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Analysis of antimicrobial prescriptions for hematological patients in relation to the safe medication protocol in a teaching hospital

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Abstract

Objective: To analyze the adequacy of the antimicrobial prescription in relation to the safety protocol in the prescription, use and administration of medicines from Ministry of Health. **Method:** This is a cross-sectional study that evaluated prescriptions from patients admitted to the medical clinic of a teaching hospital between January 1, 2017 and December 31, 2018. The data collection form was prepared according to the requirements of safe medication prescription protocol. Data were entered into the RedCap software. Descriptive data analysis was performed using Stata 14.1 software, in order to obtain relative and absolute frequencies. **Results:** In total, 57 patients had their prescriptions evaluated. In the analysis of the items referring to the prescriptions, 9,70% was in compliance as recommended in the protocol. However, patient weight and drug allergy records were absent in 87.7% and 91.2% of prescriptions, respectively. Of the prescriptions analyzed, 115 antimicrobial prescriptions were identified, and 91.3% of these prescriptions contained at least one inadequacy in relation to what was recommended in the protocol. In total, 178 inadequacies were identified and the most frequent were medication prescribed by trade name (21.9%), absence of treatment duration (19.7%), similar names (18.5%), absence and inadequacy of time or infusion rate (both with 14.0%). **Conclusion:** Most antimicrobials were inappropriately prescribed in relation to the protocol, which can compromise patient safety, facilitate bacterial resistance, and increase health costs.

Keywords: Medication Errors, Anti-Infective Agents, Patient Safety, Inpatients, Pharmacoepidemiology.

Análise das prescrições de antimicrobianos para pacientes hematológicos em relação ao protocolo de medicação segura em um hospital de ensino

Resumo

Objetivo: Analisar a adequação da prescrição de antimicrobianos em relação ao protocolo de segurança na prescrição, uso e administração de medicamentos do Ministério da Saúde. **Método:** Trata-se de um estudo transversal, que avaliou prescrições de pacientes internados na clínica médica de um hospital de ensino entre 01 de janeiro de 2017 e 31 de dezembro de 2018. O formulário para coleta de dados foi elaborado segundo os requisitos de prescrição segura de medicamentos do protocolo. Os dados foram digitados no *software* RedCap. Análise de dados descritiva foi realizada no software STATA 14.1, de modo a obter frequências relativas e absolutas. **Resultados:** No total, 57 pacientes tiveram as suas prescrições avaliadas. Na análise dos itens referentes as prescrições, 9,70% estava em conformidade como preconizado no protocolo. Entretanto, o peso do paciente e o registro de alergias a medicamentos estavam ausentes em 87,7% e 91,2% das prescrições, respectivamente. Das prescrições analisadas, foram identificadas 115 prescrições de antimicrobianos, sendo que 91,3% dessas prescrições continham ao menos uma inadequação em relação ao preconizado no protocolo. No total, 178 inadequações foram identificadas e as mais frequentes foram medicamento prescrito pelo nome comercial (21,9%), ausência da duração do tratamento (19,7%), nomes semelhantes (18,5%), ausência e inadequação do tempo ou velocidade de infusão (ambas com 14,0%). **Conclusão:** A maioria dos antimicrobianos foram inadequadamente prescritos em relação ao protocolo, o que pode comprometer a segurança do paciente, induzir a resistência bacteriana e aumentar os custos em saúde.

Palavras-chave: Erros de Medicação, Anti-Infecciosos, Segurança do Paciente, Pacientes Internados, Farmacoepidemiologia.

Introduction

Antimicrobials are a fundamental class of medications for the prophylaxis and treatment of infections, which in turn are known to be a public health problem because they contribute to the morbidity and mortality rates in the population and to the increase in health costs[1]. Data from World Health Organization (WHO) indicate that infections are responsible for nearly 25% of the deaths worldwide and that, in less developed countries, this number becomes even more significant, resulting in nearly 45% of all deaths due to infectious processes[2].

In this sense, antimicrobials are essential in recovery of people's health and constitute one of the main classes of medications prescribed, especially in hospital environments, being used by nearly 30% of the patients[3]. Despite all the benefits, their indiscriminate and irrational use exerts a negative impact on the health outcomes. The emergence of multidrug-resistant bacteria and the increase in morbidity and mortality stand out about these effects[4].

Antimicrobials are among the main medications responsible for medication errors (MEs), which are defined as "any preventable event that may cause or lead to inappropriate medication use or harms to the patient while the drug is under control of the health professional, the patient or the consumer[5]. In an observational study conducted at a hospital from Ethiopia it was shown that antimicrobials represented the class most frequently involved in MEs, accounting for 40.32% of the errors[6]. Similar results were found in another study developed in a Brazilian university hospital, which pointed out antimicrobials as the medications most involved in MEs (36% of the errors)[7].

In the specific case of some patients, the pharmacotherapy of the underlying disease involves use of antimicrobials, as is the case of onco-hematological patients who, in addition to requiring medications for the treatment of current infections, make use of antibiotic prophylaxis[8]. These patients are immunodepressed due to the use of chemotherapeutic agents and, for this reason, they are susceptible to infections. It is known that nearly 11% to 38% of the hematological patients develop bloodstream infections during chemotherapy, in addition to presenting mortality rates of 12% to 42% due to infectious causes[9].

In addition to that, the fact that onco-hematological patients use a large number of medications and require more frequent hospitalizations makes them more susceptible to harms due to failures in the medication process[9]. Thus, considering that safety in medication use is a concern in the global health agenda[2], the objective of this study was to evaluate the adequacy of antimicrobial prescriptions of hematological patients regarding the requirements of the Ministry of Health's safety protocol on drug prescription, use and administration[10].

Methods

This is a cross-sectional study, developed based on data from the 60-bed Medical Clinic ward of a university hospital in Goiânia, Goiás, which serves several specialties, including Hematology. The study included patients admitted to the ward between January 1st, 2017 and December 31st, 2018, and excluded those who did not have their full hospitalization period during the period determined in the research.

After obtaining the full list of hospitalizations (n=3,885), duplicates were excluded (n=1,267), resulting in 2,618 valid hospitalizations during the period. Subsequently, sample size was calculated, for finite populations[11]. The hospitalizations were allocated proportionally to each Medical Clinic specialty and resulted in a sample size of 336, of which 41 represented the sample of hospitalizations for the Onco-Hematology medical clinic.

The Onco-Hematology hospitalizations during the study period were numbered in ascending order and 60 of them were drawn (a number that is higher than the minimum sample size of 41) by resorting to the www.sorteador.com.br website. All prescriptions for each hospitalization drawn were numbered in ascending order and the prescription to be evaluated was also randomly selected via the www.sorteador.com.br website. If the prescription drawn did not have at least one prescribed medication of any pharmacological class, a new draw was performed until the resulting prescription had at least one drug. Of all 60 prescriptions drawn, three were excluded due to absence of necessary information in the medical chart to conduct the study, resulting in 57 valid prescriptions.

A pilot form was prepared to adjust the data collection instruments, validated by two duly trained members of the team. The study variables were divided into "those related to the safe prescription verification items" and "those on medication use based on the requirements set forth in the Ministry of Health's safety protocol on drug prescription, use and administration". For the purposes of this study, any and all deviations from the safety protocol were considered MEs. The data were typed into a structured database in the *Research Electronic Data Capture* (RedCap) software[12]. The variables related to the safe prescription verification items were the following, as well as their classification:

Type of prescription: "handwritten", when the prescription was handwritten; "typed", when the prescription was typed by means of a text editor software and/or spreadsheet; "mixed", when a part was handwritten and the other was typed by means of a software program; and "computerized" when made through the Computerized Prescription Support System;

Name of the patient: "present", when the name was written in full in the prescription; "absent" when not present; "incomplete" when present but incomplete; "illegible", when it was not possible to read it; or "abbreviated" when the name was abbreviated;

Medical record number: "present", when the medical record number was included in the prescription; "absent" when it was not included; "illegible" when it was not possible to read it; or "incorrect" when it corresponded to another patient or was incomplete;

Ward: "present", when the ward was included in the prescription; "absent" when it was not included; "incomplete" when present but incomplete; and "illegible", when it was not possible to read it;

Bed: "present", when the bed number was included in the prescription; "absent" when it was not included; "incomplete" when room numbering was present but the A, B, C or I (Isolation) nomenclature was missing; and "illegible" when it was not possible to read it;

Date: "present", when the date was included in the prescription; "absent" when it was not included; "incomplete" when present but incomplete; and "illegible", when it was not possible to read it;

Identification of the prescriber in the prescription: "present", when the full name, professional council registration number and signature were included (handwritten or stamp); "absent" when it did not contain the identification of the prescriber; "incomplete" when any identification item was missing (full name, professional registration, signature); and "illegible" when it was not possible to read any identification item;

Record of allergies: "yes" when any record regarding the presence or absence of allergies was included in the prescription, "no"when there was no record in the prescription regarding presence or absence of allergies; and "illegible" when it was not possible to read the allergy record when present;

Weight: "yes" when the patient's weight was included in the prescription; "no" when it was not included; and "illegible" when it was not possible to read the patient's weight, even if present.

The variables on medication use based on the requirements set forth in the Ministry of Health's safety protocol on drug prescription, use and administration are described in Figure 1, as well as the respective classification.

Descriptive statistics was used for data analysis, in order to obtain diverse information related to the relative and absolute frequencies, using the STATA 14.1 software. The current study was approved by the Research Ethics Committee of CHC-UFG/EBSERH under CAEE No. 14501219.6.0000.5078.

Figure 1. Performed based on identification of the active ingredient of each of the medications prescribed, and later classified according to ATC[1]

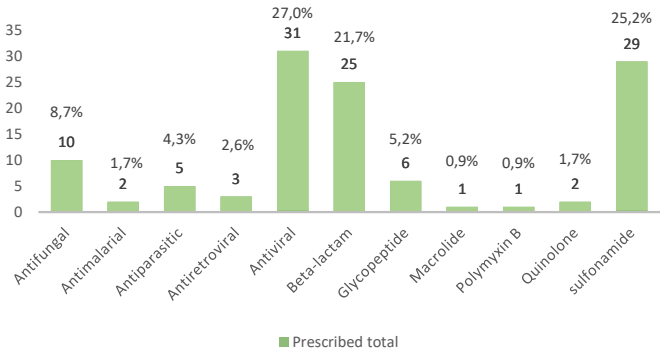
Medicamentos Prescritos	Performed based on identification of the active ingredient of each of the medications prescribed, and later classified according to ATC[1].
Antimicrobials	"Yes" when the medication was an antimicrobial and "no" when it was not.
Abbreviations	"Present" when contained in the prescription, U (Units), IU (International Units), chemical formulas (MgSO4, KCl, NaCl, etc.) and short names of medications (HCTZ, RIPE, SMZ + TMP, MTX, CBZ, HNF, etc.); and "absent" when no abbreviation was included.
Name of the medications	"Generic name" when prescribed with the generic denomination, and as "commercial name" when using the commercial name.
Medications with similar names	"Compliant" when written according to the list standardized by ISMP Brazil2; as "non-compliant" when not written according to the list; and as "not applicable" when it was not a medications standardized by ISMP Brazil[2].
Expression of doses	"Compliant" when the units (grams, milligrams, micrograms, international units) were included and legible; and as "non-compliant" when the units of measurement were present but illegible or milliliter, tablet, ampoule, teaspoon, bottle or capsule were used as a measure for the expression of the doses.
Dose conformity	"Compliant" when they were in agreement with the usual dosages recommended in the international Micromedex®3 and Up To Date®4 databases; and as "non-compliant" when the dose was not in agreement with these international databases.
Expression of the administration route	"Present" when the administration routes of each medication were prescribed and legible; "absent" when the administration route of each medication was not prescribed; and "illegible" when it was not possible to read the administration route in the prescription.
Administration route conformity	"Compliant" when the administration route prescribed was the one recommended by the manufacturer; and as "non-compliant" when the administration route did not correspond to the one indicated for the medication prescribed.
Dosage	"Present" when the medication dosage was prescribed and legible; "absent" when it was not prescribed; and "illegible" when it was not possible to read the dosage in the prescription.
Dosage conformity	"Compliant" when dosage of the prescribed medication was in accordance with the maximum doses recommended in the literature; and "non-compliant" when dosage of the prescribed medication was in disagreement with the maximum doses recommended in the literature.
Dilution	"Present" when it contained information on diluent (type and volume) for intravenous medications; "absent" when this information was not prescribed; "illegible" when it was not possible to read it, "incomplete" when some information about diluent (type or volume) was missing; or "not applicable" when it was not about these medications, or when it dealt with drugs that did not need dilution according to Micromedex®3 and Up To Date®4 or to the manufacturer.
Dilution conformity	"Compliant", when the diluents prescribed for intravenous medications and all the information on the diluent (type and volume) were in accordance with the guidelines of the databases3,4 or the manufacturer; "non-compliant" when this information was in disagreement with the literature; or "not applicable" when it was not about intravenous medications, or when it dealt with drugs that did not require dilution as directed by the databases[3,4].
Infusion time	"Present", when the prescriptions contained information on the infusion speed and time for intravenous medications; "absent" when this information was not included in the prescription; "illegible" when it was not possible to read them; or "not applicable" when it was not about intravenous medications, or when it dealt with drugs that could be administered in bolus as directed by the databases[3,4].
Infusion time conformity	"Compliant", when the prescriptions of intravenous medications contained information on the infusion speed and time of according to the guidance of the databases or of the manufacturer; "non-compliant" when this information was in disagreement with the literature; or "not applicable" when it was not about intravenous medications, or when it dealt with drugs that could be administered in bolus according to the guidance of the databases[3,4].
Treatment length in time	"Present" when duration of the antimicrobial treatment was described; "absent" when it was not described, "illegible" when it was not possible to read it; and "not applicable" when prophylactic antimicrobials were prescribed.
Use of vague expressions	"Non-compliant" when "use as usual", "use as accustomed", "continuous use", "do not stop" were present: and "compliant" when these expressions were accompanied by safety information (dose, dosage, maximum daily dose, condition that determines treatment use or interruption).
Erasures	"Present", when there were erasures in the prescriptions; and "absent" when there were no erasures.

[1]WHO, 2021. [2]ISMP BRASIL, 2014. [3]Micromedex®. [4]Up To Date.

Results

Prescriptions of 57 patients hospitalized in the Medical Clinic ward were evaluated in the study. A total of 115 antimicrobials were found in these prescriptions. The antimicrobials found in the highest numbers in the prescriptions were acyclovir (n=31; 27%) and sulfamethoxazole+trimethoprim (n=29; 25.2%). In relation to the antimicrobials group, a higher frequency of prescriptions was observed for the antiviral class medications (n=31; 27.0%) (Figure 2). In turn, referring to the fundamental safe drug prescription verification items, it was observed that 63.2% (n=36) of the prescriptions were written. On the other hand, the record of allergies was absent in 91.2% (n=52) of the prescriptions and the patient's weight was missing in 87.7% (n=50) (Table 1).

Figure 2. Absolute and relative frequency of the antimicrobial prescriptions by class.



Most of the antimicrobials prescribed (n=105; 91.30%) presented some nonconformity with the safe prescription protocol. Only ten antimicrobials were prescribed according to the exact guidelines of the protocol, and albendazole was the most appropriately prescribed drug (n=4; 40%). The most prescribed antimicrobials outside the protocol recommendation were acyclovir (n=31; 29.5%), sulfamethoxazole+trimethoprim (n=28; 26.7%), piperacillin+tazobactam (n=8; 7.6%) and vancomycin (n=6; 5.7%) (Table 2). A mean of 1.5 nonconformities was observed for each antimicrobial prescribed.

In the prescriptions evaluated, no medication was prescribed using abbreviations. Prescriptions by the commercial name corresponded to 21.9% (n=39) of the total nonconformities, with sulfamethoxazole+trimethoprim as the main medication prescribed by its trade name (n=28; 71.8%). In relation to the medications with similar names, 18.5% frequency (n=33) of nonconformities was observed regarding lack of necessary emphasis in writing, with acyclovir presenting inadequacies in relation to this verification item in all prescriptions (n=31) (Table 3).

Regarding the dose expression item, nystatin and topical ketoconazole presented nonconformities, both in 50.0% (n=2) of the prescriptions, and, in this case, the medications were prescribed using non-metric units. Also in relation to dose adequacy, a meropenem prescription with a dose above the one recommended as maximum dose in the literature for a patient on dialysis was identified. It was not possible to evaluate dose adequacy of five antimicrobials that depend on the patient's weight, as the information was not included in the prescriptions. A piperacillin+tazobactam prescription lacked the administration route. A topical ketoconazole prescription did not have its dosage correctly prescribed. In 50% (n=2) of the nystatin and topical ketoconazole prescriptions, the dosage was not been adequately described. Regarding dilution, a sulfamethoxazole+trimethoprim prescription did not contain this information. In addition to that, in an acyclovir prescription, the diluent volume was inadequate, exceeding the maximum concentration recommended.

Table 1. Analysis of the adequacy of the items to verify the prescriptions of onco-hematological patients regarding the requirements set forth in the Ministry of Health's safety protocol on drug prescription, use and administration.

Variable	n (%)
Type of prescription	
Handwritten	4 (7.0%)
Typed	36 (63.2%)
Mixed	17 (29.8%)
Computerized	0 (0%)
Total	57 (100%)
Name of the patient	
Absent	0 (0%)
Present	56 (98.2%)
Incomplete	0 (0%)
Illegible	1 (1.8%)
Abbreviated	0 (0%)
Total	57 (100%)
Medical record number	
Absent	0 (0%)
Present	51 (89.4%)
Illegible	1 (1.8%)
Incorrect	5 (8.8%)
Total	57 (100%)
Ward	
Absent	2 (3.5%)
Present	55 (96.5%)
Incomplete	0 (0%)
Illegible	0 (0%)
Total	57 (100%)
Bed	
Absent	3 (5.3%)
Present	52 (91.2%)
Incomplete	2 (3.5%)
Illegible	0 (0%)
Total	57 (100%)
Date	
Absent	0 (0%)
Present	56 (98.2%)
Incomplete	0 (0%)
Illegible	1 (1.8%)
Total	57 (100%)
Identification of the prescriber in the prescription	
Absent	0 (0%)
Present	57 (100%)
Incomplete	0 (0%)
Illegible	0 (0%)
Total	57 (100%)
Record of allergies	
No	52 (91.2%)
Yes	5 (8.8%)
Illegible	0 (0%)
Total	57 (100%)
Weight	
No	50 (87.7%)
Yes	7 (12.3%)
Illegible	0 (0%)
Total	57 (100%)

Table 2. Frequency of the antimicrobial prescriptions and non-compliance with the safe prescription protocol in a university hospital.

Antimicrobial	n (%) of prescriptions	Non-compliance with the protocol n (%)
Acyclovir	31 (27.0%)	31 (29.5%)
Sulfamethoxazole + Trimethoprim	29 (25.2%)	28 (26.7%)
Piperacillin + Tazobactam	8 (7.0%)	8 (7.6%)
Meropenem	6 (5.2%)	4 (3.8%)
Vancomycin	6 (5.2%)	6 (5.7%)
Amoxillin + Clavulanate	4 (3.5%)	4 (3.8%)
Cefepime	4 (3.5%)	4 (3.8%)
Albendazole	4 (3.5%)	0 (0%)
Nystatin	2 (1.7%)	2 (1.9%)
Topical ketoconazole	2 (1.7%)	2 (1.9%)
Fluconazole	2 (1.7%)	1 (1.0%)
Voriconazole	2 (1.7%)	2 (1.9%)
Hydroxychloroquine	2 (1.7%)	2 (1.9%)
Oxacilin	1 (0.9%)	1 (1.0%)
Ceftriaxone	1 (0.9%)	1 (1.0%)
Azithromycin	1 (0.9%)	1 (1.0%)
Clindamycin	1 (0.9%)	1 (1.0%)
Ciprofloxacin	1 (0.9%)	1 (1.0%)
Levofloxacin	1 (0.9%)	1 (1.0%)
Polymyxin B	1 (0.9%)	1 (1.0%)
Metronidazole	1 (0.9%)	0 (0%)
Amphotericin B	1 (0.9%)	1 (1.0%)
Itraconazole	1 (0.9%)	0 (0%)
Entecavir	1 (0.9%)	1 (1.0%)
Dolutegravir	1 (0.9%)	1 (1.0%)
Tenofovir + Lamivudine	1 (0.9%)	1 (1.0%)
TOTAL	115 (100%)	105 (100%)

Absence of the infusion time expression was one of the most frequent nonconformities observed in the antimicrobial prescriptions (n=25; 14.0%), and the piperacillin+tazobactam combination had the highest number of prescriptions without this information (n=7; 28.0%). Absence of treatment length in time was the second most frequent nonconformity (n=35; 19.7%), and piperacillin+tazobactam was the most prescribed medication without this information (n=7; 20.0%). Only 18.2% (n=21) of the antimicrobials had their treatment length in time prescribed correctly. In relation to the presence of vague expressions in the prescriptions, only dolutegravir was prescribed with the words "continuous use".

Discussion

In our study, we observed that most of the prescriptions were typed using text editing software. Our findings are in line with those of a study carried out at a hospital in northeastern Brazil, which observed that 85% (n=763) of the prescriptions analyzed were typed and that 15% (n=135) were handwritten[13]. Another study carried out at a hospital in São Paulo identified a high frequency of handwritten prescriptions (n=2,840; 81%) and 19% (n=566) of typed prescriptions[14]. These results point to certain uniformity of prescriptions in health institutions and, although adoption of one type of prescription to the detriment of another does not constitute a deviation from the protocol, health institutions must identify the risks that each prescription can entail and invest in training the multiprofessional team[14].

Most of the verification items related to prescription identification were in compliance with the protocol. However, most of the prescriptions did not contain the patient's weight information and allergy record, which, in turn, can compromise patient safety. Our findings are in line with those of a study carried out in England in which the authors observed absence of the patient's weight in 46% (n=474) of the prescriptions in hospitals from London[15]. In this study, 89 patients were prescribed antimicrobials, and 39% (n=35) of the prescriptions did not contain weight information. This is an important fact, especially for defining the most accurate dosage of medications. In addition to that, the patient's weight allows assessing the response to the therapy and calculating the best dosage for patients with compromised renal function[15].

In turn, regarding the allergy record, our findings are in line with those of other Brazilian studies, which identified absence of this information in 100% (n=72) of the prescriptions[16]. In addition to that, there are several reports of allergies to antimicrobials and, therefore, this information is important to minimize the possibility of severe adverse effects, such as hypersensitivity reactions[17], Toxic Epidermal Necrolysis (TEN) and Stevens Johnson Syndrome (SJS). The last two types of adverse effects mentioned are considered severe forms of hypersensitivity reactions that affect the skin and which, although rare, exert an impact on public health due to the mortality rate[18].

Our findings indicated high use frequency of acyclovir and sulfamethoxazole+trimethoprim. This result can be explained by the fact that clinical guidelines from the *American Society of Clinical Oncology* recommend using both antimicrobials for patients at high risk of infection, who undergo chemotherapy, allogeneic hematopoietic stem cell transplantation or leukemia induction therapy, in addition to those with expectation of profound and prolonged neutropenia or other risk factors[8].

In relation to the names of the medications, in slightly over one third of the prescriptions included in our study, antimicrobials were present with their commercial name. Our results are similar to the data reported in a study conducted in *Ditrito Federal*, where more than half (53.15%) of the medications were prescribed by their generic name[19]. These findings point to the need for standardization, as prescriptions by commercial names may induce errors, since there are variations across countries and these names are subjected to changes to meet market interests[20]. It is noteworthy that prescriptions by commercial names deprive the act of interchangeability of a medication with the same efficacy and safety with lower costs to the patients[20].

In turn, regarding the prescription of medications with similar names, a high frequency of prescriptions without differentiation/highlighting of the name was found. A study to assess the risk in the prescription process was carried out at a hospital in Italy and showed a series of potential failure modes in relation to the distribution system of medications with similar names[21]. In a case report of MEs with similar names, there was confusion between the "meronem" prescribed medication and another drug with a similar name ("melperon"), which might be fatal for the patient due to overdose[22]. The strategies to reduce this type of errors involve typographical adjustments, such as selective capital letters (*Tall Man* letters) or bold type and barcode[23]. In addition to that, there is software (Lasa v2) with the potential to identify mistakable medication pairs[24]. However, for the adoption of these

Table 3. Distribution of the inadequacies in the antimicrobial prescription in relation to the Ministry of Health's safety protocol on drug prescription, use and administration in a university hospital.

Antimicrobial	C.N.[1]	LASA[2]	E.DOSE[3]	A.DOSE[4]	E.ROUTE[5]	A.ROUTE[6]	E.DOS[7]	A.DOS[8]	E.DIL[9]	A.DIL[10]	E.INT[11]	A.INT[12]	D.TO[13]	E.VG[14]	Total
Acyclovir	-	31 (94.0%)	-	-	-	-	-	-	-	1 (33.3%)	1 (4.0%)	1 (4.0%)	2 (5.7%)	-	36 (20.2%)
Sulfamethoxazole + Trimethoprim	28 (71.8%)	-	-	-	-	-	-	-	1 (100%)	2 (66.7%)	-	-	-	-	31 (17.4%)
Piperacillin + Tazobactam	8 (20.5%)	-	-	-	1 (100%)	1 (100%)	-	-	-	-	7 (28.0%)	7 (28.0%)	7 (20.0%)	-	31 (17.4%)
Meropenem	-	-	-	1 (20.0%)	-	-	-	-	-	-	3 (12.0%)	3 (12.0%)	2 (5.7%)	-	9 (5.1%)
Vancomycin	-	-	-	-	-	-	-	-	-	-	3 (12.0%)	3 (12.0%)	3 (8.6%)	-	9 (5.1%)
Amoxillin + Clavulanate	3 (7.7%)	-	-	-	-	-	-	-	-	-	2 (8.0%)	2 (8.0%)	4 (11.4%)	-	11 (6.2%)
Cefepime	-	-	-	-	-	-	-	-	-	-	3 (12.0%)	3 (12.0%)	3 (8.6%)	-	9 (5.1%)
Albendazole	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0 (0%)
Nystatin	-	-	2 (50.0%)	2 (40.0%)	-	-	-	2 (50.0%)	-	-	-	-	-	-	6 (3.4%)
Topical ketoconazole	-	-	2 (50.0%)	2 (40.0%)	-	-	1 (100%)	2 (50.0%)	-	-	-	-	-	-	7 (3.9%)
Fluconazole	-	-	-	-	-	-	-	-	-	-	-	-	1 (2.9%)	-	1 (0.6%)
Voriconazole	-	-	-	-	-	-	-	-	-	-	-	-	2 (5.7%)	-	2 (1.1%)
Hydroxychloroquine	-	-	-	-	-	-	-	-	-	-	-	-	2 (5.7%)	-	2 (1.1%)
Oxacilin	-	-	-	-	-	-	-	-	-	-	1 (4.0%)	1 (4.0%)	-	-	2 (1.1%)
Ceftriaxone	-	1 (3.0%)	-	-	-	-	-	-	-	-	1 (4.0%)	1 (4.0%)	1 (2.9%)	-	4 (2.2%)
Azithromycin	-	1 (3.0%)	-	-	-	-	-	-	-	-	-	-	1 (2.9%)	-	2 (1.1%)
Clindamycin	-	-	-	-	-	-	-	-	-	-	1 (4.0%)	1 (4.0%)	1 (2.9%)	-	3 (1.7%)
Ciprofloxacin	-	-	-	-	-	-	-	-	-	-	1 (4.0%)	1 (4.0%)	1 (2.9%)	-	3 (1.7%)
Levofloxacin	-	-	-	-	-	-	-	-	-	-	1 (4.0%)	1 (4.0%)	1 (2.9%)	-	3 (1.7%)
Polymyxin B	-	-	-	-	-	-	-	-	-	-	1 (4.0%)	1 (4.0%)	-	-	2 (1.1%)
Metronidazole	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0 (0%)
Amphotericin B	-	-	-	-	-	-	-	-	-	-	-	-	1 (2.9%)	-	1 (0.6%)
Itraconazole	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0 (0%)
Entecavir	-	-	-	-	-	-	-	-	-	-	-	-	1 (2.9%)	-	1 (0.6%)
Dolutegravir	-	-	-	-	-	-	-	-	-	-	-	-	1 (2.9%)	1 (100%)	2 (1.1%)
Tenofovir + Lamivudine	-	-	-	-	-	-	-	-	-	-	-	-	1 (2.9%)	-	1 (0.6%)
Total	39 (21.9%)	33 (18.5%)	4 (2.2%)	5 (2.8%)	1 (0.6%)	1 (0.6%)	1 (0.6%)	4 (2.2%)	1 (0.6%)	3 (1.7%)	25 (14.0%)	25 (14.0%)	35 (19.7%)	1 (0.6%)	178 (100%)

[1]Antimicrobials prescribed by commercial name; [2]Medication with similar name inadequately; [3]Antimicrobial prescribed without dose expression; [4]Dose conformity; [5]Antimicrobial prescribed without expression of the administration route; [6]Administration route conformity; [7]Antimicrobial prescribed without dosage expression; [8]Dosage conformity; [9]Antimicrobial prescribed without dilution expression;[10]Dilution conformity; [11]Antimicrobial prescribed without infusion time expression; [12]Infusion time conformity; [13]Antimicrobial prescribed without treatment length in time; [14]Antimicrobial prescribed using vague expressions.

technologies, it becomes necessary to allocate financial resources, which are sometimes limited in many Brazilian institutions. To minimize the risks involved in the exchange of medications for others with similar names, adoption and dissemination of lists containing the pairs of medications that can be exchanged should be implemented in health institutions in order to raise awareness among health professionals.

Absence of the intravenous medication infusion time was one of the frequently identified inadequacies in relation to the protocol. Our findings are in line with those of a study conducted at a university hospital in São Paulo where, among the prescriptions errors identified, absence of the infusion time stood out in 20.1% (n=215) of them[25]. Including the infusion time is an essential requirement for safety in medication use because some antimicrobials may pose a risk to the patients if this information is not stated in the prescription, such as the occurrence of classic infusion reactions like Red Man Syndrome, caused by rapid vancomycin infusion[26]. It is also noteworthy to mention the amphotericin B infusion, which can cause hypersensitivity reactions, with lethal anaphylaxis as the worst clinical outcome for the patients[27]. The infusion reaction caused by amphotericin B can be avoided if the medication is administered with a slow infusion rate[27].

Also regarding absence of the infusion time, we observed in our study that the most prescribed medications without this information were piperacillin+tazobactam, meropenem and vancomycin. Another Brazilian study corroborates our results, as they noticed a high frequency of piperacillin+tazobactam and meropenem with the infusion time or speed missing in the prescription[25]. Diverse scientific evidence shows the importance of the infusion rate in optimizing antimicrobial therapy especially for time-dependent drugs, which have greater microbicidal activity when their concentration persists above the minimum inhibitory concentration for longer periods of time during the interval between doses[28]. An example is beta-lactam antimicrobials, very prescribed due to their efficacy and safety profile which, for optimized therapy, it is suggested that their infusion time be prolonged[29]. The adoption of standardized checklists to assess safety of the prescriptions by hospital pharmacists can intercept deviations of this nature, which compromise patient safety.

Another verification item in an antimicrobial prescription that needs attention is treatment length in time since, in addition to favoring bacterial resistance[30], prolonged use of antimicrobials can also be consumed continuously without indication. It should also be noted that, for antimicrobial management, this information in the medical record allows optimizing the therapy[31].

Among the strategies to reduce MEs, those centered on the pharmacist stand out. A literature review showed the positive impacts of the presence of clinical pharmacists in reducing and preventing MEs, pointing out their crucial role in health policies and prevention of these errors that exert impacts on patient safety[32]. Pharmacists assist multiprofessional teams in identifying drug-related problems and propose interventions aimed at safety in drug prescription and administration[32]. Diverse evidence suggests that pharmacists can help promote patient safety, prevent adverse events and reduce health expenses[33]. In addition to that, these professionals work in health education[34] and in the review of medications for hematological outpatients[35].

The findings of our study suggest that the adoption of standardized checklists based on the Ministry of Health's safe medication protocol can guide clinical pharmacists in their everyday practice to identify problems related to medication use safety, especially in relation to antimicrobials, a class of drugs widely used in hospital institutions.

Conclusion

In this study, regarding the verification items, most of them were in compliance with the protocol. However, the weight and allergy records were not found in most of the prescriptions. Most antimicrobials presented at least one error in their prescriptions, the most common being: prescription by commercial name, inadequacy regarding prescription of medications with similar names and absence of infusion time and treatment length in time, which can compromise pharmacotherapy as well as induce bacterial resistance.

Our findings indicate the need to improve the prescriptions, especially in relation to antimicrobials. The measures to be taken pervade both qualification and training of the professionals, focusing on prescribers in safe prescription based on the recommendations set forth in the Ministry of Health's protocol and on the adoption of checklists in order to ensure the safety in medication use, especially for hematological patients.

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Collaborators

LTF, PRM, ACFM and LTS contributed to the conception, planning, data analysis and interpretation, and were in charge of writing and critical reviewing the content. TXAMF, JCM, and PCS participated in critically reviewing relevant intellectual content. All those involved approved the final version to be published.

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Conflict of interest statement

There are no conflicts of interest in carrying out the research.

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