RBFHSS
Revista Brasileira de Farmácia Hospitalar e Serviços de Saúde

Original Paper

Open Access

Clinical pharmacist interventions in a hospital emergency

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Submitted: 08-11-2021 Resubmitted: 14-03-2022 Accepted: 17-03-2022

Peer review: blind reviewers

Abstract

Objective: To identify the types of interventions performed by clinical pharmacists in an intensive care unit and in the emergency of a hospital in the interior of Bahia. Methods: Cross-sectional study, carried out in a regional reference hospital for 27 cities, from May to August 2019. A form designed for the research was used, considering the interventions registered in the patient's medical record. Pearson's chi-square test was used to compare the proportions of categorical variables. **Results:** 814 interventions were performed in 102 patients, with a median of 14 and an interquartile range of 23. Of the most frequent interventions, 36.2% were related to drug interactions, with 99.2% being monitored (p<0.001); 10.8% dosage adjustment in renal failure interventions with 72.7% not accepted (p<0.001); 8.5% for dose interval with 73.9% not accepted (p<0.001) and 6.1% of interventions that involved orientation (nursing guidelines) with 73.9% that were monitored (p<0.001). Of the total interventions, 63.8% took place in the intensive care unit, 52.7% in male patients and 66.7% in people aged ≥ 60 years. Regarding the use of alerts, 53.4% of the interventions that were accepted had alerts (p<0.001). 46.7% were directed to the medical team; 44.9% for more than one professional; 5.8% for nurses; and 2.6% for nursing technicians. The drugs related to the interventions performed were grouped according to the ATC classification, as follows: 20.5% in group J-Antiinfectives for systemic use, 18.8% in group A-Alimentary tract and metabolism; 12.4% of the C-Cardiovascular sistem device group. **Conclusion:** The number of interventions performed, as well as the population and sectors assisted demonstrate the importance of the clinical pharmacist inserted in the multidisciplinary team in the care of critically ill patients.

Keywords: pharmaceutical services, pharmacy service, hospital, emergencies, intensive care units, drug utilization.

Intervenções de farmacêuticos clínicos em um hospital de emergência

Resumo

Objetivo: Identificar os tipos de intervenções realizadas por farmacêuticos clínicos em unidade de terapia intensiva e na emergência de um hospital no interior da Bahia. **Métodos:** Estudo transversal, realizado em um hospital que atende a 27 municípios, no período de maio a agosto de 2019. Foi utilizado um formulário elaborado para a pesquisa, sendo consideradas as intervenções realizadas no prontuário do paciente. O teste Qui-quadrado de Pearson foi utilizado para comparar as proporções das variáveis categóricas. **Resultados:** Realizou-se 814 intervenções em 102 pacientes, sendo a mediana de 14 e intervalo interquartil de 23. Das intervenções mais frequentes 36,2% foram relacionadas à interação medicamentosa sendo que 99.2% foram monitoradas (p<0.001); 10,8% intervenções de ajuste da dose pela função renal com 72.7% não aceitas (p<0.001); 8,5% para a posologia com 73.9% não aceitas (p<0.001) e 6,1% de intervenções que envolveram orientações para enfermagem que foram monitoradas (p<0.001). Do total de intervenções, 63,8% ocorreram na unidade de terapia intensiva, 52,7% em pacientes do sexo masculino e 66,7% em pessoas com idade ≥ 60 anos. Em relação ao uso de alerta, 53.4% das intervenções que foram aceitas tinham alerta (p<0.001). Quanto aos profissionais a quem se referiram: 46,7% direcionadas à equipe médica; 44,9% para mais de um profissional; 5,8% para enfermeiros; e 2,6% para técnicos de enfermagem. Os medicamentos relacionados às intervenções realizadas foram agrupados de acordo com a classificação ATC, sendo: 20,5% do grupo J-Anti-infecciosos, 18,8% do grupo A-Trato alimentar e metabolismo; 12,4% do grupo C-Aparelho cardiovascular. **Conclusão:** O número de intervenções realizadas, bem como a população e os setores assistidos demonstram a importância do farmacêutico clínico inserido na equipe multiprofissional no cuidado ao paciente gravemente enfermo.

Palavras-chaves: cuidados farmacêuticos, serviço de farmácia clínica, emergências, unidades de terapia intensiva, uso de medicamentos.

Introduction

Clinical Pharmacy (CP) is the health science in which pharmacists optimize pharmacotherapy, with the purpose of ensuring the rational use of medicines.[1] The practice is centered on the patient, providing care closer to him and other professionals, in order to obtain positive clinical results.[2]

The clinical pharmacist is able to promote excellent care, prevent diseases and promote health. Within the multi-professional team, it works in the monitoring and evaluation of prescriptions, adverse reactions and drug interactions; in the orientation to the team; in the promotion of continuing education; in adverse event notifications; in the creation of protocols, among others.[3-4] In addition, its performance is related to the identification, resolution and prevention of Drug-Related Problems (DRP), providing their reduction in the incidence of the same.[5] DRP are associated with the issue of safety for hospitalized patients and may cause a reduction in quality of life, increase in length of stay in the hospital, increase in care costs and the risk of morbidity and mortality.[6]

The use of drugs in a hospital environment, especially in intensive care units (ICU) and in the emergency department, represents a high level of care complexity, mainly due to factors related to polypharmacy, use of potentially dangerous drugs, as well as the clinical condition of the patient.[7] In this scenario, CP has demonstrated a positive impact on the clinical outcome, by acting on the optimization of therapy, promoting the timely administration of pharmacotherapy, the safe use of medicines and reducing care costs, in the education of patients and the care team.[8-9]

In this perspective, this study aimed to identify the types of interventions performed by clinical pharmacists in the intensive care unit and in the emergency of a hospital in the interior of Bahia.

Methods

Cross-sectional study, carried out from May to August 2019, in a regional reference hospital that serves the population of 27 municipalities in the southwest of Bahia. It is a public hospital, with 270 beds (29 in the ICU), with the main focus on urgent and emergency care, with the following structure: adult emergency according to risk classification (stabilization, specialties, observation (1 and 2)), medical clinic, neurological, surgical, orthopedic, vascular, pediatrics (emergency and infirmary), psychiatry and ICU.

The CP service was implemented in 2018 through the Multi-professional Residency Program in Urgency and Emergency, through a partnership between the State University of Southwest Bahia and the hospital, being maintained by the work of four resident pharmacists, who rotate between the ICU and the Emergency department.

Data collection was performed by filling out a form prepared for the purposes of the research, based on the pharmaceutical evolution in the medical record. The pharmaceutical interventions performed were classified according to their type and the sector in which they were performed (ICU or adult emergency). The main types of DRP, the acceptability of the interventions, as well as the professionals to whom they were directed were identified. In addition, interventions carried out using alerts in electronic medical records were identified.

The unit of analysis was the pharmaceutical interventions performed in ICU (29 beds) and in the emergency sector. Inclusion criteria were: patients who underwent pharmaceutical interventions with registration through pharmaceutical evolution in medical records. As for the size of the study, all the medical records that had pharmaceutical interventions during the period were taken. These interventions were considered[10], Figure 1.

Interventions were performed through pharmaceutical evolution in the patient's electronic medical record. Their acceptability was divided in to: accepted; partially accepted; not accepted; not accepted with justification; monitoring; with no possibility of identifying acceptability. The DRP were classified into Indication, Safety and Effectiveness and Adherence.[11]

For the interventions, the following were used: professional package inserts made available by the National Health Surveillance Agency (ANVISA)[12] and the Micromedex® database version 2.0 (2011), available through the website on the journal portal of the Coordination for the Improvement of Higher Education Personnel (CAPES).[13] The drugs were classified as per the first and fiveth level of the Anatomical Therapeutic Chemical Classification (ATC) of the World Health Organization (WHO).[14]

The descriptive analysis was performed by estimating the absolute and relative frequencies of the categorical variables (for quantitative ones, calculations of central tendency (mean and median) and dispersion (standard deviation and interquartile range) were performed)). To check the normal distribution of quantitative variables, the Kolmogorov-Smirnov test was used, considering p> 0.05 normal distribution. Pearson's Chi-square test and /or likelihood ratio were used to compare the proportions of categorical variables. The results were expressed with a significance level of 5%. Data was analyzed using SPSS® software version 21.0.

The referred research m*et al*l ethical precepts. The study "Clinical Pharmacy: Evaluation of the use of medicines in a regional hospital" was approved by the Research Ethics Committee (REC) of State University of Southwest Bahia, No. CAAE 29780014.8.0000.0055.

Results

In the study, 814 interventions were performed in 102 patients, median of 14 and interquartile range of 23. Of these, 54.9% were performed on male patients. The age of the patients ranged from 14 to 97 years, with a median of 62, interquartile range 19, with 66.7% of interventions being performed in people aged 60 years or over. Of the total, 63.8% (520) were performed in the ICU.

The interventions performed were classified into 24 categories, the three most frequent: 36.2% related to drug interaction (99.2% were monitored (p<0.001)); 10.8% dosage adjustment in renal failure (72.7% not accepted (p<0.001)); 8.5% at dose interval (73.9% not accepted (p<0.001)), Table 1.

Figure 1. Type of pharmaceutical interventions and parameters evaluated.

Type of intervention	Evaluated parameters
Dose	Evaluation of the prescribed dose, according to the usual recommended dose for the indication, for the patient's weight, for the loading dose, maintenance dose or maximum dose and for other recommendations from databases and package inserts, except for the adjustment of dose for renal and / or liver function (analyzed in another category
Dose interval	correction of dose and / or interval of administration prescribed, according to the recommended posology for the indication)
Administration route	indication of therapeutic alternative in another route of administration, evaluation of the effectiveness of the drug through the route in which it was being administered)
Chronopharmacology	adjusting the drug administration time to the best time to ensure greater effectiveness and safety
Schedule	evaluation of drug administration time, observing the interval between doses
Dosage adjustment in renal failure	adjustment of dose and / or interval of administration according to renal function (creatinine clearance)
Dosage form	evaluation of the dosage form prescribed according to the route of administration and proposed alternative dosage form, when necessary
Dilution	assessment of the suitability of the diluent for the drug and the volume
Infusion time	analysis of the time the drug was being administered, in order to ensure stability and avoid Adverse Drug Reactions (ADR)
Drug reconciliaton	guarantee of continuity of drugs for continuous use after hospital admission, and / or during the transfer of a unit or hospital discharge
Drug x drug / Drug x food interaction	assessment of the existence of interactions, their severity (contraindicated or severe) and possible clinical management (change in therapy or monitoring)
Incompatibility	analysis of possible incompatibilities between injectable drugs administered at the same time and in the same route or in Y route)
Drug adding	assessment of the need to add a drug to the prescription
Drug suspension	analysis of the need to suspend a drug from treatment
Substitution	evaluation of the possibility of substituting drugs for reasons of safety, effectiveness or economy
Contraindication	information on drug contraindication for the patient / pathology
Treatment time	monitoring the treatment time of drugs that have a pre-established use term. Ex: antimicrobials, octreotide)
Management of ADR	suggestion of possible clinical management and patient follow-up
Guidance	information on drug administration time after diet, maximum dose of the drug, divergences in the evolution to prescription, drugs repeated in the prescription

ADR: adverse drug reaction

Table 1. Frequency and types of pharmaceutical interventions performed in the emergency departments and intensive care units of a regional hospital in the interior of Bahia. Bahia, Brazil, 2019 (N= 814).

Information	All	Interventions			p-value[1]
		Accepted	Not Accepted	Monitoring	
Sociodemographic	**N = 102**	**N=65**	**N=141**	**N=223**	
Male[1] n (%)	56 (54.9)	9 (16.1)	18 (32.1)	29 (51.8)	0.082
Age (years) Median (IR)	62 (19)	-	-	-	-
Type of pharmaceutical intervention	**N= 814**	**129 (15.8)**	**240 (29.5)**	**445 (54.7)**	
Drug interaction	294 (36.2)	1 (0.3)	1 (0.3)	292 (99.3)	<0.001
Dosage adjustment (renal function)	88 (10.8)	16 (18.2)	64 (72.7)	8 (9.1)	<0.001
Dose interval	69 (8.5)	14 (20.3)	51 (73.9)	4 (5.8)	<0.001
Orientation (nursing guidelines)	50 (6.1)	-	4 (8.0)	46 (92.0)	<0.001
Infusion time	44 (5.4)	12 (27.3)	-	32 (72.7)	<0.001
Substitution	32 (3.9)	14 (43.8)	17 (53.1)	1 (3.1)	<0.001
Chronopharmacology	27 (3.3)	9 (33.3)	7 (25.9)	11 (40.7)	0.039
Drug Adding	26 (3.2)	4 (15.4)	21 (80.8)	1 (3.8)	<0.001
Examination request	25 (3.1)	15 (60.0)	9 (36.0)	1 (4.0)	<0.001
Use of medication via NET	24 (2.9)	4 (16.7)	11 (45.8)	9 (37.5)	0.166
Dose	22 (2.7)	8 (36.4)	13 (59.1)	1 (4.5)	<0.001
Drug suspension	17 (2.1)	10 (58.8)	7 (41.2)	-	<0.001
Schedule	17 (2.1)	14 (82.4)	3 (17.6)	-	<0.001
Dilution	15 (1.8)	1 (6.7)	1 (6.7)	13 (86.7)	0.041
Dosage form	15 (1.8)	2 (13.3)	12 (80.0)	1 (6.7)	<0.001
Others	49 (1.0)	5 (10.2)	19 (38.8)	25 (51.0)	0.259

IR: interquartile range. NET: nasoenteral tube. [1]Pearson's chi-square test, considering p <0.05 significant.

As for the professionals to whom they referred the interventions, the classification was made in: 46.7% (380) of the interventions were made in relation to the medical team; 44.9% (366) for more than one professional; 5.8% (47) for nurses; and 2.6% (21) for nursing technicians.

Among the interventions performed, 54.7% (445) of them were considered as monitoring and / or it was not possible to assess acceptability. Among the remaining 369, 33.3% were accepted, 1.7% partially accepted, 60.3% not accepted and 4.7% not accepted with justification.

As for the relationship between the use of alerts for professionals and the acceptability of interventions, 53.4% of the interventions that were accepted had an alert and 34.6% of the interventions that were not accepted had an alert. In this way, it was possible to verify the association between the acceptability of interventions and the use of alert presented a significance value of p <0.001.

The analysis of the association between the types of interventions performed with the sector and the team to which they were directed showed that both had a significance value of p <0.001, Table 2.

Each intervention was related to a possible or existing DRP, so 814 DRP were identified. The identified DRP were: 70.3% Safety (53.8% related to the possibilities / management of ADR and 16.5% linked to overdose), 24.6% Effectiveness (23.2% related to sub-dose and 1.4 % inappropriate drug), 5% indication (4.3% need for treatment and 0.7% unnecessary treatment) and 0.1% adherence. DRP were associated with professionals and sector, Table 2.

Regarding to the ATC classification, the drugs involved in the interventions performed were divided into 11 categories. Interventions that had more than one drug involved (from different ATC categories) were distributed into 18 other classifications, in which class groupings were made, the most frequent being: 6.4% B+C groups, 4.7% A+N and 3.3% C+J groups.

Of the 11 ATC categories, the three most frequent were: 20.5% of the J-Antiinfectives for systemic use group; 18.8% of the A-Alimentary tract and metabolism group; 12.4% of the C-cardiovascular system group. The three most frequent drugs that were involved with the interventions performed in the three most frequent categories, Table 3.

Table 2. Association between types of interventions and drug-related problem identified with sector and staff in a regional hospital in the interior of Bahia. Bahia, Brazil, 2019 (N= 814).

Information	Sector		Team	
	Emergency n (%)	ICU n (%)	Doctor n (%)	Others[1] n (%)
Types of DRP	**294 (36.1)**	**520 (63.9)**	**380 (46.7)**	**434 (53.3)**
Indication (need for treatment)	18 (51.4)	17 (48.6)	35 (100.0)	-
Indication (unnecessary treatment)	5 (83.3)	1 (16.7)	6 (100.0)	-
Effectiveness (inappropriate drug)	4 (36.4)	7 (63.6)	7 (63.6)	4 (36.4)
Effectiveness (subdose)	71 (37.6)	118 (62.4)	79 (41.8)	110 (58.2)
Safety (ADR)	153 (34.9)	285 (65.1)	122 (27.9)	316 (72.1)
Safety (overdose)	42 (31.3)	92 (68.7)	131 (97.8)	3 (2.2)
Adherence	1 (100.0)	-	-	1 (100.0)
p-value[2]	p= 0.045		p<0.001	
Types of interventions	**294 (36.1)**	**520 (63.9)**	**380 (46.7)**	**434 (53.3)**
Drug interaction	111 (37.8)	183 (62.2)	30 (10.2)	264 (89.8)
Dosage adjustment (renal failure)	19 (21.6)	69 (78.4)	88 (100.0)	-
Dose interval	36 (52.2)	33 (47.8)	68 (98.6)	1 (1.4)
Orientation (nursing guidelines)	12 (24.0)	38 (76.0)	18 (36.0)	32 (64.0)
Infusion time	4 (9.1)	40 (90.9)	-	44 (100.0)
Substitution	19 (59.4)	13 (40.6)	31 (96.9)	1 (3.1)
Chronopharmacology	9 (33.3)	18 (66.7)	1 (3.7)	26 (96.3)
Drug adding	16 (61.5)	10 (38.5)	4 (100.0)	-
Examination request	21 (84.0)	4 (16.0)	25 (100.0)	-
Use of medication via NET	2 (8.3)	22 (91.7)	10 (41.7)	14 (58.3)
Dose	3 (13.6)	19 (86.4)	21 (95.5)	1 (4.5)
Medicine Suspension	14 (82.4)	3 (17.6)	17 (100.0)	-
Schedule	2 (11.8)	15 (88.2)	-	17 (100.0)
Dilution	1 (6.7)	14 (93.3)	-	15 (100.0)
Dosage form	-	15 (100.0)	14 (93.3)	1 (6.7)
Others	25 (51.0)	24 (49.0)	53 (46.1)	62 (53.9)
p-value[2]	p<0.001		p<0.001	

DRP: drug-related problem. ADR: Adverse drug reaction. NET: nasoenteral tube. [1]Doctors associated with another professional, nurses, nursing technicians and others. [2]Pearson's chi-square test and Likelihood ratio, considering p <0.05 significant.

Table 3. Most frequent drugs among the ATC categories in interventions at a regional hospital in the interior of Bahia. Bahia, Brazil, 2019 (N= 814).

ATC[1]	Todos n (%)	Interventions n (%)											
		DI	Schedule	DA	Dose Interval	Substit.	Dilution	TD	Via NET	Chron.	Orient.	TI	Others
A-Food Tract and Metabolism													
Ranitidine	91 (11.2)	14 (15.4)	-	22 (24.2)	31 (34.1)	3 (3.3)	-	3 (3.3)	9 (9.8)	-	2 (2.2)	-	7 (7.7)
Omeprazole	57 (7.0)	26 (45.6)	-	-	6 (10.5)	15 (26.3)	-	3 (5.2)	2 (3.5)	1 (1.8)	1 (1.8)	-	3 (5.3)
Metoclopramide	38 (4.7)	17 (44.7)	-	8 (21.0)		9 (23.8)	-	1 (2.6)	-	-		-	3 (7.9)
C- Cardiovascular system													
Simvastatin	47 (5.7)	33 (70.2)	-	2 (4.3)	3 (6.4)	-	-	-	-	5 (10.6)	1 (2.1)	-	3 (6.4)
Clopidrogel	36 (4.4)	34 (94.4)	-	-	-	-	-	-	-	-	-	-	2 (5.6)
Furosemide	29 (3.6)	25 (86.2)	-	-	-	-	-	-	-	1 (3.4)	-	-	3 (10.4)
Metoprolol	25 (3.1)	4 (16.0)	-	-	6 (24.0)	4 (16.0)	-	-	7 (28.0)		1 (4.0)	-	3 (12.0)
J-Antiinfectives													
Rifampicin	69 (8.5)	58 (84.1)	10 (14.5)		-	-	-	-	-	-		-	1 (1.4)
Piperacillin + Tazobactam	41 (5.0)	5 (12.2)	--	19 (46.3)	-	-	5 (12.2)	-	-	-	1 (2.4)	5 (12.2)	6 (14.6)
Meropenem	29 (3.6)	-	-	3 (10.3)	-	-	3 (10.3)	-	-	-	9 (31.0)	12 (41.4)	2 (7.0)
Outros	352 (43.2)	-	-	-	-	-	-	-	-	-	-	-	-

[1]Anatomical Therapeutic Chemistry: classification 1st and 5th level. DI: drug interaction. DA: dosage adjustment. Subst.: substitution. TD: therapeutic duplicity Chron.: chronopharmacology. Orient.: orientation. TI: infusion time. NET: nasoenteral tube.

Discussion

Through the study, it was observed that the largest number of interventions were in male patients aged 60 years or older. These data are compatible with the more frequent profile of patients treated in emergency units and ICU, especially considering the increase in aging.[15-16] In this patient profile, the main interventions were related to drug interaction, dose adjustment in renal failure and dose interval.

The number of interventions in the elderly demonstrates the need for greater pharmacotherapeutic monitoring for these patients. Mainly because it should be borne in mind that the aging process is related to physiological changes, which can significantly affect the pharmacokinetics and pharmacodynamics of the drugs used and, consequently, increase the risk of damage induced by them.[17]

As for the study sector, most interventions were performed in the ICU (63.8%), corroborating to demonstrate the complexity of care provided in this type of unit. With this finding, the idea defended by the Society of Critical Care Medicine about the importance of the pharmacist's role exclusively in the multidisciplinary intensive care team is confirmed.[4]

Among the types of interventions performed, the most prevalent was in relation to drug interactions, which are related to the large amount of drugs that patients in intensive care or in emergency situations need. These findings were also demonstrated in a study carried out in the Caribbean with patients admitted to the emergency department, in which possible drug interactions were associated with polypharmacy, and its incidence was significantly higher in the elderly.[18] A Brazilian study carried out in an ICU also found drug interactions between the three main problems related to drug interventions.[19]

The second most frequent intervention occurred with the dosage adjustment in renal failure, similarly to what was verified in a Brazilian study conducted with the analysis of clinical activities of the pharmacist during three years in an ICU, in which 12% of the interventions performed were about this category.[4] The high frequency of this intervention can be explained by the large number of patients who have acute kidney injury as one of the biggest complications of ICU admission.[20]

Regarding the professionals to whom the interventions were directed, physicians presented the highest frequency. Similarly, the study carried out by Fidelis *et al*[4], showed that of the 834 interventions. 83.4% (699) were directed to these professionals. In the same study, the nursing team was linked to 5.9% of accepted interventions, while in this study, nurses received 5.8% of performed interventions.

The association between the DRP identified in this study and the professionals involved reaffirms the idea that successful pharmacotherapy is dependent on several professionals within the drug chain. In addition, this study demonstrated that the cooperative work only between pharmacists and doctors could be responsible for preventing approximately 2/5 of the identified DRP.

The acceptability of interventions can still be considered small compared to other studies. For example, the study carried out in an intermediate care unit (between emergency and ICU) that had 64.3% of the 212 interventions accepted with prescription changes, 28.5% as not accepted and 7.2% verbally accepted, but without prescription changes.[21] In another study carried out in an intensive care unit, the acceptability of interventions by the medical team was 97% and only 3% were not accepted.[22]

The number of interventions not accepted by other professionals demonstrates the need for the team to be closer to the clinical pharmacy experience. In addition, pharmacists need to improve in defining the most appropriate time to carry out interventions. In addition, the instability of critically ill patients may have an influence on the non-acceptance of interventions, considering in many cases the rapid evolution to death.[17]

The low acceptance rates are related to the fact that the implementation of the PC service in the hospital is recent (about two years), as it is not yet fully known by the care team of the units. Thus, the acceptance rates of the interventions demonstrate how the success of the clinical pharmacist's actions depends on the other components of the multidisciplinary team.[23]

The study revealed that the use of alerts issued by pharmacists in the electronic medical record had a positive impact on the acceptability of interventions, as they manage to draw the attention of professionals regarding the conduct involving the drugs used by patients. The availability of alerts is a very useful tool for the pharmacist's work, considering that there is an increased chance of the pharmaceutical evolution being read by doctors and/or other professionals and the interventions being accepted.

With regard to DRP, it is known that they directly influence the clinical aspect, as well as causing an increase in economic costs. Within the multi-professional team, the clinical pharmacist acts providing an additional point of view in the analysis of prescriptions, contributing to a greater identification of DRP and its resolution.[24] Gaskin *et al*., demonstrated that by reducing the damage that would be caused by the drug, the performance of CP in the emergency was able to provide a cost reduction greater than three times the cost of its service.[25]

An adaptation of the DRP categorization by Cipolle & Strand[11] was also used in a Dutch study[24], similarly to this study. In the Dutch study, the main DRP identified were: Pharmaceutical Care (drug interactions are the most prevalent among the class), followed by Safety, Indication, Effectiveness and related to the use of medications.

The categories of the ATC classification that presented the highest number of drugs related to the interventions were Antiinfectives for systemic use, Alimentary tract and metabolism, Cardiovascular system, Nervous system, Blood and blood forming organs. The four most frequent categories among the interventions showed the same descending order among those identified in the study by Fidelis.[4]

In the study carried out in the Netherlands, the main categories involved were A, B, C, J, L, among 841 interventions performed.[24] The frequencies of these categories may be linked to the complexity of treatment in the units where the studies were conducted, as they serve patients with serious infections, comorbidities related to the cardiovascular system and the very common use of antiemetic, prokinetics, laxatives and drugs used for prophylaxis such as stress ulcer.[17]

The high frequency of interventions related to the class of antibiotics reflects the importance of identification and resolution of DRP by the pharmacist. Mainly because this class is used in most hospitalized patients and its inappropriate use can bring risks of the occurrence of ADR, of therapeutic ineffectiveness, among other factors.[26]

The limitation of the study was the absence of a survey of the total number of prescriptions evaluated by the Clinical Pharmacy service. By counting the total number, it would be possible to identify the number of prescriptions that did not have some type of DRP, thus allowing the assessment of the quality of the prescriptions made at the study hospital. In addition, there were interventions in which it was not possible to assess the acceptability by the professionals.

Although the study did not assess the global impacts and clinical outcomes after the interventions, as the patients were not followed up. This study becomes relevant since it demonstrates the performance of the clinical pharmacist in both sectors of assistance complexity, being able to obtain a situational diagnosis of the Clinical Pharmacy service after two years of its implantation. In addition, it reveals the main types of interventions that are carried out and the most commonly identified DRP. It is noted that the identification and resolution of DRP, especially those related to Safety, is one of the key points of the professional's performance, in a way that corroborates for a safer and more rational therapy, with less chance of adverse events related to medicines.

Conclusion

The pharmaceutical performance within the multi-professional team that provides assistance to the seriously ill patient could be demonstrated through the number of interventions registered in this study, the main ones referring to drug interactions and medication dose adjustment. The clinical pharmacist can promote interventions with doctors, nurses and other professionals, in order to contribute so that patients receive an individualized treatment that is effective and safe, seeking to promote the rational use of medicines.

Funding source

The authors declare that the research did not receive funding for its conduction.

Collaborators

NJSS: Study conception and design; Acquisition of data; Analysis and interpretation of data; Statistical analyses; Drafting of manuscript; Critical revision of the intellectual content. TDBS: Acquisition of data; Analysis and interpretation of data; Critical revision of the intellectual content. AMSM: Acquisition of data; Analysis and interpretation of data; Critical revision of the intellectual content. DSL: Acquisition of data; Analysis and interpretation of data; Critical revision of the intellectual content. AMMR: Analysis and interpretation of data; Critical revision of the intellectual content. GSL: Study conception and design; Analysis and interpretation of data; Statistical analyses; Drafting of manuscript; Provision of resources Critical. revision of the intellectual content.

Conflict of interest statement

The authors declare that there are no conflicts of interest regarding this article.

References

1. American College of Clinical Pharmacy. The definition of Clinical Pharmacy. 2020. Accessed on: 09 feb 2020. Available in: <https://www.accp.com/stunet/compass/definition.aspx>.
2. Association Pharmacist American. Principles of Practice for Pharmaceutical Care. 2020. Accessed on: 09 feb 2020. Available in: <https://www.pharmacist.com/principles-practice-pharmaceutical-care >.
3. Conselho Federal de Farmácia. Resolução nº 585, de 29 de agosto de 2013. Regulamenta as atribuições clínicas do farmacêutico e dá outras providências. Conselho Federal de Farmácia. 2013.

4. Fideles GMA, Alcântara-Neto JMD, Júnior AAP, Souza-Neto PJD, Tonete TL, Silva JEGD, *et al*. Pharmacist recommendations in an intensive care unit: three-year clinical activities. Rev Bras Ter Intensiva. 2015; 27(2): 149–154. DOI: 10.5935 / 0103-507X.20150026.

5. Rodrigues JPV, Marques FA, Gonçalves AMRF, Campos MSDA, Reis TMD, Morelo MRS, *et al*. Analysis of clinical pharmacist interventions in the neurology unit of a Brazilian tertiary teaching hospital. Plos One. 2019; 14(1): e0210779. DOI: 10.1371/journal.pone.0210779.

6. Bhagavathula SA, Meknonnen BG, Birarra KM, Tekle TM. Assessment of Drug Related Problems and its Associated Factors among Medical Ward Patients in University of Gondar Teaching Hospital, Northwest Ethiopia: A Prospective Cross-Sectional Study. J Basic Clin Pharma 2017; 8: S016-S021.

7. Silva ACS, Sousa DSDC, Perraud EBDC, Oliveira FRDA, Martins BCC. Pharmacotherapeutic follow-up in a respiratory intensive care unit: description and analysis of results. Einstein (São Paulo). 2018; 16(2). eAO4112. DOI: 10.1590 / S1679-45082018AO4112.

8. Morgan SR, Acquisto NM, Coralic Z, Basalyga V, Campbell M, Kelly J, Phelan, M. (2018). Clinical pharmacy services in the emergency department. Am J Emerg Med. 2018; 36 (10): 1727-1732. DOI: 10.1016 / j.ajem.2018.01.056.

9. Farmer BM, Hayes BD, Rao R, Farrell N, Nelson L. The Role of Clinical Pharmacists in the Emergency Department. J Med Toxicol. 2018 Mar; 14(1): 114-116. DOI: 10.1007/s13181-017-0634-4. Epub 2017 Oct 26. PMID: 29075954; PMCID: PMC6013729.

10. Reis WCT, Scopel CT, Correr CJ, Andrzejevski VMS. Analysis of clinical pharmacist interventions in a tertiary teaching hospital in Brazil. Einstein (São Paulo). 2013; 11(2): 190–6. DOI: 10.1590/S1679-45082013000200010.

11. Strand LM, Cipolle RJ, Morley PC, Cipolle RJ. Pharmaceutical care practice. McGraw-Hill; 2012. 3ª edição.

12. Brasil. Agência Nacional de Vigilância Sanitária. Bulário Eletrônico. Available in: http://www.anvisa.gov.br/datavisa/fila_bula/index.asp.

13. WHO. World Health Organization. Collaborating Centre for DrugStatisticsMethodology. Guidelines for ATC classification-and DDD assignment. Oslo: WHO Collaborating Centre for DrugStatisticsMethodology; 2021. Disponível em: <https://www.whocc.no/atc_ddd_index/>.

14. Micromedex® 2.0 Healthcare Series [on line]. Thomson Reuters: 1974-2011. Available in: http://www.periodicos.capes.gov.br.

15. Soto PHT, Raitz GM, Bolsoni LL, Costa CKF, Yamaguchi MU, Massuda EM. Morbidades e custos hospitalares do Sistema Único de Saúde para doenças crônicas. Rev Rene. 2015 jul-ago; 16(4): 567-75. DOI: 10.15253/2175-6783.2015000400014.

16. Oliveira CP, Santos IMG, Rocca AR, Dobri GB, Nascimento GD. Epidemiological profile of elderly patients treated in the emergency room of a university hospital in Brazil. Rev Med (São Paulo). 2018 jan.-fev.; 97(1): 44-50. DOI: 10.11606/issn.1679-9836.v97i1p44-50.

17. Viana SDSC, Arantes T, Ribeiro SCDC. Interventions of the clinical pharmacist in an Intermediate Care Unit for elderly patients. Einstein (São Paulo). 2017; 15(3): 283–8. DOI: 10.1590/S1679-45082017AO3894.

18. Dookeeram D, Bidaisee S, Paul JF, Nunes P, Robertson P, Maharaj VR, *et al*. Polypharmacy and potential drug–drug interactions in emergency department patients in the Caribbean. Int J Clin Pharm; 2017; 39(5): 1119–27. DOI: 10.1007 / s11096-017-0520-9.

19. Dias D, Wiese LPL, Pereira EM, Fernandes FM. Evaluation of pharmaceutical clinical interventions in the icu of a public hospital of Santa Catarina. Rev Bras Farm Hosp Serv Saude. 2019; 9(3): 1-5. DOI: 10.30968/rbfhss.2018.093.005.

20. Hamid S-A, Adnan W-N-A, Naing N, Adnan A. Acute kidney injury in intensive care unit, hospital Universiti Sains Malaysia: A descriptive study. Saudi Journal of Kidney Diseases and Transplantation. 2018; 29(5): 1109. DOI: 10.4103 / 1319-2442.243961.

21. Kjeldsen L, Olesen C, Hansen M, Nielsen T. Clinical Outcomes Used in Clinical Pharmacy Intervention Studies in Secondary Care. Pharmacy. 2017; 5(4): 28. DOI: 10.3390 / pharmacy5020028.

22. Barros ME, Araújo IG. Evaluation of pharmaceutical interventions in an intensive care unit of a teaching hospital. Rev Bras Farm Hosp Serv Saude. 2021; 12(3): 0561. DOI: 10.30968/rbfhss.2021.123.0561.

23. Ertuna E, Arun MZ, Ay S, Fatma Özge, Kayhan Koçak, Gökdemir B, Ispirli G. Evaluation of pharmacist interventions and commonly used medications in the geriatric ward of a teaching hospital in Turkey: a retrospective study. Clin Interv Aging. 2019; 14: 587–600. DOI: 10.2147/CIA.S201039.

24. Zaal RJ, Haak EWD, Andrinopoulou ER, Gelder TV, Vulto AG, Patricia M. L. A. Van Den Bemt. Physicians' acceptance of pharmacists' interventions in daily hospital practice. Int J Clin Pharm. 2020: 1-9. DOI: 10.1007 / s11096-020-00970-0.

25. Gaskin J, Conyard E. CP-181 Clinical pharmacist interventions in the emergency department and their impact on preventable adverse drug events and associated cost avoidance. Eur J Hosp Pharm. 2017. DOI: 10.1136/ejhpharm-2017-000640.179.

26. Sushilkumar P L *et al*. Identification and Evaluation of Drug Related Problems in Intensive Care Units and Emergency Ward of A Tertiary Care Teaching Hospital. Indo Am J Pharm Res. 2019; 9(02). DOI: 10.5281/ zenodo.2592001.