DOI: https://doi.org/10.36489/saudecoletiva.2021v11i68p7269-7278

Clinical pharmaceutical and costs with antimicrobials: a study in an intensive care unit

Farmacéutica clínica y costos con antimicrobianos: estudio en una unidad de cuidados intensivos

O farmacêutico clínico e os custos com antimicrobianos:um estudo em uma unidade de terapia intensiva

ABSTRACT
Objective: To evaluate the importance of the clinical pharmacist both in the use of antimicrobials and in reducing the cost of these drugs. Method: The study, characterized as descriptive, with a quantitative approach, was carried out from October to December 2016 in an Intensive Care Unit of a public hospital in the city of Caruaru-PE. Data collection occurred through documentary analysis using the MV200 standard operating system as a tool. Results: There was a greater use of piperacillin + tazobactam and meropenem, both antibiotics with a broad spectrum of action, evidencing the choice of therapies by the patients. hospital protocols with this characteristic. However, there is no significant reduction in costs due to the high prevalence of antimicrobials still prevalent among ICU patients. Conclusion: In view of the results, it appears that the action of a clinical pharmacist in the Intensive Care Unit would help with greater control of these prescriptions, avoiding drug interactions and meeting the needs of each patient.
DESCRIPTORS: Antibiotics; Costs; UCU; Pharmacist.

RESUMEN
Objetivo: Evaluar la importancia del farmacéutico clínico tanto en el uso de antimicrobianos como en la reducción del costo de estos medicamentos. Método: El estudio, caracterizado como descriptivo, con abordaje cuantitativo se realizó de octubre a diciembre de 2016 en un centro de cuidados intensivos. Unidad de un hospital público de la ciudad de Caruaru-PE. La recolección de datos se realizó mediante análisis documental utilizando como herramienta el sistema operativo estándar MV200 Resultados: Mayor uso de piperacilina + tazobactam y meropenem, ambos antibióticos de amplio espectro de acción, evidenciando la elección de terapias por parte del hospital. protocolos con esta característica. Sin embargo, no hay una reducción significativa en los costos debido a la alta prevalencia de antimicrobianos que aún prevalecen entre los pacientes de la UCI. Conclusión: A la vista de los resultados, parece que la actuación de un farmacéutico clínico en la Unidad de Cuidados Intensivos ayudaría a un mayor control de estas prescripciones, evitando interacciones medicamentosas y satisfaciendo las necesidades de cada paciente.
DESCRIPTORES: Antibioticos; Costos; UCI; Farmacéutico.

RESUMO
Objetivo: Avaliar a importância do farmacêutico clínico tanto na utilização dos antimicrobianos, quanto na redução de custo desses medicamentos.Método: O estudo caracterizado como descritivo, com abordagem quantitativa foi realizado no período de outubro a dezembro de 2016 em uma Unidade de Terapia Intensiva de um hospital público na cidade de Caruaru-PE. A coleta de dado ocorreu por meio de análise documental utilizando como ferramenta o sistema operacional padrão MV200.Resultados: Verificou-se uma maior utilização de piperacilina+tazobactam e meropenem, ambos antibióticos com amplo espectro de ação, evidenciando a escolha de terapias por parte dos protocolos do hospital com essa característica. Entretanto, não se observa uma redução de gastos significativos em decorrência de um alto consumo ainda prevalente de antimicrobianos por pacientes de UTI. Conclusão: Diante dos resultados, infere-se que a ação de um farmacêutico clínico na Unidade de Terapia Intensiva auxiliaria com um maior controle dessas prescrições, evitando interações medicamentosas e atendendo às necessidades de cada paciente.
DESCRITORES: Antibióticos; Custos; UTI; Farmacêutico.

RECEIVED ON: 03/30/2021 **APPROVED ON:** 04/06/2021

Letícia Amorim da Silva
Pharmacist, Postgraduate Student in Hospital and Clinical Pharmacy, at Centro Universitário Redentor, IDE pole, Caruaru-PE, Brazil.
ORCID:0000-0002-8493-8391

Rianne Kercia Godoi da Silva
Pharmacist, Postgraduate Student in Hospital and Clinical Pharmacy, at Centro Universitário Redentor, IDE pole, Caruaru-PE, Brazil.
ORCID:0000-0002-8326-5914

Thais Morais da Silva
Pharmacist, Post-Graduated in Hospital Pharmacy with Oncological Follow-up, by the Institute of Technology, Sciences and Quality - ICTC, Recife-PE, Brazil.
ORCID:0000-0002-6935-4558

Jucélia Ivonete dos Santos
Pharmacist and Master's Student in Management, Innovation and Consumption (PPGIC), by the Federal University of Pernambuco-UFPE, Caruaru-PE, Brazil. Postgraduate in Hospital and Clinical Pharmacy, at Centro Universitário Redentor, IDE Caruaru-PE, Brazil. Post-Graduate Student in Public Health, North University of Paraná-UNOPAR, Caruaru-PE, Brazil.
ORCID:0000-0003-2375-0456

Analúcia Guedes Silveira Cabral
Graduated in Pharmacy from the Federal University of Paraíba-UFPB, Masters and Doctorate in Natural and Synthetic Bioactive Products, from the Federal University of Paraíba-UFPB, Brazil. Professor at the Tabosa de Almeida University Center, Caruaru-PE.
ORCID: 0000-0002-1617-5329

INTRODUCTION

Antimicrobials in hospitals are among the most prescribed drugs in choice of drug therapy, in addition to being considered one of the drug groups that cause the most adverse events and presenting inappropriate use in about 50% of cases. [1] In the hospital environment, antimicrobials account for 20% to 50% of total drug costs, making it necessary to establish a surveillance mechanism on the use of these drugs.

One way to improve the efficiency of spending on these drugs is the evaluation of drug therapy and the application of pharmacoeconomics. Areda et al [2] says that pharmacoeconomics can be considered one of the aspects of health economics, being one of the most advantageous strategies in which a relationship is made between efficacy, safety and quality of procedures in the health area.

The study related to the costs of treatments with antibacterials can be considered an indispensable management tool for the control, evaluation and design of corrective actions. [3] This procedure is performed by the clinical pharmacist who will be not only contributing to the improvement in the optimization of the costs of these drugs, but also leading to an adequate treatment for patients.

In order to meet and better understand the object of the study, this research aimed to evaluate the use of antimicrobials by patients in the intensive care unit, as well as to analyze variables such as time, replacement and adjustment of medications that lead to this institution. In addition to highlighting how the follow-up of the clinical pharmacist interferes with the expenses and use of antimicrobials.

METHOD

Study design, period and place

This descriptive study [4], of quantitative approach [5] was carried out from October to December 2016 in an Intensive Care Unit III of a public hospital located in the city of Caruaru-PE. The hospital under study has a profile of medium and high complexity aimed at emergency services, and as a large hospital, it offers urgent and emergency services aimed at the following specialties: medical and surgical clinics, cardiology, neurology and pediatrics. [6]

Data collect

Fifty-five antibiotic records were evaluated, data collection was performed using an operational standardization system MV 2000 of antimicrobials implemented by the Hospital Infection and Control Commission (CCIH - Comissão de Controle e Infecção Hospitalar) team. In addition, antimicrobial control sheets were used as data collection. To follow this second option, the files of patients who were not using antimicrobials during the study period were used as exclusion criteria.

Ethical aspects

The research data were collected after approval by the Research Ethics Committee of the Centro Universitário Tabosa de Almeida (ASCES-UNITA), under the opinion of nº 1.722.899 and CAAE 59175716.9.0000.5203, respecting Resolution 466, of December 12th of 2012 which has guidelines and regulatory standards for research involving human beings. [7]

Analysis and treatment of data

The variables collected were sex, an-

timicrobials used, dose, treatment time and status of use. Antimicrobial costs were collected and calculated according to the MV 200 operating system. As for the method of data interpretation, to enable the analyses, at first, the obtained data were transcribed, and then entered into the Microsoft Excel 2010 program to be accounted for.

RESULTS

Looking at the chart below, we can see the situation of patients from the start of treatment, dose adjustment until the treatments of patients completed. One of the very interesting data is in relation to the treatments that started without the antimicrobials form and the treatments identified as not completed. Much evidence suggests the existence of an association between the use of antimicrobials and the development of bacterial resistance. [8] In this sense, it is necessary to establish a surveillance mechanism on the use of these drugs, which restrict hospitalization costs due to greater treatment effectiveness.

As we can see below, Graph 2 shows that among the classes of antimicrobials analyzed, penicillins and carbapenems were considered the most prescribed, these being represented by piperacillin + tazobactam at concentrations of 4,5 g and meropenem at a concentration of 1g.

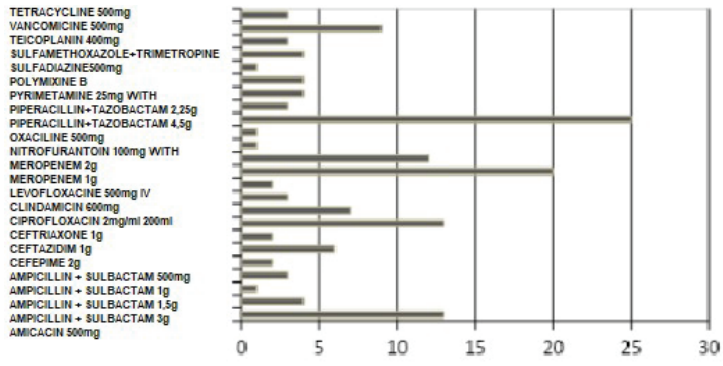
In the present research, it was evaluated, for example, that cefepime, a 4th generation antibiotic of cephalosporins, had a limited use. Revealing that there is a restriction in the use of cefepime, as it has a high cost and great capacity to produce a selection of resistant strains.

Regarding the costs of using the most dispensed antimicrobials, it was observed that, in the period from October to December 2016, there was an average of R$ 32.431,06 of costs with antimicrobials in the adult ICU-III of the hospital. An average of R$ 6.883,56 of the three months under analysis for piperacillin+tazobactam and an average of R$ 8.301,47 for meropenem (Chart 1). This increase is justified by the fact that many of the patients have undergone some therapeutic regimen with other classes of antibiotics that were not as effective, thus resorting to the use of carbapenems and penicillins.

Graph 1- Situations of patients undergoing treatment with antimicrobials.

Source: Research Data (2017).

Graph 2 - Demonstration of the most used antibiotics during the study



Source: Research Data (2017).

Chart 1 - Costs of antimicrobials used in the Intensive Care Unit III.

MONTHS ANALYZED	TOTAL DRUG COSTS BY THE PATIENTS OF THE ICU (3)	COSTS OF ANTIMICROBIAL DRUGS BY ICU PATIENTS (3)	PERCENTAGE OF COSTS PER MONTH	COST OF THE MOST DISPENSED ANTIMICROBIAL (PIPERACILLIN)	COST OF THE MOST DISPENSED ANTIMICROBIAL (MEROPENEM)
October	72.865,15	28.471,92	39,07%	8.963,95	6.555,48
November	79.233,93	37.252,82	47,01 %	5.726,64	8.561,12
December	76.602,68	31.569,32	41,21%	10.213,84	5.534,08

Sorce: Own elaboration (2017)

As seen in the table below, the hospital under study has a protocol for the use of antibiotics for emergency patients, which currently applies to all inpatient sectors, helping to choose the treatments to be started depending on the suspected focus. This was implemented after an epidemiological study developed by the CCIH in which the predominant microorganisms in the area were identified. In the act of prescription, the sensitivity of each bacteria to the antimicrobial must be taken into account, and each one's hierarchy of action must be followed.

However, the study developed by the CCIH is not specific because it details only the microbiota present in the emergency, which was carried out in August 2016, justifying the preparation of the antibiotic protocol. Despite the implementation of the protocol, which does not require prior authorization to start treatment, the adult ICU-III presented a significant value in the cost of purchases of piperacillin + tazobactam and meropenem during the analyzed period (Chart 2).

DISCUSSION

Results similar to the study carried out in an adult ICU of a hospital in the city of Passo Fundo, the most prevalent antibiotic class was penicillin, found in 12 cases, accounting for (30,8%). [3] Knowing that penicillins are the first choice medication for the treatment of illnesses in intensive care units. Jharn et al [3] report an individual or associated use of meropenem with vancomycin, both because they have a broad spectrum, providing greater early antimicrobial coverage for the patient.

As this is an environment where there is intensive care, the predominance of resistant agents is greater, which would justify a common characteristic between the prescriptions of vancomycin and meropenem, in inhibiting the action of microorganisms, using drugs that have different spectra of action, it is observed in the study a choice for larger spectrum drugs. As highlighted by Klopotowsk et al [9] the differentiation of changes in the pattern of microorganisms caused by antibiotics is one more reason for prescribers to have greater control over these drugs and to be aware of their responsibility when prescribing them.

With regard to the costs of antimicrobials, the admission of a critically ill patient to an intensive care unit entails several costs for the institution that maintains them. These costs can be considered even higher in relation to expenses with other pharmacological classes. Although the use of antimicrobials in intensive care units is essential, the demand can be reduced through their rational use. The price of the drug is just one of the factors that interferes with the total amount spent, another important factor is the frequency with which these drugs are prescribed. [10] As a way of evaluating these prescriptions and consequently reducing costs, there is the inclusion of the clinical pharmacist in ICUs, which provides the patient with better care in relation to drug therapy used not only for antimicrobials, but also for other classes of drugs.

In this sense, it is essential not only a pharmacological anamnesis during

Chart 2 - Most used antimicrobials and the sensitivity of microorganisms.

MEROPENEM				
	SENSITIVE	RESISTANT	NT	%
Acinetobacter sp	13%	53%	4%	19,7%
Escherichia coli	21%	0%	0%	100,0%
Klebsiella sp	120%	17%	7%	87,6%
Morganella morganii	1%	0%	0%	100,0%
Proteus mirabilis	17%	3%	3%	85,0%
Providencia sp	8%	1%	0%	88,9%
Pseudomonas aeruginosa	63%	45%	6%	58,3%
Pseudomas sp.	23%	9%	3%	71,9%
Piperacillin + Tazobactam				
Escherichia coli	20%	1%	0	95,2%
Klebsiella sp	94%	34%	16%	73,4%
Morganelle morganii	1%	0%	0%	100,0%
Proteus mirabilis	20%	2%	1%	90,9%
Providencia sp.	7%	1%	1%	87,5%
Pseudomonas aeruginosa	69%	15%	30%	82,1%
Pseudomonas sp	27%	1%	7%	96,4%
Amikacin				
Acinetobacter sp	33%	33%	4%	50,0%
Escherichia coli	16%	4%	1%	80,0%
Klebsiella sp	134%	7%	3%	95,0%
Proteus mirabilis	9%	9%	5%	50,0%
Providencia sp	9%	0%	0%	100,0%
Pseudomonas aeruginosa	57%	49%	8%	53,8%
Pseudomonas sp	27%	8%	0%	77,1%

Sorce: Own elaboration (2017)

the patient's admission, but also the result of the culture to start a new antimicrobial, thus avoiding possible errors of choice by physicians. Still in this thinking, a study observed that anamnesis performed by clinical pharmacists were more complete, with an average of 6,2 medications per history, while physicians were able to identify only 4,2 medications. [11]

Another study developed by Klopotowska et al, [9] identified per patient monitored/day that the intervention itself costs €3 but can result in savings of €26 to €40. Once the pharmacist's prescription monitoring service is well established, a return of nine to thirteen times on investment seems feasible. In another analysis, it showed that the cost to the institution in a period of 4,5 months, without the presence of the clinical pharmacist in the ICU, would increase from 209.000 to 280.000 dollars. [12] Most of the avoided costs were generated from interventions made in participation in rounds and review of medical records.

In this sense, the presence of the clinical pharmacist, in addition to allowing the detection of possible errors related to medications, especially drug interactions, promotes its therapeutic effectiveness and the reduction of costs with prolonged therapies. In the present study, it was observed that of the analyzed patients, four had drug interactions between the prescribed antibiotics. Based on this, in their study, Michels et al [11] identified that due to the involvement of the pharmacist and the daily assessment of patients, there was a reduction in relation to drug interactions in the ICU.

Interaction risks increase with age, with the number of medications prescribed and as a result of the severity of the clinical condition and instabilities presented by patients admitted to the ICU, in addition to comorbidities that may be associated. Despite the expenses with the pharmacist, the return for the institution can reach 9 to 13 times the value of the investment. [9]

CONCLUSION

In view of the results mentioned above, there was a choice of therapies with antibiotics with a broad spectrum of action, through patients in the ICU III, in the hospital under analysis. This demonstrates that the availability of rationalization protocols in certain situations does not fully promote the rational use of these drugs. Therefore, one of the alternatives for the reduction and greater control of the use of antimicrobials would be the presence of a clinical pharmacist, aiming at a multidisciplinary work, involving other health professionals and seeking a greater burden for the institution, with significant expenses in relation to the cost of the hospital.

It is noteworthy that the constant use of antimicrobials promotes the existence of a cycle that involves the increase in antibiotic prescription, increasing bacterial resistance, and in this sense establishing the use of new antimicrobial agents. ■

REFERENCES

1. Piedade DV, et al. Interações medicamentosas potenciais em prescrições, contendo antimicrobianos de uso restrito, de pacientes internados em um hospital no interior da Bahia. Medicina (Ribeirão Preto. Online), v. 48, n. 3, p. 295-307, jun. 2015.

2. Areda CA, Bonizio RC, Freitas OD. Farmacoeconomia: uma ferramenta indispensável para a racionalização dos custos em saúde. Revista Brasileira de Ciências Farmacêuticas, 47 (2), 231-240, 2011.

3. Jharna MN, Srinivas AD, Buddhapriya D. Antibiotic resistance pattern among common bacterial uropathogens with a special reference to ciprofloxacin resistant Escherichia coli. Indian J Med Res 136(5): 842–849, 2012.

4. Fonseca A. Método de gerenciamento de projeto: uma análise de projeto em uma empresa do setor Farmacêutico, 2017.

5. Malhotra N.K. Pesquisa de marketing: uma orientação aplicada. São Paulo: Editora Bookman, 2012.

6. Ses.Secretaria Estadual de Saúde. http://portal.saude.pe.gov.br/unidades-de-saude-e-servicos/secretaria-executiva-de-atencao-saude/hospital-mestre-vitalino. Acesso em 07.03.2021.

7. Bolpato MB, Costa-Neto SB, Sousa IF. Qualidade de vida e bem-estar subjetivo de idosos no programa de academia de saúde, Revista saúde coletiva, (11) N.62, 2021.

8. Silva LB,Santos RA, Silva MOM, Souza TAF. Atividade antimicrobiana do Hibiscus sabdariffa L. em Escherichia coli isoladas de urocultura realizada em laboratório público de Caruaru- PE. Journal of Biology & Pharmacy and Agricultural Management, v. 17, n. 1, jan/mar 2021.

9. Klopotowska JE, Kuiper R, Kan HJV. et al. On-ward participation of a hospital pharmacist in a Dutch intensive care unit reduces prescribing errors and related patient harm: an intervention study. Crit Care. 14(5): 174, 2010.

10. Santos PN, Silva GA, Coelho TS, Oliveira RA, Neto MPL. Análise farmacoeconômica dos antimicrobianos na unidade de terapia intensiva em um hospital terciário. Research, Society and Development. 9 (5):14,2020.

11. Michels MA, Dick NRM, Zimerman RA, Malinsky RR. Auditoria em Unidade de Terapia Intensiva: vigilância de procedimentos invasivos. Rever.Epidemiol.Control.Infect. 3(1): 12-16, 2013.

12. Millan LS, Benedette CEM, Maximo L, Almeida PCC, Gomes DS, Gemperli R, Ferreira MC. Infecções de corrente sanguínea por bactérias multirresistentes em UTI de tratamento de queimados: experiência de 4 anos. RevBrasCirPlást. 27 (3): 374-8, 2012.