PRESCRIPTION ERRORS AND ADMINISTRATION OF INJECTABLE ANTIMICROBIALS IN A PUBLIC HOSPITAL

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ABSTRACT

To analyze the errors of prescription and administration of antimicrobials powder for solution for injection in a public hospital. This is a cross-sectional study carried out in a public hospital, in which antimicrobials prescriptions and administrations were analyzed for patients admitted to the Intensive Care Unit (ICU) and Medical Clinic (CM) from November 2015 to February 2016. The tabulation and data analysis were done in Epidata software version 3.1 of 2008 and IBM Statistical Package for the Social Sciences (SPSS). In the statistical analysis, chi-square tests or Fisher's exact test were applied when necessary. The level of significance was 5%. Among the statistically significant results, the following are the errors related to medical prescription with the variables: age at 57% and medical specialty at 67%, both at the ICU; bed with 30% and hospitalization unit with 37%, both in CM. In the administration of antimicrobials, statistically significant differences were observed only in the failure to identify the patient (30% in CM). Regarding the use of antimicrobials, Cefepime was the most prescribed with 65.1%. In view of these aspects, it is extremely important that errors arising from an incomplete and misleading prescribing are identified, to propose improvements in the medication system, in order to prevent errors, and to promote a more rational antibiotic therapy, avoiding infections.

Keywords: Medication errors, medication prescriptions, anti-infectives.

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INTRODUCTION

Health care is developed in a complex and multidisciplinary system that may predispose to the occurrence of adverse medication events (AME), which must be identified and characterized to understand the impact of these events on public health.[1] This study points to a variation of 5% to 8% in AME as a cause of hospital admissions, with a resulting increase in length of hospital stay, of material resources and health professionals.[1,2]

Adverse events (AE) compromise the quality of hospitalized patient care and refer to damage during care that was not caused by the patient's underlying disease, and medication use is a critical point in health care and occurrence of AE.[3-4]

The Ministry of Health (MS) conceptualizes medication error (ME) "as any preventable event that causes or induces the inappropriate use of a medication, the medication being in the control of the health professional or the patient".[5] ME may occur at any stage of daily care practice, including prescribing, dispensing, and administering the medication.[1-4]

Thus, errors can occur both in the preparation and in the use of the medications, which can result in serious damages, disabilities and deaths.[4] To curb the occurrence of these errors, in March 2017, the World Health Organization (WHO) launched the third Global Patient Safety Challenge, entitled "No-harm Medication", in Germany, with the purpose of addressing the weaknesses in health systems and to establish strategies to reduce by 50% the serious and preventable damage associated with MS in all countries over five years.[6]

Regarding ME, a international study conducted in 1995 showed that 39% of errors occur during prescription and 38% during administration.[7] Research performed in a teaching hospital showed that the pharmacological class most involved with MS are systemic antimicrobial (ATM), accounting for 19% of the notifications.[8]

MS involving ATM can lead to the dissemination of resistant strains of microorganisms, increased hospital costs and risks of adverse medication reactions (AMR).[8] Research on this topic shows that annual deaths from infections caused by medication resistance increase from 700,000 to 10 million by 2050, with a cumulative cost of 100 trillion dollars in the United States of America.[9]

Antimicrobial resistance is considered a worldwide public health problem, due to the inadequate and inconsistent use of ATMs in the hospital and in the community, which induces the emergence of multi resistant bacteria, impacting the morbidity and mortality outcomes, stay and cost increase. This phenomenon imposes severe restrictions on the therapeutic arsenal available for the treatment of bacterial infections, representing a growing concern for humanity.[8-10]

In view of these aspects, it is imperative to carry out studies on the practice of prescribing and administering ATMs in hospital settings. Thus, the objective of the present study was to analyze the main errors occurred in the prescription and administration of injectable antimicrobials in a public hospital in the interior of Bahia.

METHODOLOGY

Type and place of study

A cross-sectional, descriptive-analytical study carried out between November 2015 and February 2016, through the analysis of prescriptions and observations of injectable ATM administrations,

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used by patients hospitalized in a public hospital in the state of Bahia, linked to the Public Healthcare System (SUS).

The hospital serves an approximate population of 600,000 inhabitants and serves 180 active beds in the specialties of Clinical Medication (CM), Clinical Surgery, Pediatrics, Neurology, Psychiatry, Intensive Care Unit (ICU) and Urgency/Emergency. The said hospital also carries out teaching, research and extension, receiving students for practical classes, internship, research and extension of the medical, nursing, pharmacy, physiotherapy, nutrition, psychology and biomedicine courses of a public university as well as private colleges.

Study population and inclusion and exclusion criteria

Inclusion criteria were all patients admitted to the ICU (ten beds) and male and female CM (thirty-two beds), with an indication of using ATM powder for solution for injection. The choice of ATM was based on the standardized list of the Hospital Infection Control Commission (CCIH). The following antimicrobials were selected: Cefepime, Piperacillin + Tazobactam and Vancomycin, since at the time of collection only these were available in the pharmacy stock. The pediatrics, surgical clinic, psychiatry and neurology sectors were excluded from the study, since no prescriptions of these medications were observed in the period of the research, and the emergency/emergency sector for not attending hospitalized patients.

Sample calculation and data collection

The sample size was calculated using StatCalc from the Epi info program version 7.0, with reference to the work of Neri[11] (292.5 errors per 1000 items), an alpha error of 5%, a 10% beta error, and the average prescriptions with ATM powder for solution for injection in the month prior to the beginning of the data collection, totaling 39 prescriptions. However, all the prescriptions were evaluated from November 2015 until the end of February 2016, which totaled 43 prescriptions.

The evaluation of the prescription was performed using a systematized form, *checklist* type, of the protocol of prescription, use and administration of medications of the Ministry of Health of Brazil.5 The following variables were considered as dependent variables: prescribing errors and administration of injectable ATMs and as independent variables the hospital sectors (ICU and CM) and sociodemographic data.

According to the protocol of MS,[5] absence of data, illegibility or non-standard abbreviations or incorrect information in the items: full name, age and weight of the patient, bed, date of prescription, use of non-standard abbreviations , signature, specialty, and stamp of the prescriber, Brazilian Common Name (DCB), pharmaceutical form, route of administration, frequency of administration, prescribed dose, duration of treatment, administration information, hospitalization unit and medical record number.

In addition, any discrepancy exercised during the preparation and administration of medicinal products in relation to medical prescription, non-compliance with hospital recommendations or guidelines or the manufacturer's technical instructions.[3-4]

Thus seven different types of administration errors were considered: i) Dose administration errors - when the administered dose was different from that prescribed; ii) Route of administration errors - when administration was carried out via a route other than that prescribed; iii) Time errors - when the administration occurred in 30 minutes before or after the prescribed time; iv) Wrong patient - when the patient receiving the medication was different from the patient for whom the medication was prescribed; v) Failure to identify the patient - when there was no identification of the patient's name and date of birth, mother's name, or chart number on bracelet or bed; vi) Preparation and administration technique errors when different from those recommended by the institution and/or manufacturer vii) Omission of dose - when it was not administered and checked by the nursing team.

To follow preparation and administration, the methodology was conducted by Silva et al. (2017)[12], in which the selection of ATM, dilution, schedule of administration, dose administered, dose omission, route of administration, preparation technique, patient receiving medication and identification of the patient in the bed were observed by a properly trained researcher. Socio-demographic data (marital status, ethnicity, sex, age and the diagnosis of hospitalization) were extracted from the patient's chart.

The stage of evaluation of the prescription happened after the monitoring of the administration of the medications, due to ethical questions, being all the data annotated for later comparison. ICD Classifications 10 (International Classification of Diseases and Related Health Problems), described with an alphanumeric code, and published by WHO to standardize and codify diseases, were used. In addition, the electronic bulletin of the National Agency of Sanitary Surveillance (ANVISA) was consulted to verify the data regarding the use and administration of the medications.

The observed nursing professionals were those who worked in the day service of the sectors.

Data analysis

Data was tabulated in the *software* Epidata version 3.1 2008 and IBM *Statistical Package for the Social Sciences* (SPSS), version 23.0, 2015 (IBM Corp., Armonk, United States of America) for statistical analysis.

The sociodemographic variables, hospital sectors, administration errors and prescription errors were described in the form of absolute (FA) and relative (FR) frequencies, after which they were analyzed with the likelihood ratio to verify the differences between the proportions. For the statistical procedures, the significance level of $p < 0.05$ was considered.

Ethical considerations

The research followed all ethical precepts in force, Resolution of the National Health Council - CNS No. 466/12 and was approved by the Ethics and Research Committee of the State University of Southwest of Bahia with protocol number 29780014.8.0000.0055 and a favorable opinion number 703.376.

RESULTS

A total of 43 prescriptions and ATM administrations, mainly from the medical clinic (69.8% [30]), were analyzed. Approximately 77% (33) of the patients were male, 88% (38) non-white and 72% (31), with a mean age of 68 (SD±20.54), (Table 1).

Table 1 - Percentage distribution of sociodemographic data of patients hospitalized in a public hospital teaching in injectable antimicrobial use, Jequié (BA) Brazil, 2015/2016 (N=43).

Variables	N	%
Sector		
Medical clinic	30	70
ICU	13	30
Gender		
Female	10	23
Male	33	77
Race		
Whites	5	12
Not white*	38	88
Marital status		
With partner	12	28
Without partner	31	72

Source: Own search: ICU: intensive care unit. *Non-white: black, brown, unidentified.

Considering the diverse information related to the diagnosis of patients' hospitalization, according to ICD10, the prevalent diseases were in the respiratory and circulatory systems, accounting for 23.7% (9) and 20.51% (8), respectively, followed by clinical signs and symptoms (dyspnea and edema) 17.95% (7). Regarding the ATMs included in the study, Cefepime 65.1% (28) was the most prescribed, followed by Piperacillin+Tazobactam 23.3% (10) and Vancomycin 11.6% (5).

Regarding the errors of prescription, the variables name of the patient and use of the official nomenclature (DCB) were correctly filled in 100% of the prescriptions. The use of non-standard abbreviations, absence of medical records, weight and information on ATM administration, in both sectors, presented the highest frequencies of errors. No discrepancies in prescription were identified with respect to the therapeutic decision involving the dose, route or frequency of administration compared to that recommended in the package insert.

Table 2 - Percentage distribution of writing errors in prescriptions of inpatients in a public hospital of teaching using injectable antimicrobials, Jequié (BA), Brazil, 2015/2016 (N=43).

Variable	Error (%)		p-value*
	ICU (n=13)	CM (n=30)	
Patient name	0	0	-
Age	0	57	< 0.001
Weight	100	100	-
Prescription by DCB	0	0	-
Route of administration	7	0	0.118
Pharmaceutical form	50.0	53	0.708
Frequency of ADM	0	0	-
Prescribed dose	0	0	-
Signature of the prescriber	0	13	0.081
Medical specialty	67	17	0.015
Prescriber's stamp	0	13	0.081
Date on prescription	0	7	0.223
Computerized prescription	0	3	0.393
Non-standard abbreviation	100	100	-
Medical history number	100	100	-
Bed	0	30	0.006
Hospitalization unit	0	37	0.002
Additional information	100	100	-
Duration of treatment	84	70.0	0.547

Source: Own search. ICU: intensive care unit. CM: medical clinic. DCB: Common Brazilian Denomination. ADM: administration. *Significant p value < 0.05

Regarding the administration of injectable ATMs, the main failures observed in CM were related to the dose that was not administered in 7% of the patients, administered dose different from that prescribed in 17% and incorrect preparation technique in 7% (Table 3).

Among the nursing professionals observed during the administration (22), 100% had the function of nursing technicians, of which 4.5% had undergraduate nursing. As for the time of profession, 80% had five or more years of work in the hospital and all engaged between 20-30 hours a week and had an effective employment relationship.

Regarding the prevalence of prescription errors, the results among the sectors were similar, 339.58 (CM) and 312.5 (ICU) errors per 1,000 items evaluated, respectively. As for the administration, the CM presented a higher prevalence of errors than the ICU, 118.51 and 25.64 administration errors per 1000 items evaluated, respectively.

Table 3: Percentage distribution of errors of administration of inpatients in a public hospital of education using injectable antimicrobials, Jequié-BA, Brazil, 2015/2016 (N=43).

Variable	Error (%)		p-value*
	ICU (n=13)	CM (n=30)	
Medication not administered	0	7	0.223
Dose omission	0	7	0.223
Incorrect dose	0	5	0.049
ADM route	0	0	-
Right patient	0	0	-
Patient identification failed	0	30.0	0.006
Preparation technique	0	7	0.223
Schedule	23.1	40.0	0.275

Source: Own search. ICU: intensive care unit, Medical C. ADM: administration. *Significant p value < 0.05.

DISCUSSION

The results show that among the errors related to prescription, the absence of duration of treatment, complementary information, pharmaceutical form and prohibited abbreviations are highlighted. In the administration, time errors, preparation technique and administered dose different from the prescribed one were observed. These data corroborate with the national literature, which demonstrates the occurrence of failures in the medication system often having prescription as a vulnerability.[10-13] Considering the increasing rise in microbial resistance and the low number of new ATM records,[14] it is imperative to evaluate the medication errors involving these medications.

Among the prescriptions analyzed, the highest frequency was of males and with a mean age above sixty years old. The predominant masculine gender can be justified by the hospital's attendance profile, a regional reference in orthopedic traumatology, situated on the banks of BRs 116 and 330, which has a relevant role in the care of victims of motor vehicle accidents on these federal highways.[13,15,16] In addition, the prevalence of males in the study is related, due to work-related aspects, to preventive habits and external causes (accidents involving firearms and weapons).[15]

Regarding the age group, the results characterize a profile of the elderly, which is related to the rapid demographic transition, which demonstrates the aging of the population worldwide. In this sense, the elderly patient is more susceptible to physiological changes and hospitalizations.[16-18] In addition to the studied clinics, hospitalized patients are afflicted with associated comorbidities (diseases of the circulatory and respiratory systems).

As for the CID, diseases of the circulatory and respiratory systems were the most outstanding. Similar data was found in surveys conducted in public hospitals.[15,17] The frequencies of respiratory infections may justify the predominance of the prescription of Cefepime and Piperacillin+Tazobactam. Although the use of these ATMs is predicted by the CID, the frequency of use of these medications is an alert, as they should have limited use to prevent future problems in relation to the selection of resistant strains.[17] It should be noted that they were the ones available at the pharmacy at the time.

Regarding the errors of prescription, attention is drawn to variables like abbreviations, number of the medical record, weight and complementary information, which they represented a hundred percent of errors. Assuming that prescribing is viewed as the beginning of a series of events within the medication treatment process, lack of information is considered a serious error and increases the risk for medication errors to occur.[15-19] Although prescriptions in this hospital are semi-computerized, written in a standardized worksheet in Excel *software*, with gaps to be filled, the absence of a document with all the necessary data in a prescription is a factor that contributed to the occurrence of medication errors.[5]

The presence of non-standard abbreviations was found at high frequency in the prescriptions evaluated in this study, as well as in other studies.[18-20] In studies on medication errors performed in Brazilian hospitals, non-standard abbreviations were found in frequencies ranging from 70 to 80%.[18,20] Usually the high frequency of abbreviations in hospital prescriptions is related to the simplification of the writing and the time savings, however, it is a risk factor, since they can be misinterpreted and compromise communication among the professionals that provide assistance to the patient causing severe medication errors.[21] When used, abbreviations should follow standardization, as established by the safety protocol on the prescription, use, and administration of medications from the National Patient Safety Program.[5]

As for the absence of the medical record number in all the prescriptions analyzed, it can be explained, because the hospital registers this number only in the patient's medical record, which is originated at the time of admission. However, this absence is an error, since this number is one of the variables suggested for patient identification.[11-13] The implementation of the electronic prescription with mandatory data, such as the medical record number, can reduce the occurrence of these errors.[19]

Weight is a relevant variable, mainly because the profile of inpatients, as it was verified, is of elderly people and normally their physiological conditions are altered, weight being necessary, even if estimated, to establish the medication dose, minimizing the possibility of the patient receiving an underdosage or overdosage of the medication.[13] In Cefepime information leaflet, the ATM most frequently used in this study, it is recommended that in adults and children weighing more than 40 kg the dose should be established according to the guidelines described in package.[22]

Complementary information for administration of medications is useful to assist nursing professionals in the preparation of medications, especially those requiring dilution, which are absent in all prescriptions. Omission of information on the diluent to be used and rate of infusion can lead to the occurrence of AMR or ME, such as the red man syndrome, related to rapid infusion of Vancomycin. In addition, ATMs may present incompatibilities with diluents, such as Piperacillin+Tazobactam, which is incompatible with ringer lactate.[23-26]

The omission of the route of administration in the ICU prescriptions was also observed, similar results were found in studies performed in Brazilian hospitals.[13,15,16] The absence of this variable can generate doubts in the team involved, which can culminate in an incorrect administration.[24] This error becomes more important, especially when the medication has different routes, such as Cefepime, the antibacterial most prescribed in this study, which can be administered intravenously or intramuscularly.[21]

Another frequent error in the ICU and CM was the absence of the pharmaceutical form, which is imperative for safe dispensing and administration. A study carried out in a hospital in the southern region of Brazil showed an absence of 83.1% of the pharmaceutical form, corroborating with the results found in our evaluation. When the hospital provides only one pharmaceutical form of the prescribed medication, the consequences are minimized by the absence of such information[7,11] but, otherwise, changes may occur in the dispensing of the medication generating errors of administration and possible adverse events to the patient.

As for the data referring to the prescribing professional, the two sectors presented errors regarding the medical specialty. In the hospital or outpatient setting, knowledge about the prescribing professional is relevant to ensure communication between the staff when there is a need to resolve any doubts about the prescribed therapy. In addition, the presence of this information gives legal validity to the prescriptions, mainly because in the place of study, there are professionals of various specialties.[12,13,26]

The absence of the bed number, hospitalization unit and patient identification, a frequent error in CM, makes it difficult to locate the patient, which can lead to errors in administration. In a survey conducted in the same sector of this hospital with a potentially dangerous medication[12] there was absence of bed in 34.4%, hospitalization unit in 40.3% and failure to identify the patient in the bed in 88.9% of the prescriptions/administrations evaluated. To minimize adverse events related to identification, the Ministry of Health and ANVISA recommend the use of bracelets.[5]

The duration of treatment is substantial to ensure rational therapy for hospitalized patients, especially in the use of ATMs, a variable that is absent in both sectors. In the hospital environment, as the prescriptions are valid for 24 hours, some prescribers deem this item indispensable. But the presence of this variable in the prescription, determines the time of use of the medication, preventing the patient from unnecessarily taking the medication beyond the expected time,[12,13] avoiding selective pressure of resistant strains. In addition, it is worth noting that for clinical management of antimicrobial use (*Antimicrobial Stewardship Program*), an optimization of therapy is required, related to its duration, dose and route of administration.[5]

ATMs should be administered in correct doses and at appropriate intervals to provide the patient with effective treatment.[25] In the administration of the evaluated medications the preparation technique errors were related to the material used (blind needle), which made reconstitution difficult, and when aspirating the solution for dilution the medication flowed out of the vial, giving considerable amount to the professional and could have administered a subdose to the patient, which can lead to therapeutic failure and cause adverse events to the patient. [24,26]

Non-administration of the prescribed medication and omission of dose was also verified; this fact compromises the entire treatment of the patient, justification for this result is due to the patient's exit for performing surgical procedures, and the companion's refusal to administer the medication, since the patient had AMR at the ATM in use, in the case of Cefepime.[22] Failure to administer the dose may lead to treatment failure, compromising the therapeutic response of the antimicrobial, thus favoring the multiplication of microorganisms at the site of infection.[7]

In addition, a dose administered other than that recommended in the prescription was observed. Literature shows that dose errors are common.[11-24,26] However, when the medications involved are ATMs, the severity of the error may become potentially greater due to the fact that they are hepato or nephrotoxic, besides contributing to bacterial resistance, since the patient may be exposed to an ineffective dose and pharmacodynamically incompatible with the microorganism,[13,15-20, 24, 26] and may generate microbial resistance to the antimicrobials in use.

Regarding the time errors, the results of this research evidenced errors in both sectors, data coincides with those shown by other studies.[1-2,13] The determinants of these errors may be related to internal planning processes by the nursing team for medication administration, which is usually in the same time period. The delay in ATM administration schedules is considered extremely serious because, when plasma levels between one administration frequency and another are not maintained, it compromises the elimination half-life of the medications, medication onset, maximum or peak concentration and duration of action. Thus, since some microorganisms have sophisticated adaptation mechanisms, this fact may induce bacterial resistance.[24]

Regarding the sector, the ICU presented a lower frequency of errors when compared to CM; this fact can perhaps be explained by the number of patients under the responsibility of the nursing professional in each clinic, ICU's each nursing technician is responsible for the care of two patients and CM 8 patients for each technician, in addition a better culture of patient safety of the professionals working in the ICU is noticeable.[1]

The analogy between the two sectors makes it possible to state that the prescription errors were similar and could be minimized with the creation of electronic prescription with clinical support, which second recent research[19], contributes to reducing medication errors, as well as reducing costs and ensuring quality care. This is because prescription is the first step in the medication therapy chain, and when it is well written, with clear, complete and objective information, it is an essential tool to prevent medication errors.[16-20] In addition, we can cite the role of the clinical pharmacist in the evaluation of medication prescriptions, especially ATMs, contributing to the surveillance and monitoring of this class of medications promoting the rational use and management of these medications.[5,9]

As a limitation of this study, the fact that the study was carried out in a single hospital cannot be extrapolated to other hospital organizations. The questionnaire used was restricted only to prescribing and administration errors and did not evaluate the request of microbiological exams to justify the choice of ATM and the time of use of these medications. However, this study presents relevant data on medication errors involving the use of these medications, which is currently a growing concern and is considered a global public health problem.

CONCLUSION

This study aimed to analyze the main errors which occurred in the prescription and administration of injectable antimicrobials in a public hospital. The findings of this study pointed to a greater proportion of errors of administration and prescription in the medical clinic. In addition, an exacerbated frequency was observed in the use of broad-spectrum antimicrobials, requiring interprofessional work for a more rational therapeutic approach, mainly to avoid increasing the resistance of microorganisms to the medications available for treatment of infections related to hospital health.

The results of the present study indicate the need for improvements in the medication system of the hospital studied, in order to prevent errors, especially with the creation of fully computerized prescription mechanisms, trying to avoid, as far as possible, adverse events that can reach the patient.

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IVRM collected, interpreted study data and written this paper. LBL, PHRFA e MBR contributed to analysis of results and critical review of text. GSL contributed to study coordination, analysis and interpretation of results and critical review of text. All authors are responsible for the article information and have approved the final version for publication.

Conflict of Interest

The authors declare that there is no conflict of interest for the work.

REFERENCES

1. Duarte S da CM, da Costa Machado Duarte S, Stipp MAC, da Silva MM, de Oliveira FT. Eventos adversos e segurança na assistência de enfermagem. Rev Bras Enferm. 2015;68(1):144–54.

2. Silva YDOM, De Oliveira Machado Silva Y, Lima MG. Incidência de internações por eventos adversos a medicamentos em Minas Gerais. Sci Med. 2017;27(1):24936.

3. Couto RC, Pedrosa TMG, Rosa MB. Erros acontecem. A força da transparência para o enfrentamento dos eventos adversos assistenciais em pacientes hospitalizados. Construindo um sistema de saúde mais seguro. Instituto de Estudos de Saúde Suplementar . Universidade Federal de Minas Gerais. 2016.

4. Makary MA, Daniel M. Medical error - the third leading cause of death in the US. BMJ. 2016;353(2139):1-5.

5. Brasil. Ministério da Saúde. Agencia Nacional de Vigilância Sanitária. Protocolo de segurança na prescrição, uso e administração de medicamentos do programa nacional de segurança do paciente. 2013.

6. ORGANIZAÇÃO MUNDIAL DE SAÚDE. OMS. Medication without harm: WHO's third global patient safety challenge. Geneva: WHO, 2017.

7. Leape LL, Bates DW, Culllen DJ, Cooper J, Demonaco HJ, Gallivan T, et al. Systems analysis of adverse drug events. JAMA. 1995; 274(1):35-43.

8. D' Aquino FFR, Flávia FR, Carmen MCl, Lima SAM, Spiri WC, Gabriel CS. Incidentes relacionados a medicamentos em uma instituição hospitalar: subsídios para a melhoria da gestão. Revista Enfermagem UERJ. 2015;23(5):616-21.

9. Davies SC, Fowler T, Watson J, Livermore DM, Walker D. Annual Report of the Chief Medical Officer: infection and the rise of antimicrobial resistance. Lancet. 2013;381(9878):1606–9.

10. Noemi A, Aguilera ACS, Rigo H. Evolución del consumo de antibióticos y resistencia antimicrobiana en un hospital de Argentina. Rev. Bras. Farm. Hosp. Serv. Saúde São Paulo. 2014;5(2):8-13.

11. Rabelo Néri ED, Néri EDR, Gadêlha PGC, Maia SG, da Silva Pereira AG, de Almeida PC, et al. Erros de prescrição de medicamentos em um hospital brasileiro. Revista da Associação Médica Brasileira, 2011;57(3):306–14.

12. Silva JSD, Almeida PHRF, Padua CAM, Perini E, Rosa MB, Lemos GS. Erros de prescrição e administração envolvendo um medicamento potencialmente perigoso. Rev enferm UFPE on line., Recife. 2017;11(10):3707-17.

13. Dantas JO, Porto SC, Mendonça PTN, Lima MMM, Lobo, IMF. Avaliação da prescrição de antimicrobianos de uso restrito em um hospital universitário. Federal de Sergipe (UFS), São Cristóvão, SE, Brasil. Official Journal of the Brazilian Association of Infection Control and Hospital Epidemiology, 2015;4(2):39-48.

14. Botelho SF, Martins MAP, Reis AMM. Análise de medicamentos novos registrados no Brasil na perspectiva do Sistema Único de Saúde e da carga de doença. Ciência & Saúde Coletiva. 2018; 23(1):215-228.

15. Nery AA, Alves MS, Rios MA. Perfil epidemiológico da morbimortalidade por causas externas em um hospital geral. Rev enferm UFPE on line. Recife. 2013 7(2):562-71.

16. Santos RG, Alves CDS, Lemos LB, Jesus IS, Lemos GS. Prescrições de antimicrobianos de uso restrito de pacientes internados em um hospital de ensino. Rev. Bras. Farm. Hosp. Serv. Saúde São Paulo. 2016;7(1):8-12.

17. Neves C, Colet C. Perfil de uso de antimicrobianos e suas interações medicamentosas em uma UTI adulto do Rio Grande do Sul. Rev Epidemiol Control Infect. 2015;5(2):65-71.

18. Silveira MPT, Jacobsen TF, Mussi MM. Análise de erros de prescrição em um hospital da região sul do Brasil. Rev. Bras. Farm. Hosp. Serv. Saúde São Paulo. 2015;6(3):23-26.

19. Volpe CRG, Melo EMM, Aguiar LB, Pinho DLM, Stival MM. Risk factors for medication errors in the electronic and manual prescripion. Rev. Latino-Am. Enfermagem. 2016;(24): 27-42.

20. Miasso AI et al. Erros de prescrição em hospitais brasileiros: um estudo exploratório multicêntrico. Cad. Saúde Pública. 2009; 25(2):313-320.

21. Instituto para Prática Segura de Medicamentos. Erros de medicação associados a abreviaturas, siglas e símbolos. [Internet]. 2015 [cited 2017 Outub 14];4(2):1-7. Disponível em: http://www.ismpbrasil.org/site/wpcontent/uploads/2015/07/V4N2.pdf

22. Cloridrato de cefepima. Pó para solução injetável. Bula do profissional. http://www.anvisa.gov.br/datavisa/fila_bula/frmVisualizarBula.asp?pNuTransacao=17240302016&pIdAnexo=3460999.

23. Piperacilina sódica + tazobactam sódico. Pó para solução injetável.

Bula do profissional.http://www.anvisa.gov.br/datavisa/fila_bula/frmVisualizarBula.asp?pNu Transacao=5751582013&pIdAnexo=1699600.

24. Aquino GA, Melo GAA, Praxedes CO, Caetano JA. Conformidades e não conformidades no preparo e administração de antibacterianos. Cogitare Enferm. 2016; 21(esp):01-09.

25. Cloridrato de vancomicina. Pó para solução injetável. Bula do profissional. http://www.anvisa.gov.br/datavisa/fila_bula/frmVisualizarBula.asp?pNuTransacao=6415362015&pIdAnexo=2751653.

26. Silva LD, Camerini FG. Análise da administração de medicamentos intravenosos em hospital da rede sentinela. Texto & Contexto - Enfermagem 2012; 21(3):633–41.