

Medication Wrong-Route Administrations in Relation to Medical Prescriptions

Fernanda Raphael Escobar Gimenes¹

Tatiane Cristina Marques²

Thalyta Cardoso Alux Teixeira³

Maria Lurdemiler Sabóia Mota⁴

Ana Elisa Bauer de Camargo Silva⁵

Silvia Helena De Bortoli Cassiani⁶

This study analyzes the influence of medical prescriptions' writing on the occurrence of medication errors in the medical wards of five Brazilian hospitals. This descriptive study used data obtained from a multicenter study conducted in 2005. The population was composed of 1,425 medication errors and the sample included 92 routes through which medication was wrongly administered. The pharmacological classes most frequently involved in errors were cardiovascular agents (31.5%), medication that acts on the nervous system (23.9%), and on the digestive system and metabolism (13.0%). In relation to the prescription items that may have contributed to such errors, we verified that 91.3% of prescriptions contained acronyms and abbreviations; patient information was missing in 22.8%, and 4.3% did not include the date and were effaced. Medication wrong-route administrations are common in Brazilian hospitals and around the world. It is well established that these situations may result in severe adverse events for patients, including death.

Descriptors: Medication Errors; Drug Prescriptions; Safety Management; Drug Administration Routes.

¹ RN, Doctoral Student of Nursing, Escola de Enfermagem de Ribeirão Preto, Universidade de São Paulo, WHO Collaborating Centre for Nursing Research Development, SP, Brazil. Professor, Universidade Camilo Castelo Branco, São Paulo, SP, Brazil. Email: fer_gimenes@yahoo.com.br.

² Pharmacy-Biochemistry, M.Sc. in Nursing, Hospital São Lucas, Ribeirão Preto, SP, Brazil. E-mail: tatianecm@hotmail.com.

³ RN, Hospital Vera Cruz, Campinas, SP, Brazil. Doctoral Student in Nursing, Escola de Enfermagem de Ribeirão Preto, Universidade de São Paulo, WHO Collaborating Centre for Nursing Research Development, SP, Brazil. E-mail: thalytacat@yahoo.com.br.

⁴ RN, Ph.D. in Pharmacology, Assistant Professor, Universidade de Fortaleza, CE, Brazil. Email: mila269@terra.com.br.

⁵ RN, Ph.D. in Nursing, Adjunct Professor, Universidade Federal de Goiás, GO, Brazil. E-mail: anaelisa@terra.com.br.

⁶ RN, Ph.D. in Nursing, Full Professor, Escola de Enfermagem de Ribeirão Preto, Universidade de São Paulo, WHO Collaborating Centre for Nursing Research Development, SP, Brazil. E-mail: shbcassi@eerp.usp.br.

Corresponding Author:

Fernanda Raphael Escobar Gimenes
Universidade de São Paulo. Escola de Enfermagem de Ribeirão Preto.
Departamento de Enfermagem Geral e Especializada.
Av. Bandeirantes, 3.900
Bairro Monte Alegre
CEP: 14040-902 Ribeirão Preto, SP, Brasil
E-mail: fer_gimenes@yahoo.com.br / fergimenes@usp.br

Administração de medicamentos, em vias diferentes das prescritas, relacionada à prescrição médica

O objetivo foi analisar a influência da redação da prescrição médica nos erros de via de administração, ocorridos em enfermaria de clínica médica de cinco hospitais brasileiros. Estudo descritivo que utilizou dados de pesquisa multicêntrica, realizada em 2005. A população foi composta por 1.425 erros de medicação e a amostra por 92 erros de via. As classes farmacológicas mais envolvidas no erro foram as cardiovasculares (31,5%), drogas que atuam no sistema nervoso (23,9%) e no sistema digestório e metabolismo (13,0%). No que diz respeito aos itens da prescrição médica, que poderiam ter contribuído com os erros de via, verificou-se que 91,3% das prescrições continham siglas/abreviaturas, 22,8% não continham dados do paciente e 4,3% não apresentavam data e continham rasuras. Erros de via são frequentes nos hospitais brasileiros e ao redor do mundo, e se sabe que essas situações podem resultar em eventos adversos severos aos pacientes, incluindo morte.

Descritores: Erros de Medicação; Prescrições de Medicamentos; Gerenciamento de Segurança; Vias de Administração de Medicamentos.

Administración de medicamentos en vías diferentes de las indicadas en la prescripción médica

El objetivo fue analizar la influencia de la redacción de la prescripción médica en los errores de vía de administración ocurridos en la enfermería de clínica médica de cinco hospitales brasileños. Se trata de un estudio descriptivo que utilizó datos de investigación multicéntrica realizada en 2005. La población fue compuesta por 1.425 errores de medicación y la muestra por 92 errores de vía. Las clases farmacológicas más envueltas en el error fueron: 1) las cardiovasculares (31,5%), 2) las drogas que actúan en el sistema nervioso (23,9%), y 3) las que actúan en el sistema digestivo y metabolismo (13,0%). En lo que se refiere a los ítems de la prescripción médica que podrían haber contribuido con los errores de vía, se verificó que 91,3% de las prescripciones contenían siglas/abreviaturas; 22,8% no contenían datos del paciente, y 4,3% no presentaban fecha y contenían raspados. Errores de vía son frecuentes en los hospitales brasileños y alrededor del mundo y se sabe que estas situaciones pueden resultar en eventos adversos severos en los pacientes, incluyendo la muerte.

Descriptores: Errores de Medicación; Prescripciones de Medicamentos; Administración de La Seguridad; Vías de Administración de Medicamentos.

Introduction

Errors in healthcare result from a non-intentional action caused by some problem or failure during care delivered to patients⁽¹⁾, and can be committed by any member of the health team at any point of the care process such as when administering medication to patients. Medication errors can occur at any stage of medication therapy, from writing the prescription to the administration of medication to patients, and represents about 65% to 87% of all adverse events⁽²⁾.

Physicians traditionally decide on the medication to be used and then prescribe it so that pharmacists and the nursing staff implement their decisions. Hence, the medical prescription is the document that guides and influences the other stages of the medication process. Medical prescriptions have an important role in the prevention and occurrence of errors. It is known that ambiguous, illegible or incomplete prescriptions, the use of abbreviations, obscured writing and the lack of

a standardized medication nomenclature (brand name or generic) are factors that can contribute to medication errors⁽³⁾.

In relation to medication errors that may occur in the administration stage, we can highlight dosage errors (overdosing or underdosing, including omissions), dosage form, and route of administration, in addition to administering the wrong medication, to the wrong patient, with the wrong frequency and/or at the wrong time.

An account of error reporting from the United States Pharmacopeia (USP) stated that one of the most frequent errors harming patients is related to the route of administration⁽⁴⁾. Studies presented frequencies of 19%⁽⁵⁾ and 18%⁽⁶⁾ of errors related to the route of administration among all medication errors.

Since errors in the route of administration are common in care delivery, this study analyzes the influence of a prescription's writing on the administration of medication resulting in wrong-route administration that occurred in the medical units of five Brazilian hospitals.

Methods

This descriptive study used secondary data obtained from a multicenter study carried out in 2005 in five Brazilian university hospitals⁽⁷⁾, named A, B, C, D, and E, all belonging to the ANVISA network of Sentinel Hospitals. The study was authorized by the studied hospitals and approved by the Research Ethics Committee.

The study's population was composed of 1,425 situations in which the administered medication was in disagreement with the medical prescription; the sample also included 92 situations in which the route of

administration used was different from that specified in the medical prescription. For that information, data from the databases EPIDATA version 3.1 of the five studied hospitals, obtained through a data collection instrument of the multicenter study and which addressed the prescription of medication dosages, was used.

The variables were determined based on items contained or lacking in medical prescriptions: *absence of patient's data (name, bed number, and registration number); absence of data; absence of medication data (route of administration); acronyms and/or abbreviations; changes and/or discontinuation of medication; and obscure writing.*

This information was passed through the SPSS version 11.5 (SPSS Inc., Chicago, IL, USA). The results obtained in this analysis were distributed in tables and expressed as absolute frequencies and percentages.

The pharmacological classification of medication involved in errors was performed according to the Anatomical Therapeutic Chemical (ATC) classification system by WHO Collaborating Centre for Drug Statistics Methodology.

Results

With respect to medication wrong-route administrations, discrepancies were observed in 92 (6.5%) cases of the total of the 1,425 medication errors and hospital A accounted for the majority of such events, with a frequency of 34 (37.0%). Hospital B was responsible for 22 (23.9%); C for five (5.4%); D for 26 (28.3%); and five (5.4%) drugs were administered via routes different from those prescribed in hospital E.

Some examples wrong-route administrations are presented in Table 1.

Table 1 – Examples of situations in which discrepancies between prescribed and administered routes were observed. Ribeirão Preto, SP, Brazil 2006

Prescription	Wrong-routes administrations	Description
metoprolol tablet 50 mg orally (O)	Situation 1: metoprolol tablet 50 mg was administered through nasogastric tube (NT)	Patient with NT with prescription to administer medication orally
dipyron 40 drops orally	Situation 3: 2ml of dipyron were administered intravenous (IV) diluted in 18ml of distilled water	The drug's name was obscured: Dipyron 2:18 DW IV say 40 drops O

In relation to the pharmacological classes involved in wrong-route administrations, according to the ATC system, 31.5% of the medication belonged to group C (cardiovascular system), while captopril was the most frequent drug, representing 16.3% of the total of

cases; 23.9% of the medication administered in wrong routes belonged to group N (nervous system). Of these, dipyron and tramadol hydrochloride were the most frequent, each representing 3.3% of the total of events (Table 2).

Then the medications of group A (digestive system and metabolism) were present in 13.0% of the wrong-route administrations, while ranitidine was the most common (6.5%) in this group. Group H (hormones used for systemic therapy, except sexual hormones) was also administered in wrong routes in 9.8% of the total cases (Table 2).

Table 2 – Distribution of the frequency with which medication wrong-route administrations occurred in the medical wards of five Brazilian hospitals according to the WHO's ATC system. Ribeirão Preto, SP, Brazil. 2006

ATC Class – Level 1	N	%
Group C – Cardiovascular system	29	31.5
Group N – Nervous system	22	23.9
Group A – Digestive system and metabolism	12	13.0
Group H – Hormones for systemic use, with exception of sex hormones	9	9.8
Group M – Musculoskeletal system	4	4.3
Group J – Anti-infectives for systemic use	3	3.3
Group B – Blood, organs and derivatives	3	3.3
Others	10	10.9
Total	92	100.0

Analyzing the items of the medical prescriptions that could be related to discrepancies in the routes of administration, we observed that 84 (91.3%) prescriptions had acronyms and/or abbreviations (e.g. clindamycin 600mg GTT; dipyrone 1 ampoule IV PRN; Predifort 1 drop O); the patient's registration number was not recorded in 21 (22.8%) prescriptions; two (2.2%) omitted the date and had erasures. The route of the medication administration was not specified in one (1.1%) prescription (Table 3). The patients' name and bed, though, were specified in all situations in which wrong-administrations occurred.

Table 3 presents the analysis of items in the prescriptions that may be related to wrong-route administrations according to the studied hospital.

According to Table 3, of the 34 medication administered via routes different from those prescribed in hospital A, 26 (76.5%) had acronyms and/or abbreviations in the dosage wording even though the prescriptions were electronic.

Table 3 – distribution of the frequency with medication wrong-route administrations occurred in medical wards of five Brazilian hospitals according to the presence or absence of items in the prescription. Ribeirão Preto, SP, Brazil. 2006

Prescriptions items*	Hospital											
	A (n=34)		B (n=22)		C (n=5)		D (n=26)		E (n=5)		Total (n=92)	
	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)
Patient data missing (registration)	0	(0.0)	0	(0.0)	1	(20.0)	15	(57.7)	5	(100)	21	(22.8)
Data missing	0	(0.0)	0	(0.0)	1	(20.0)	1	(3.8)	0	(0.0)	2	(2.2)
Medication data missing (route of administration)	0	(0.0)	0	(0.0)	1	(20.0)	0	(0.0)	0	(0.0)	1	(1.1)
Acronyms and/or abbreviations	26	(76.5)	22	(100)	5	(100)	26	(100)	5	(100.0)	84	(91.3)
Changes and/or discontinuation of medication	0	(0.0)	1	(4.5)	0	(0.0)	0	(0.0)	0	(0.0)	1	(1.1)
Obscured medication name	1	(2.9)	0	(0.0)	0	(0.0)	1	(3.8)	0	(0.0)	2	(2.2)

* Each prescription may have more than one error.

The following acronyms and abbreviations were found: TB for tablets (e.g. "Complex B 1 TB"); the use of the letter D to indicate the number of days an antibiotic should be administered (e.g. "metronidazole 100 mg tablet oral beginning on 06/22/2005 D1/3"); IU instead of International Units (e.g. heparin sodium 5,000 IU subcutaneously); DRP referring to drops (e.g. "clonazepam 10 DRP orally"), among others. In hospitals

B, C, D and E, 100% of the prescriptions had acronyms and/or abbreviations.

Yet, according to Table 3, the patients' registration information was missing in 100% of the prescriptions where the medication was administered via routes different from those specified in hospital E and in 15 (57.7%) prescriptions of hospital D. The date and route of administration were also omitted in one (20.0%) prescription at hospital C.

Discussion

A study conducted in the United States of America identified 1.8% of medication wrong-route administrations in a total of 146,974 events reported in the United States Pharmacopeia system (USP)⁽⁴⁾. Only one (0.4%) route error was detected in a total of 240 events in an large American university hospital⁽⁸⁾.

Among the 798 administered doses investigated by a study conducted in six European hospitals, 1% was wrong-route administrations⁽⁹⁾. In another study carried out in a French hospital, 102 (19.0%) cases of medication wrong-route administrations were identified in a total of 538 adverse events related to medication. Most of these events were related to the administration of doses through nasogastric tubes (NGT) instead of oral administration,, similar to data found in this study and which corroborates the results of other studies^(5,10-11).

The frequency of wrong-route administrations found in this study is considerably divergent from other studies, probably due to the different methods adopted, since not all consider an error to have occurred when medication is administered through gastric or enteric tubes instead of orally or *vice-versa*⁽⁹⁾. In practice, what normally occurs is that the nursing team crushes tablets or pills, or open capsules and dissolves the powder in some liquid to enable the administration of medication actually prescribed for the oral route in patients with gastric or enteric tubes⁽¹²⁾.

However, it must be noted that it is crucial in the administration of medication to consider the medication's pharmaceutical form and the chemical and physical features of each drug. Among these characteristics are solubility, partition coefficient, dissolution rate, dosage form and stability. For instance, pH variation in the gastrointestinal tract affects the degree of ionization of the drug molecules, which in turn influences its solubility and absorption capacity⁽¹²⁻¹³⁾. Hence, the administration of medication via routes different from those indicated by the manufacturer may represent a variation in the bioavailability of the drug and consequently change its therapeutic response.

Additionally, the process of crushing and dissolving solid oral dosage forms may generate other problems such as destroying the protective coating of enteric or controlled release medications or even clogging the tube, consequently increasing the risk of morbidity and mortality and also costs related to drug therapy⁽¹⁴⁾.

Considering these aspects, the literature has demonstrated that among wrong-route administrations, the most frequent situation is that in which medication

prescribed for oral use is administered through tubes^(5,10-11). Many factors contribute to these errors, such as lack of knowledge or information concerning the therapy and alternative pharmaceutical forms, inappropriate evaluation and use of patients' information, prescription and confusing drug nomenclature, wrong calculation of dosage and inappropriate pharmaceutical form, factors that also contribute to the occurrence of prescription errors^(6,15).

Properly administering medication to patients is the role of the nursing team, which represents an important barrier for the interception of errors⁽¹⁵⁾. However, it is necessary for professionals to be technically and scientifically supported to safely and efficiently administer pharmacotherapy. A study carried out in Europe showed that integrated multidisciplinary actions involving nurses, pharmacists, physicians and nutritionists, promoted the correct implementation of medication therapy, especially in patients using gastric and enteral tubes⁽¹⁴⁾.

In regard to pharmacological groups, medication wrong-route administrations were the most frequent in the groups C, N, and A, that is, medication for the cardiovascular, nervous and digestive systems. Other investigations also indicate that cardiovascular and digestive medication are the main classes involved in the occurrence of discrepancies between the prescribed and administered routes⁽¹⁰⁻¹¹⁾. This finding may be explained by the large use of these classes of medication, especially captopril and ranitidine, in medical wards.

Hospital A, in which prescriptions were electronic, accounted for the highest frequency of wrong-route administrations. Electronic prescription is a technology that should be used to facilitate and ensure the safer use of medications⁽¹⁶⁾, however, when not appropriately used, it does not meet such objectives. It is apparent that the implementation of electronic prescriptions does not eliminate the possibility of medication errors since wrong-route administrations still frequently occurs in Brazilian hospitals and around the world. Such findings are of concern because we know that, depending on the medication and its pharmacological class, errors may lead to severe adverse events, including death.

In relation to the writing of medical prescriptions and what may have contributed to this type of error, the use of acronyms and abbreviations was the most common. It seems that the use of these is seen as a way to save time during the writing of the prescription, since a single physician is responsible for prescribing several patients a day. This practice, however, needs

to be reviewed by physicians, since many of these acronyms and abbreviations are not understood by all the professionals who handle prescriptions, especially when there is not a formal standard in the facility.

Even when acronyms and abbreviations are standardized, the health team should avoid them, especially when the method of prescription is manual since illegible handwriting may lead to a misunderstanding with a consequent inappropriate use of medication (e.g. the acronym SC may be easily misunderstood as SL, and IV may also be read as IM).

Additionally, the omission of information in prescriptions can greatly contribute to errors. In a situation that occurred in hospital C, the absence of the route of administration in the prescription was possibly the main cause that led to the wrong-route administration. It shows that a correctly written prescription with complete and necessary information for the safe administration of medication is a barrier to medication errors⁽¹⁶⁾.

Another important factor contributing to errors in the medication system is the presence of obscured writing in prescriptions, which may confuse the nursing team. The error situation presented in Table 1 involving dipyrene demonstrates that the dosage form was changed (drops and ampoule), which may have been induced by damage to the prescription that led to the administration of the injectable form instead of the oral form. It is also recommended that professionals carefully read the medical prescription identifying the "five rights" of medication safety that includes the route of administration so to ensure the correct administration of medication⁽¹⁷⁾.

We also know that the analysis of the origins of such events reveal they are related to a deficit of knowledge on the part of the health team, as well as a deficit of performance⁽¹⁸⁾, which requires that the quality of teaching of pharmacology in undergraduate and graduate nursing programs be reviewed and also the implementation and maintenance of permanent education programs in health units promoted by nurses and the other members of the nursing staff.

There has been growing interest in studies addressing medication errors from the perspective that deeper knowledge regarding this topic may represent increased safety for patients and, consequently, increased quality of health services. Therefore, studies have addressed the occurrence of errors in the prescription, dispensation and administration of medication that need to be analyzed more deeply to determine their causes and

intervening factors⁽¹⁶⁻²²⁾. Hence, this study contributes to an analysis of the importance of medical prescriptions in the prevention of medication administration errors, especially in relation to errors related to the route of administration.

Conclusion

This study's results revealed that most of the 92 medication wrong-route administrations occurred in hospital A, whose prescription method is electronic.

In relation to the pharmacological classes most involved in this type of error, 25.0% included anti-hypertensives followed by analgesics, antipyretics and anti-inflammatory medication. Steroids and glucocorticoids presented a frequency of 9.8%, while antiulcer drugs represented 8.7% of total cases.

In relation to the items in the medical prescription that may have contributed to wrong-route administrations, 91.3% of the prescriptions written in the five studied hospitals had acronyms and/or abbreviations such as SC (subcutaneous) and GTT (gastrostomy), while there were acronyms and/or abbreviations in 100% of the prescriptions involved in this type of error in the hospitals B, C, D and E.

Even though the use of electronic prescriptions was adopted in one of the studied hospitals, it did not eradicate medication errors, since it permits the use of acronyms and/or abbreviations, a factor that may lead to misunderstanding information. From this perspective, health professionals need to be continually trained so as to avoid the use of acronyms and abbreviations in prescriptions even if standardized by the hospital, as well as erasures, which may also lead to misunderstanding.

Therefore, the implementation of permanent education for the professionals involved in the medication process can minimize harm caused to hospitalized patients due to medication wrong-route administrations, consequently improving the quality of care delivery.

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