	57.75	50.90

*MPP: potentially dangerous drugs

DISCUSSION

A health system needs to offer safe and quality care to the user. Considering the complexity of the aforementioned demand, it should be prioritized by the institutions and professionals that integrate them [26]. Quality in health care is defined by *the Institute of Medicine* (IOM) by Kohn [27] (2000), as "the degree to which health services increase the chance of achieving desired health outcomes, both for individuals and populations, and which are consistent with current professional knowledge". The contribution of this study to the literature in the area is highlighted due to the evaluation of the quality and safety of prescriptions containing MPP, since prescribing errors of these drugs have been associated with a significant risk of permanent and sometimes fatal damage to the patient. In this study, the mean number of PPM identified by prescription was 3.19. Passos 28 (2017), in a study conducted in a tertiary hospital in Fortaleza, identified 4.66 MPP by prescription, corroborating the data founds.

On the other hand, the occurrence of errors in the use of tramadol, an opioid analgesic, can result in adverse reactions such as nausea, vomiting, cardiovascular changes, headache, decreased motor capacity, constipation and severe cases of respiratory depression that can result in death and death. The wide availability of alternative opioids can make the error more likely due to the lack of familiarity with the professional. For this, professionals must always be aware of the administered dose and whether it is safe for the patient. A study by Krawczyk (2018) showed that there was a significant increase in the number of medical prescriptions for opiates between 2009 and 2015 in Brazil, so that it is necessary to understand the risks that continuous use can cause, in addition to strategies for the safe use of the drugs opioids and harm reduction. The occurrence of episodes of hospital hypoglycemia occurs relatively frequently, and hyperglycemia or hypoglycemia in hospitalized patients is associated with increased morbidity and mortality, which can generate thrombosis, phlebitis and neurotoxic effects that range from coma to

death due to hyperglycemia. The extravasation of hypertonic glucose solution can lead to skin and/or soft tissue injuries, phlebitis, loss of limbs and even death (Umpierrez, 2012). The study by Pires (Saucer, 2016) (2016), carried out in a teaching hospital in Minas Gerais, identified that 63.43% of the prescriptions analyzed did not present metric measures. However, the literature in the area recommends that the metric system should be used when expressing doses, eliminating expressions such as spoon, ampoule and bottle to avoid misinterpretation by health professionals. Heparins and insulins are usually expressed in international units. The use of the abbreviation "U" (units) and "UI" (international units) does not follow the system of official weights and measures and, when they appear, they must be described in full and with lowercase letters, that is, the use of "U" " or "UI" is expendable. This is because the use of "U" and "UI" can be confused with the number zero and lead to the administration of doses 10 or 100 times higher than those prescribed. Neri *et al*., (2011) found an even more worrying situation, as the use of abbreviations was observed in 98.00% of prescriptions; so that incomplete and inadequate information on medications are one of the main factors associated with medication errors. Finally, errors made during intravenous infusion therapy are responsible for approximately 60.00% of fatal errors in a hospital environment, influenced by the difficulty in programming pumps and the absence of such information [20]. In this sense, a study by Gomes, Galato & Silva[20] (2017) showed errors related to infusion in 10.40% of medications in a tertiary hospital in the Federal District. Although the computerized system increases the efficiency of the service and reduces the time needed to prepare the prescription, careful preparation of prescriptions is necessary in order to avoid new types of errors related to the electronic prescription model (Saucer, 2016). It is also noteworthy that consistent information in prescriptions reduces the risk of adverse events, as they reduce communication failures. The rate of PDM-related prescribing errors in this study was 50.90%. Based on the literature in the area, prescribing error rates identified in other national studies range from 18.20% to 48.20 %. The systematic review carried out between 2008 and 2014 in the United States by Alanazi, Tully & Lewis 38 (2016) showed that the prevalence of PPM prescribing errors was highly variable (0.24 to 89.6 errors per 100 prescriptions). PDMs are drugs more likely to cause significant harm to the patient, even when used properly. It is known, however, that many health professionals are not aware of the risks involved in the use of these drugs and do not even identify them as potentially dangerous. For example, a study carried out in a teaching hospital in Goiás identified that 42.80% of nursing professionals were unaware of PDM (Barbosa, 2016).

Thus, it is suggested that care teams involved in the drug chain receive continuing education related to PDM and publish their own list containing the most used ones, in order to indicate the maximum dose of each drug, form of administration (reconstitution, infusion time, route of administration), indication and usual dose. Ideally, such drugs should be standardized and, preferably, with limited presentations and concentrations, preventing possible errors. Based on the results found in this study and in the literature in the area, it is suggested that PDM are widely prescribed in the hospital environment and that there are important flaws in the elaboration of the prescription and with a tendency to present defined standards. It is important to emphasize how necessary is the adoption of standardization and constant improvement of the electronic prescription system. Despite this, the automation and computerization of the prescription alone are not capable of eliminating all errors, requiring the incorporation of more efficient practices, aimed at safety and prevention of medication errors. The literature in the area presents some practices that can be adopted to reduce medication errors involving PDMs, such as preventing the incomplete filling of prescriptions, inserting automatic maximum dose alerts, possible drug interactions and the need for dilution, differentiating similar names using capital and lowercase letters, highlight the PDM with a red color label, prevent the use of non-standard abbreviations, standardization of prescriptions and protocols, eliminate abbreviations, carry out medication reconciliation, adopt bar codes at the bedside, incorporate safety alerts in the computerized prescription systems, use indicators to manage errors and notify them and train prescribers (Saucer, 2016). The role of the pharmacist is essential in several phases of the dispensing and monitoring process of pharmacotherapy, in order to prevent risks[37]. Al Khani [40] (2014), in his study on prescribing errors in Saudi Arabia, concluded that the pharmacist was considered to be primarily responsible for reducing medication errors. The errors identified represent a risk to the medication system, so the prescription is considered the first step and if there are failures, either directly or indirectly, it can lead to problems in the subsequent steps, leading to an increase in medication error statistics and affecting patient safety. It is suggested the elaboration of a specific protocol related to the identification and monitoring of medication errors, as well as the development, together with the institution's employees, of the error notification culture, in addition to expanding access to medication information at all stages of the process. Medication system, in order to develop quality improvement programs that result in greater patient safety.

CONCLUSION

The MPPs most commonly associated with prescribing errors in this study were regular human insulin, tramadol, and 50% glucose solution. In addition, the main types of prescribing errors identified were the use of incorrect dose expressions, the use of contraindicated abbreviations and the absence of infusion time and rate. The PDM prescribing error rate in this study was 50.90%. The results obtained showed the profile of PDM prescription errors in the evaluated hospital sector and represent the importance of the indicators generated by the institution's clinical pharmacy service, in order to allow the development of strategies aimed at reducing the occurrence of these errors, contributing as a tool of decisions related to the optimization of internal processes, as well as pharmaceutical interventions with the multiprofessional team in search of promoting patient safety and the rational use of medicines in the hospital environment.

Conflict of Interest: All authors declare that they have no conflict of interest.

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