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# Root cause analysis of falling accidents and medication errors in hospital

Análise de causa raiz de acidentes por quedas e erros de medicação em hospital

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## Keywords

Quality of health care; Patient safety; Accidental falls; Medication errors; Risk management; Medication system, hospital

## Descritores

Qualidade da assistência à saúde; Segurança do paciente; Acidentes por quedas; Erros de medicação; Controle de risco; Sistemas de medicação no hospital

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## Abstract

**Objective:** To identify fall incidents and medication errors reported in a general private hospital and to introduce the causal factors categories of these incidents.

**Methods:** Cross-sectional and exploratory study based on 62 reported incidents within the period of study. The research instrument was created in order to collect data from notification forms and patients' medical records. The content validation of the instrument was performed by judges. Two teams were set up to analyze the root cause of incidents and to categorize the causal factors.

**Results:** Within the period of study, 62 incidents were reported, of which 11 were falls and 51 were medication errors. Most of the fall were from own height, and the main medication error types were omission and timing. Out of the 19 analyzed incidents, a total of 118 causal factors were identified, most of which were related to systemic failures, followed by individual and patients failures.

**Conclusion:** Medication errors occur more frequently than fall accidents. The root cause team analyzed 14 medication errors with potential to cause harm and five fall accidents, with 83 and 35 identified causal factors respectively.

## Resumo

**Objetivo:** Identificar incidentes por queda e erros de medicação notificados em um hospital geral e privado e apresentar as categorias de fatores causais desses incidentes.

**Métodos:** Trata-se de estudo transversal e exploratório realizado com 62 incidentes notificados no período de estudo. O instrumento de pesquisa foi elaborado para coletar dados dos formulários de notificação e dos prontuários dos pacientes. A validação de conteúdo do instrumento foi realizada por juízes. Foram constituídas duas equipes para análise da causa raiz dos incidentes e categorização dos fatores causais.

**Resultados:** No período de estudo foram notificados 62 incidentes, sendo 11 quedas e 51 erros de medicação. A maior parte das quedas foi da própria altura, e os principais tipos de erros de medicação foram omissão e horário. Dos 19 incidentes analisados, um total de 118 fatores causais foram identificados, sendo a maioria relacionada às falhas sistêmicas, seguidas por falhas do indivíduo e do paciente.

**Conclusão:** Erros de medicação ocorrem com maior frequência do que acidentes por quedas. A equipe de causa raiz analisou 14 erros de medicação com potencial para causar danos e cinco acidentes por queda, sendo identificados 83 e 35 fatores causais, respectivamente.

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**Conflicts of interest:** there are no conflicts of interest to declare.

## Introduction

Currently, most institutions have been seeking to achieve quality of care and safety for patients in health services, in order to provide risk-free care.

There are many definitions of quality, used both in relation to health care and health systems and in other spheres of activity. In technical use, quality can have two meanings: the characteristics of a product or service that affects one's capacity to meet explicit or implicit needs, and a product or service with no deficiency.<sup>(1)</sup>

According to the World Health Organization, a quality health service is the one that organizes its resources in the most effective way to meet the actual needs, safely, without any waste and according to high standards and respect for human rights.<sup>(2)</sup>

For this end, it is necessary to implement safe practices in this context in order to prevent their occurrence, such as training, the use of updated protocols by the multidisciplinary team, the presence of safety committees for patients, the notification of incidents by the professionals, and subsequently, analyses of these incidents that identify the causes, among other strategies.

It is observed that incidents related to the patient's safety are events or circumstances that might have resulted, or resulted in unnecessary harm to the patient. An incident can be a reported circumstance, a near mistake, an incident with no harm to the patient or an incident with harm, that is, an adverse outcome, whereas the patient's safety involves the reduction of risks and unnecessary harm related to the health care to a minimum extent.<sup>(3)</sup>

The expression "patient safety" refers to the factors that lead the institutions to make use of the safety culture, considering the best practices. This expression must be seen as a result, that is, the work that is performed in a system in which protocols are updated and based on scientific literature, in which technology is implemented in order to improve the processes and training is carried out for the whole healthcare staff, providing more safety and fewer risks to patients.

It often involves the promotion of a safe environment, exploring the possibilities of occurrence

of incidents in health, such as falls, medication errors, and infections, among others.

Many incidents related to patient safety, such as falls and medication errors, are often studied and presented in national and international studies, as they might cause harm to patients.

In the United States, falls are the most common causes of non-lethal injuries to people over 65 in neighborhoods. Out of the individuals living in neighborhoods who are over 65, 32% fall every year, and this happens more frequently to women.<sup>(4)</sup>

Regarding medication errors, although it is known that the adequate use of medicine can have positive effects on individuals, improper use may occur, resulting in undesired and even harmful effects for the patients.

A study identified 2,181 medication errors in 54,169 cases, and the implementation of new technologies in the distribution process has increased safety, especially with electronic prescription, which allows a decrease in this type of errors.<sup>(5)</sup>

As for the preparation and administration of drugs by the nursing staff, the occurrence of 550 events was observed, most of which were related to the absence of checking of at least "five rights" in the drug administration, to drugs not administered and to inaccurate notes.<sup>(6)</sup>

When quality levels show significant loss, actions must be taken in order to correct them, which means improvement for the institution. To ensure this, the analysis of incidents related to patient safety must be carried out, based on quality methodologies.

As the root cause analysis is a methodology that is easy to apply, which does not require many resources and promotes a critical and thorough analysis of the incidents, it was used in this study to analyze falls that caused harm and medication errors with potential to cause harm, that is, that involved the administration of potentially dangerous drugs (PDD) and anti-infective agents.

The root cause analysis analyzes incidents in a reactive manner and can introduce actions that reduce them. It is a systematic process in which the factors that contribute to the occurrence of an incident are identified by means of reconstruction of this logic sequence and the question

“why” is asked until the underlying causes have been found.<sup>(3,7)</sup>

After the identification of incidents by means of voluntary reports and notification, it is necessary to set up a root cause analysis team, which is multidisciplinary, in order to contribute with different points of view about the analyzed incident and to identify different causal factors. Also, a person with knowledge of this analysis is essential, so they can act as a facilitator.

This analysis favors the assessment of the studied system, the identification of errors in the processes and the conclusion that systemic failures are often prevalent in health institutions when compared to individual failures. Furthermore, the root cause analysis allows investigating any kind of incident related to health care and that is why it was chosen for this study.

Hence, we made an adjustment of the methodologies of root cause analysis proposed by Taylor-Adams and Charles Vincent, in the London Protocol, by Seeking Out the Underlying Root Causes of Events (SOURCE) and by Andersen and Fagerhaugh, to analyze the falls and medication errors that caused harm or had potential to do so.<sup>(8)</sup>

The objectives of this study were to identify fall incidents and medication errors reported in a general private hospital and introduce the causal factors categories of these incidents.

## Methods

A cross-sectional and exploratory study was carried out between January and March of 2012, in which the nature of incidents related to patient safety were investigated, as well as the way they manifest and other possible factors such as their cause, rather than the simple observation and description.

The study was carried out in a private general hospital, located in the countryside of the state of São Paulo, southern Brazil. This hospital is certified by the Commitment to Hospital Quality Program, which fosters self-assessment and includes an educational component that encourages changes of attitude and behavior.

The hospital had a total of 158 beds and, in March 2011, the electronic prescription was implemented in the adult, cardiac and pediatric ICUs.

Drug distribution was performed through individual doses, by five pharmacists in the whole institution.

The nursing staff was composed of nursing technicians and nurses. There were forms for notification of incidents related to patient safety, identified by the nursing staff.

The studied universe was composed by 62 incidents related to patient safety, out of which 11 were falls and 51 were medication errors that were reported in 44 forms filled out by the nursing staff.

Out of these, five falls and 14 medication errors that might have caused harm or had potential to do so were identified and submitted to the root cause analysis.

The research instrument was created in order to collect data from notification forms and patients' medical records. To validate the content, the instrument was submitted to five experts, all of them nursing masters or PhDs with knowledge of the quality and patient safety topics.

For data collection, notification forms that are kept by the coordinators of each area were used, and these data, as well as those contained in the medical records, were transcribed into the data collection instrument, by three auditors.

The researcher identified the incidents related to patient safety that caused harm, regarding falls, or that presented potential risks in the case of medication errors, and submitted them to the root cause analysis methodology.

Hence, five falls that caused harm to patients and 14 medication errors related to potentially dangerous drugs and anti-infective agents were selected for analysis.

Two root cause analysis teams were set up, one to analyze falls and the other to analyze medication errors, and a total of ten meetings were held.

The team for root cause analysis of falls was made up of two treating nurses, two coordinating nurses, a nurse from the hospital infection control service, and a pharmacist.

The other root cause analysis team was made up of two attending nurses, two coordinating

nurses, a nurse from the hospital infection control service, an auditor nurse, and a pharmacist. In this team, the auditor nurse and one of the attending nurses attended only the first meeting, due to their activities within the institution or because of holiday periods.

Medical professionals were invited to participate in the study but they stated that, due to their work routine, they would not be able to attend the meetings.

The development of the study complied with national and international ethical guidelines for studies involving human beings.

## Results

A total of 62 incidents related to falls and medication errors were reported between January and March of 2012 in the aforementioned institution, where 11 (17.7%) were falls and 51 (82.3%) were medication errors.

Out of these incidents, nine (17.7%) occurred in January, 15 (33.9%) in February and 27 (48.4%) in March. Most medication errors (43.5%) occurred in March, whereas most falls (9.7%) happened in February.

Regarding the period of occurrence, eight incidents (12.9%) occurred during the morning, 22 (35.5%) in the afternoon and 29 (46.8%) during the evening. For three incidents related to medication errors (4.8%), it was not possible to identify the period of occurrence, as the notification form did not contain this piece of information and there was no report of the incident in the patient's medical record.

Most incidents (42, or 67.8%) occurred in the hospitalization ward, followed by the maternity ward (10, or 16.1%), neonatal ICU (4, or 6.5%), cardiac ICU (1, or 1.6%), and no incidents were reported in the pediatric ICU.

Regarding falls, most of them were from own height (5, or 45.5%), followed by bed height (3, 27.3%), toilet (2, or 18.2%) and rest chair (1, or 9%).

Regarding medication errors, a total of 51 incidents related to drug administration were identified

in 33 notification forms, where 54 types of error occurred.

In that sense, omission errors (17, or 31.5%), timing errors (12, or 22.2%), administration technique errors (8, or 14.8%), extra doses errors (4, or 7.4%), non-authorized drug errors (4, or 7.4%) and route of administration errors (1, or 1.9%) were reported.

After the identification of patients, the five falls that caused harm to patients were submitted to root cause analysis.

Therefore, there was a total of 35 causal factors, out of which nine (25.7%) were related to the 'patient' category, eight (22.9%) to the 'team' category, six (17.1%) to the 'environment' category, five (14.3%) to the 'task' category, four (11.4%) to the 'individual' category and three (8.6%) to the 'management' category, as shown in table 1.

**Table 1.** Categories of causal factors related to falls

Categories of causal factors	Causal factors	n(%)
Patient	Medical diagnosis and symptoms such as dizziness, history of falls, low or advanced age (5 years-old or under, and 60 years-old or over), immediate post-operative, anesthesia effect, non-compliance with guidance.	9(25.7)
Team	Verbal communication failure in the nursing staff to inform about the previous fall; Verbal communication failure between the nursing staff and the reception regarding the release of beds; Verbal communication failure between the nursing staff and the patient with risk of falling; Lack of preventive care notes about falls in the nursing prescription. Bad supervision of staff to assess the risk of falling and the type of bed/cradle that presented greater risk for the patient.	8(22.9)
Environment	High bed, small number of cradles, absence of a bell next to the bedside table, time close to change of shift, time of greater work demand.	6(17.1)
Task	Absence of protocol for prevention of falls.	5(14.3)
Individual	Leaving the bars lowered and place pads between bars; inexperience; lack of examination of patients in the immediate post-operative period by the nurse at admission.	4(11.4)
Management	Small number of professionals	3(8.6)
Total		35(100)



Likewise, the root cause analysis team analyzed 14 medication errors with potential to cause harm and identified a total of 83 causal factors. As for the categories of causal factors related to medication errors, 27 (32.6%) were related to management, 18 (21.7%) to the individual, 16 (19.3%) to the team, 10 (12%) to the environment, eight (9.6%) to the task, and four (4.8%) to the patient. Table 2 shows this distribution.

**Table 2.** Causes of medication errors regarding the causal factors categories

Causal factors categories	Causes	n(%)
Management	Absence of a safety committee for the patient, absence of electronic prescription in the service, absence of a predetermined schedule for drug prescription, policy for an increased hiring of nurses and pharmacists, small number of nursing and pharmacy professionals, lack of training of professionals about the topic.	27(32.6)
Individual	Professionals' lack of attention, no check of any of the "five rights" or the identification bracelet, professionals' lack of knowledge of the protocol, dispensation without following the pharmacy protocol, preparation and administration of drugs by the professional to several patients at the same time, no observation of the drugs infused to the patient at the beginning of the shift.	18(21.7)
Team	Bad or no supervision by the nurse and pharmacist and inadequate search for help by nursing and pharmacy technicians, lack of congruency among the members of nursing staff, illegibility of the medical prescription, inadequate communication between physician and nurses and between members of the nursing staff.	16(19.3)
Environment	Excessive workload, inadequate combination of skills between pharmacy and nursing, absence of a strategic place to store current prescriptions in the services, interruptions.	10(12.0)
Task	Absence of protocol in the drug administration that focuses on the patient's safety, absence of control of the number of prescriptions per patient.	8(9.6)
Patient	Complexity and severity of the patient.	4(4.8)
Total		83(100)

After the identification of the causal factors and by adopting the best practices, the root cause analysis teams identified the recommendations in order to avoid these incidents within the institution.

## Discussion

This study has limitations due to the method adopted, that is, a cross-sectional study with a retrospective analysis of data that does not establish cause and effect relations, which instead identifies patients and allows the understanding of the occurrences.<sup>(9)</sup>

The root cause analysis method allows achieving a deep analysis of the incidents that occur, by identifying the different causes that contributed to a specific incident, and to suggest ways to prevent recurrence, which partly overcomes these limitations.

The nursing staff is part of this context, where medication errors and falls occur, and in Brazil, the cause for incidents related to patient safety very often falls upon this staff, although it is known that, in addition to individual failures, badly made processes and other failures such as environmental or structural ones also contribute to it.

Only after the investigation and analysis of incidents, recommendations can be implemented in order to ensure a safe, risk-free working environment and based on best practices, which will consequently result in improvements of care given to patients, including nursing care.

Nevertheless, the fact is that incidents must be reported, notified and analyzed, not only by the nursing staff, but by the whole multidisciplinary staff, so as to find the causes for these problems.

In this study, a greater number of notifications was found regarding medication errors (51, or 82.3%) when comparing to falls (11, or 17.7%) occurred within the institution.

A study that analyzed the report of incidents related to patient safety reported in the American health system showed that 9% of patients had at least a reported incident, of which 29% were medication errors and 14% were falls.<sup>(10)</sup>

In contrast, a Brazilian study identified 229 incidents related to patient safety in a hospital, where 57.6% were related to the removal of the nasogastric tube, 16.6% to falls and 14.8% to drug administration errors.<sup>(11)</sup>

Thus, both the results of this study and the literature had a higher incidence of medication errors than falls, due to the high number of drugs prescribed and administered on a daily basis to hospitalized patients.

Most incidents related to falls and medication errors occurred in the hospitalization wards (42, or 67.8%), as this service has a greater number of beds than other assessed services. Also, there was no notification of this type of incident in the pediatric ICU during that period of three months.

Managers and administrators must encourage professionals to report the occurrence of incidents related to patient safety by focusing on the safety culture rather than focusing on punishment, as fear of punishment often results in the absence of notification of incidents.

The success of a notification system depends on the break of some taboos associated with it, so cultural changes must be implemented in order to make notifications a voluntary action.

Regarding the type of fall, most were from own height (5, or 45.5%) and from bed (3, or 27.3%) and they occurred mainly when the patient tried to leave the bed or when they left it for physiological reasons.

Hospitalized patients are often more fragile and need help from the nursing staff when they have to complete daily routine tasks such as getting out of bed or bathing.

That is why health institutions, along with their nursing staff, must focus on their participation in these activities and give appropriate guidance on the risks the patient might run, such as falls, and for that, it is necessary to have an adequate quantity of nursing professionals to meet this demand, who should be properly trained to prevent these falls.

In the study, 54 types of medication errors were found, and most of them were omission errors (17, or 31.5%), timing errors (12, or 22.2%), administration technique errors (8, or 14.8%), and dosage errors (8, or 14.8%).

An American study that evaluated an error notification system found that 631 errors were report-

ed, where omission errors (32%) and dosage errors (21%) were the most common.<sup>(12)</sup>

In contrast, a Brazilian study found that dosage errors (24.3%) and timing errors (22.9%) happened more frequently in a teaching hospital.<sup>(13)</sup>

In our study, the causes were categorized according to causal factors and by applying the root cause analysis methodology. Therefore, regarding falls and medication errors, most causal factors found were systemic failures, followed by individual and patient's failures, confirming that incidents occur mainly because of systemic failures rather than individual ones.

The psychologist Reason suggests two ways to approach the incident: the individual approach and the systemic approach. The first includes the individual unsafe acts from first line professionals, which are mistakes and violation of procedures, starting from a non-standard mental process such as: forgetfulness, lack of attention, carelessness, poor motivation, negligence and imprudence. The second considers that incidents occur due to a badly shaped system.

In this system, active failures and latent failures lead to the occurrence of incidents. Active failures are those that occur in the front line, and their effects are noticeable almost immediately; their forms are oversights, slippages and failures in the process. Latent failures remain "asleep" in this system and are related to organizational influences, unsafe supervision and predisposition to unsafe acts.<sup>(14)</sup>

Another important aspect of the study was the finding that a great part of causal factors of falls was affected by the absence of protocol of fall prevention within the studied institution.

The institutional protocol oriented towards fall prevention has a key role in health institutions, in order to avoid incidents related to patient safety. From the moment it is created, focusing on best practices, a risk assessment scale is added to the patient's evaluation, on a daily basis, in order to identify the risk, and adequate preventive measures can be taken by the members of the health staff.<sup>(15)</sup>

To implement the protocol, a program must be created in order to do it efficiently, seeking the decrease of falls in the institution, and this program must be evaluated periodically so as to find out whether it is being performed adequately.<sup>(15)</sup>

Regarding the causal factors of medication errors, several factors affected the occurrences, like the absence of a patient safety committee, electronic prescription available only in a few services, individual failures, among others.

When medication errors occur, multifactorial causes in a badly shaped system affect their occurrence, as well as manual prescriptions, lack of bar codes, stress, fatigue, lack of attention and lack of ability.<sup>(16,17)</sup>

Currently, it is recommended that health institutions organize a patient safety committee, as it is essential for the development of a safety culture where the main focus is not to punish when an incident is detected, and to promote the implementation of recommendations oriented toward best practices, in order to contribute to patient safety and to consequently reduce the number of accidents related to that.

In that sense, institutions must focus on this safety culture, to encourage the involvement of professionals into patient safety, aiming to identify, notify and analyze incidents, and consequently improve the quality of care.

## Conclusion

The application of the root cause analysis methodology allowed to find the causes and categorize them according to causal factors. Therefore, most causal factors found regarding falls and medication errors were systemic failures, followed by individual and patient's failures, confirming that incidents occur mainly because of systemic failures rather than individual ones.

## Collaboration

Teixeira TCA contributed to the conception of the project, to the execution of the research, the writing of the article and the final approval of

the version, and Cassiani SHB contributed to the conception of the study and to the critical review of the content.

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