CLINICAL SCIENCES

DRUG-DISPENSING ERRORS IN THE HOSPITAL PHARMACY

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OBJECTIVE: To determine the dispensing error rate and to identify factors associated with them, and to propose prevention actions.
METHODS: A cross-sectional study focusing on the occurrence of dispensing errors in a general hospital in Belo Horizonte that uses a mixed system (a combination of multidose and unit dose systems) of collective and individualized dosing.
RESULTS: A total of 422 prescription order forms were analyzed, registering 81.8% with at least 1 dispensing error. Opportunities for errors were higher in the pretyped prescription order forms (odds ratio = 4.5; P <.001), in those with 9 or more drugs (odds ratio = 4.0; P <.001), and with those for injectable drugs (odds ratio = 5.0; P <.001). One of the teams of professionals had a higher chance of errors (odds ratio = 2.0; P =.02). A multivariate analysis ratified these results.
CONCLUSIONS: The dispensing system at the pharmacy can produce many latent failures and does not have an adequate control; it has several conditions that predispose it to the occurrence of errors, contributing to the high rate reported.

KEYWORDS: Medication errors. Dispensing errors. Drugs. Hospital pharmacy. Adverse events.

INTRODUCTION

Many prescription errors are made during the various phases of medication usage in the hospital environment; dispensation is one of the most sensitive phases of the process. Safe, organized, and effective dispensing systems are, therefore, fundamental to ensure that drugs will be properly dispensed according to the prescription order forms, and to reduce the possibility of errors. The use of medication may present shortcomings due to the many mistakes which individually would not be enough to cause errors. These are latent mistakes, dynamic as the system is, and capable of variation as a function of different possible situations. The creation of oversight for the system focuses on preventing these mistakes, either isolated or in synergetic action, that result in errors.[1] In a study carried out in 1994 in the USA, it was demonstrated that transcription and administration could be responsible for 50% of the medication errors, considering that 39% of the errors involved prescription order forms and 11% involved dispensation.[2] A British study from 2002 reported a 2.1% rate of of dispensation errors. The most frequent type of error was medication dispensed with an incorrect dose.[3] The dispensation error rate found in an American study in 2003 was 3.6%.[4] The differences between the rates reported in these studies can be related to the different methodologies that have been applied. They can also be related to the improvement in the dispensation systems and actions to reduce dispensing errors implemented in these countries.

Today, there are different drug dispensing systems in hospital units, and a different expectation of errors is associated with each of them. It is known that in American, British, and Canadian hospitals where the unitary dose (UD) system is used, the rate of medication errors has been reduced from 1 error/patient/day to 2 - 3 errors/patient/week. It has also been observed that the rates of drug dispensing errors in work environments with high levels of interruption, distraction, noise, and overload are higher (3.23%) compared with the environments with lower levels of these aspects (1.23%).[6–8]

In Brazil, research regarding medication errors in hospitals is scarce. The 1990s and the first years of the current century saw the beginning of coordination among pharmaceuti-

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cal groups. This occurred in an attempt to determine the realities of the work conditions and their effects on the quality of the provided services, as well as to overcome bureaucracy and master the techniques of efficient hospital pharmacy operation in the country. In a broad bibliographical research about the dispensing errors in Brazil,[5,9] very few reports mentioned the errors that occurred, or that were related to failures in the drug dispensing system. In one of them, the errors totalled 26.8% of the procedures. Errors in the drug dispensing system included the following: delay in the dispensing time; medication with similar labelling and packaging; many drugs to be given at the same time, with the consequent delay in the administration; and drugs sent with the wrong identification.[10] The present study undertaken in the pharmacy of a general hospital was the first in the country specifically planned to detect and to analyze drug dispensing errors. Its objective is to determine the rate of dispensing errors, to identify associated factors, and to suggest preventative actions.

METHODS

A cross-sectional study was performed to evaluate the drug-dispensing process used by the mixed system in a public hospital in Belo Horizonte, Minas Gerais, having 276 beds and specializing in emergencies and urgent care. The concept of dispensation error adopted was the discrepancy between the written instruction found on the prescription order form and the accomplishment of this instruction by the pharmacy when the drug was dispensed to the wards or hospital services.[11,12] Data collection was performed during the day in the place where the medication was dispensed to pediatrics, intermediary care, neurology, internal medicine, surgery, plastic surgery, acute and chronic burn units, and the intensive care units ICUs. Three teams of professionals (who worked every 3rd day) were responsible for the drug-dispensing process. From Monday to Friday in the afternoon, a pharmacist was responsible for the dispensing process and for the supervision.

The following were excluded from the study: oral use liquids, injectables given at higher volumes, frequently used ointments, and ICU prescriptions where a confrontation between dispensation and the medical prescription was impossible due to the use of a multidose system. Also excluded were thermolabile drugs, eye drops, suppositories, and narcotics, given that checking would delay delivery as these drugs are separated when a nurse goes to the pharmacy to fetch the medication.

Drugs dispensed as individualized doses were included in the study as follows: oral-use solids, injectable drugs of low volume, and creams and ointments of low consumption. The prescription under conditional form ("at doctor's orders" or "if necessary") has rules that aim to decrease the quantity of drugs dispensed and reduce the amount of drugs stored at the hospital. These medications and the psychotropic drugs (controlled by law) have a dispensed quantity limited to 1 daily dose. If necessary, nurses could request additional units from the pharmacy. These rules were considered for identification of errors.

Data collection was carried out after 10 days of taking part in the routine and applying participant observation with the adoption of a "field diary" and after 3 days of a pilot collection. During this time, the form was tested, and parameters for calculation and arrangement of the sampling were defined. One of the aims was to introduce a professional in the routine of work, and thus to decrease the risk of collection bias. An average of 220 prescription order forms were dispensed per day and 50% was defined for the expected occurrence of the event of errors with a confidence level of 95%,[13] reaching a final *n* of 462. Systematic collection took place during 21 consecutive days, in September 2002, involving 7 days of work from each team. Medications separated for dispensing were registered in the form. Afterwards, these data were compared with the prescription order forms. The qualitative observations allowed an evaluation of the dispensing service.

The variables considered and their definitions were: (1) date of the prescription and dispensation, the prescription origin sector, the name of the patient, the ward number, the bed and the staff responsible for drug dispensing; (2) type of team in the shift "complete," as the one comprising 4 professionals; "incomplete," as the team with 3 professionals; and "replaced," as that team that worked with 3 of one team and 1 of another team as a substitute due to vacation reasons; (3) separated medications to be dispensed (name of the medicine, pharmaceutical formula, concentration, and dispensed amount); (4) prescribed medication (name, pharmaceutical form, concentration, and time of administration); (5) quantity of prescribed medication, with its commercial or generic name, (6) whether the medicine is standardized or not in the hospital or if there is a shortage of it in the pharmacy; (7) legibility of the carbon copy of the prescription order form "legible handwriting", ie, read without assistance, with a normal time required for comprehension of words, numbers, symbols, and abbreviations; "poorly legible or doubtful handwriting", ie, in which a longer time was needed to read the prescription order form, not being completely sure of the understanding of every word, number, symbol, or abbreviations, in many occasions with a partial comprehension of what was written[14]. (8) type of prescription "written", ie, handwritten; "typewritten", ie, standardized by the sector and pressed by the printer or elaborated in the computer; and "mixed", ie, part hand-written and part type-written; (9) drugs with quality deviations or labelling problems.

The errors identified were classified into 7 types (Ta-

ble 1).[15] Data were analyzed for their simple frequency and through the uni- and bivariate analysis (using EPI INFO 6.04) and through the multivariate analysis (using STATA). The project was approved by the Committees of Ethics on Research at the organization in which it was carried out and at the Federal University of Minas Gerais (UFMG).

RESULTS

A total of 422 prescription order forms were analyzed (average, 20.1 ± 2.1 SD prescriptions/day) totalling 2,143 dispensed drugs. The sample was proportionally distributed among the 8 admission sectors. At least 1 dispensing error was registered in 81.8% (345) of the prescription order forms. Among those, 72.7% (251) showed 1 or 2 drugs dispensed with some type of error. Out of the 719 (33.6%) drugs dispensed with some type of error, 365 (50.8%) were prescribed using the generic name, and 354 (49.2%) using the commercial name.

The most frequent error was dose omission (Table 2), and 58.5% (241) of these occurred with the drugs prescribed under conditional form, of which 46.8% (193) had omission of all doses. Heparin represented 89.7% (52) of the 8% of drugs prescribed without concentration. Heparin was also involved in all errors with drugs prescribed without the amount (2.8%) and effectively dispensed. From the 9.3% of the drugs dispensed in excessive doses, 77.6% (52) were prescribed under conditional form.

The "C" team, the pretyped prescription order forms, the number of drugs per prescription, and the injectable pharmaceutical form were shown to be significant determinants of drug dispensing errors. There was no significant associa-

Table 1 - Classification of the types of dispensing errors used for data collection

Types of dispensing error
Dose omission: no dose (unit) of the prescribed drug was dispensed or the number of the dispensed doses was lower
Medication prescribed without administration schedule or without the quantity to be administered or without concentration or without pharmaceutical form, and that was dispensed
Dispensed medication with wrong concentration, ie, a concentration lower or higher than that prescribed
Excessive dose: 1 or more doses (units) were dispensed beyond the quantity described in the prescription.
Wrong dispensed medication: a medication was prescribed, but another was dispensed, or a nonprescribed medication was dispensed.
Medication dispensed with a wrong pharmaceutical form
Medication dispensed with labelling problems or with quality deviation

Table 2 - Distribution of the frequencies of the types of dispensing errors

Type of dispensation errors	Frequencies	%	Total
Dose omission	412	100	57.3
All the doses	320	77.7	44.5
1 or more doses	92	22.3	12.8
Medication prescribed without concentration, quantity, time or pharmaceutical form	96	100	13.3
Without concentration	58	60.4	8.0
Without quantity	20	20.8	2.8
Without timing	17	17.7	2.4
Without pharmaceutical form	1	1.1	0.1
Medication dispensed with wrong concentration	91	100	12.7
With higher concentration	87	95.6	12.1
With lower concentration	4	4.4	0.6
Excessive dose	67	100	9.3
Wrong medication	25	100	3.5
Not prescribed but dispensed	22	88	3.1
One medication prescribed and another dispensed	3	12	0.4
Medication with labelling problems	23	100	3.2
Correct medication, wrong pharmaceutical form	4	100	0.6
Medication with quality deviation	1	100	0.1
TOTAL	719	-	100

tion between the percentage of errors and the legibility of prescription order forms (Tables 3 and 4), and none of the prescription order forms for medication was classified as illegible. Pretyped and mixed prescription order forms showed higher rates of dispensing errors and a higher number of drugs prescribed (Table 3 and 4). Apart from legibility issues, these prescriptions were kept in the multivariate model as a risk factor for dispensing errors. In this model, the number of drugs/prescription and the team responsible for dispensing were also at a higher risk of error (Table 5).

From 431 injectable drugs dispensed with errors, 134 (31%) were high-risk medications heparin comprised 67.2% (90), and nalbuphine comprised 22.4% (30). Examples of dispensing errors according to the different types encountered are shown in Table 6.

DISCUSSION

During the adaptation period of the researcher to the environment, it was noticed that there was an absence of pharmacy professionals in the sectors of hospitalization. There was also a lack of checking the drugs dispensed and a lack of a routine of returning unused medications back to the pharmacy. Some routines observed during this period can be considered as actions that are not characteristic of the dispensation for the individual dose, making these actions more characteristic of the collective dose. Each team dispenses an average of 220 prescriptions in 3 hours. The absence of the pharmacist was common during the separation of drugs, which resulted in difficulties in clarifying the issues that arose. Interpreting the prescription was a frequent action, and it was common to hear sentences such as, “I think it is this,” “I believe it is this,” “It must be this,” “in this sector it is common to prescribe this.” Clarifying with the doctor who prescribed the medication was not common. Distraction and interruptions were frequent and common, being primarily made by the presence of nursing professionals, excessive chats, phone calls, stock replacement of drugs, and a radio that diverts the professional’s

Table 3 - Prescriptions with dispensation errors according to the team, type of prescription order form, the handwriting, and the amount of drugs per prescription

Variable analyzed	n	% error	OR (CI)	*P*	
Team	A	136	75.7	1.00	-
	B	144	81.3	1.39 (0.75-2.56)	.328
	C	142	88.0	2.36 (1.19-4.70)	.012
	C x (A+B)	-	-	2.01 (1.08-3.75)	.025
Type of prescription order form	Written	97	66.0	1.00	-
	Mixed	189	84.1	2.73 (1.48-5.05)	.000
	Typewritten in advance	136	89.7	4.49 (2.14-9.56)	.000
Handwriting	Legible	296	83.8	1.00	-
	Almost legible	126	77.0	0.65(0.37-1.12)	.129
Number of drugs/prescription	0 - 9	253	74.7	1.00	-
	10 - 26	169	92.3	4.06 (2.08-8.06)	.000

Number of prescriptions n = 422; OR = odds ratio; CI = 95% confidence interval

Table 4 - Medications dispensed with errors according to the team, kind of prescription order form, handwriting, and pharmaceutical form

Variable analyzed	n	% error	OR (CI)	*P*	
Team	A	730	29.9	1.00	-
	B	706	32.6	1.13(0.90-1.43)	.292
	C	707	38.3	1.46(1.17-1.83)	.000
	C x (A+B)	-	-	1.37(1.13-1.66)	.001
Type of prescription order form	Written	321	29.1	1.00	-
	Mixed	1151	35.8	0.74 (0.56-0.96)	.025
	Pre-typed	671	40.1	1.20 (0.90-1.59)	.222
Handwriting	Legible	1483	35.0	1.00	-
	Almost legible	660	30.5	0.82 (0.67-1.00)	.048
Pharmaceutical form	Oral	1333	20.3	1.00	-
	Topical	62	29.0	3.32 (1.83-6.10)	.000
	Injectable	748	57.6	5.35 (4.37-6.55)	.000
	Injectable x (Oral+Topical)	-	-	5.23 (4.28-6.38)	.000

Dispensed medications n = 2143; OR = odds ratio; CI = 95% confidence interval

Table 5 - Multivariate analysis of the dispensing error indicators

Error Indicator	OR (CI)	*P*
Sunday	1.83 (0.67-4.99)	.235
Tuesday	3.15 (0.97-10.18)	.055
Wednesday	1.86 (0.64-5.37)	.253
Thursday	1.26 (0.47-3.38)	.647
Friday	1.38 (0.47-4.05)	.559
Saturday	1.38 (0.49-3.89)	.545
Team A	0.05 (0008-0.32)	.001
Team B	0.17 (0.04-0.79)	.024
Complete team	7.53 (1.08-52.27)	.041
Incomplete team	1.58 (0.33-7.54)	.563
Pretyped prescription order form	3.28 (1.43-7.55)	.005
Mixed prescription	1.36 (0.68-2.70)	.380
Legible handwriting	1.07 (0.57-2.00)	.829
Number of medications prescribed	1.23 (1.13-1.35)	.000

OR = odds ratio; CI = 95% confidence interval

concentration. The communication between the teams and the pharmacists was not sufficient, with most of the instructions being given verbally; there was no routine for written instructions. The medications were organized according to consumption and were often stored incorrectly.

The most frequent type of dispensing error, dose omission, was possibly associated with the interruptions and distractions and exacerbated by the lack of communication. Older studies done in the USA have reported dose omission as the most frequent error, although with a lower percentage: 37% of the errors in 1962 and 4.1% in 1984.[6,16] It was observed that prescribed drugs under conditional form presented high rates of dose omission, indicating problems in the fulfilment of the rules set for dispensing. This also supported the observations made within the adaptation period when each professional or each team appeared to work with their own set of rules.

Prescription order forms involving injectable drugs are generally more complex, and can create more uncertainties and more dispensing errors. Errors involving injectable drugs have a higher potential for causing severe damage to the patients and adverse events than medication administered through other routes, in addition to the operational aspects related to their preparation and administration. Furthermore, after being injected, the drug cannot be recovered, and its effects are difficult to reverse.[17] The frequency in which the high-risk medication is dispensed with error shows the need for establishing different procedures for storage and dispensing areas as a preventative strategy.[11]

Despite recommendations of applying extreme care in its use, heparin is one of the drugs that is closely related to life-threatening situations of patients in hospital environments.[18] Heparin was shown to be one of the 10 medications responsible for 60% of the adverse events that occurred in hospitals during a study between the years 1994 and 2000. In the same hospital in which this study was carried out, Rosa (2002)[14] reported a frequency of 58% of the prescriptions of heparin without the pharmaceutical form, 40% with incomplete concentration, 20% without concentration, and 14% without administration route.

The results of the current work showing a higher risk of dispensing errors related to one of the teams point to a possible structural problem in the work organization. On the other hand, if a positive correlation of the number of drugs/prescriptions with the number of errors is an expected result because of the difficulty associated with prescription order forms with many items, our results contradict this expectation as well as those reported in the literature.[11,20,21] These results suggest that the main cause of dispensing errors in this pharmacy was dependent upon the dispensation system adopted and can be re-

Table 6 - Examples of the types of dispensing errors

Prescribed medication	Dispensed medication
Dose omission	
metoclopramide 1 vial 8/8 h IV	None
metoclopramide 1 vial 8/8 h IV	1 vial metoclopramide
Medication prescribed without concentration, quantity, time or pharmaceutical form	
heparin 0.25 mL 12/12 h SC	heparin 0.25 mL/5000 IU or 5 mL/5000 IU
heparin 0.25 mL/5000 IU 12/12 h SC	heparin 0,25 ml/5000 UI
codeine 30 mg+ Acetaminophen 500 mg if pain	codeine 30 mg +acetaminophen 500 mg
dipyrone 6/6 h VO	dipyrone 500 mg tablets
Medication dispensed withwrong concentration	
iron sulphate 200 mg	iron sulphate 300 mg
diazepam 10 mg	diazepam 5 mg
Excessive dose	
nalbuphine 0.5 mL 6/6 h SC if intense pain	4 vials of nalbuphine
Wrong Medication	
None	3 vials dopamine
Tazocin[â]	Levaquin[â]

lated to the fragmented pharmaceutical supervision and the organizational problems in the work teams. All other analyzed variables seem to be secondary, determined by those problems.

Many potential causes of dispensing errors are related to the studied environment that as a group contributes to the high rate registered. The type of dispensing system, organization of the work process, the interruptions during the separation of drugs, the environment, and the excessive workload stand out as main factors. Accord to Cohen (1999), the most significant cause of dispensing errors is an excessive workload and the stress that the limited time available for dispensing the medication can cause. The systems and chores must be organized in such a way that the workload, circadian rhythms, the pressure of time, memory limits, and the vigilance and human attention required are to be respected.[22–24] Errors originating from the interpretation of the prescription order forms were the second most frequent complaint from a list of 90,000 complaints made to the American Medical Association over a period of seven years.[11]

Highlighting the need for silence and concentration during the separation of the medication, reductions of distractions and interruptions, and the implementation of systematic procedures for drug storage can contribute to the reduction of dispensing errors. The mistakes in communication in other hospital sectors are frequently reported as a cause of errors. The use and improvement of the communication standards must also be put into practice in the pharmacy.[2,8,21,24,25]

Even if many of the errors registered during this study did not reach the patients, the high rate of errors can be seen as a sign of low quality in the service performed. This creates a lack of trust among the professionals from other sectors in the hospital and could even harm the professionals in the pharmacy, known as the second-error victim.[26] The dispensing system analyzed had little oversight, many latent failures, and several conditions that predisposed the occurrence of errors, showing a need for implementation of a safer system and of preventative measures. The automation and computerization of drug dispensing are important tools for reducing dispensing error rates, as are the new procedures for checking routines of dispensed medication before they leave the pharmacy.[4, 27]

Nevertheless, there is a need for adjustment of these measures to different socio-cultural work realities and the characteristics of the different types of errors and problems in these environments. Therefore, the prevention of errors demands initiatives that include all the components of the system, and its application is the responsibility of organizations, health authorities, and all professionals involved pharmacists, nurses, and doctors.[28]

RESUMO

Anacleto TA, Perini E, Rosa MB, César CC. Erros de Dispensação de Medicamentos em Farmácia Hospitalar. Clinics. 2007;62(3):243-50.

OBJETIVO: Determinar a taxa de erros de dispensação e identificar fatores associados, propondo ações de prevenção. **MÉTODOS:** Estudo transversal investigou-se a ocorrência

de erros de dispensação em um hospital geral de Belo Horizonte que emprega um sistema misto de dose coletiva e individualizada.

RESULTADOS: Foram analisadas 422 prescrições, registrando em 81,8% destas pelo menos um erro de dispensação. Oportunidades de erros foram maiores nas prescrições pré-digitadas (Odds Ratio=4,5; p<0,001), naquelas com nove ou mais medicamentos (Odds Ratio=4,0; p<0,001) e com os injetáveis (Odds Ratio=5,0; p<0,001). Uma das equipes de profissionais apresentou maior chance de erros (Odds Ratio=2,0; p=0,02). A análise multivariada ratifica estes resultados.

CONCLUSÃO: Conclui-se que o sistema de dispensação da farmácia apresenta muitas falhas latentes e poucas defesas, com diversas condições que predispõe a ocorrência de erros, contribuindo para a elevada taxa registrada.

UNITERMOS: Erros de medicação; Erros de dispensação, Medicamentos, Farmácia hospitalar, Eventos adversos.

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