

Diagnosis and identification of key issues of usability for reducing medication errors

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Abstract

At a unit of a hospital in the Brazilian city of Florianópolis, from the diagnosis to the administration of medicines in the inpatient, usability problems like errors were detected in the flow of medication as well as problems of greater severity. This paper aims to perform a diagnosis of usability in the inpatient unit of a teaching hospital in Florianópolis in order to identify the main problems in the flow of medication. As a method, the authors used literature review, field visits, assessments of usability principles and determination of the severity of the problems found. The step of lowest usability was the preparation, followed by the steps of dispensation, administration and prescription. As for severity, the similarity of names, colors and shapes of packages of drugs was identified as the most problematic. Beside the problems that involves the health care professionals, the hospital has problems like the environment and the products, like the packaging of medications. The usability diagnosis can help find ways to make the flow of medication more efficient and safe.

Keywords: design, usability, medication errors.

Introduction

Health access in Brazil is guaranteed by SUS (Single Health System), a system that is unique in the world, allowing integral access to the health to the entire population. This system has transformed Brazil in the country with greater free health services. However, a system of this magnitude also face some difficulties (Brasil, 2009, 2011).

The health system currently faces numerous problems such as the devaluation of health workers, the significant deterioration of labor relations, low investment in ongoing training, limited participation in the management of services and fragile links with users (Costa, 2004; Pasche, 2010). According to Pasche (2010), these problems generate many phenomena of dehumanization such as unnecessary queues; neglect and carelessness with people, inability to cope with life stories (singular and complex) and misplaced ethical practices (discrimination, intimidation, subjection to unnecessary procedures and practices, illegal collection, exclusion and abandonment).

Moreover, in this context, there is the problem of error within the health system, also known as adverse events or iatrogenesis, which results in physical and psychological harm to all involved. Recent studies indicate that the number of fatal cases resulting from errors in medication administration in hospitals is alarming (Seitz, 2013; Mansoa, 2010; Nascimento and Travassos, 2010; Gonçalves, 2009). For Reason (1990), the management of errors requires a variety of measures aimed at different levels of a system: its actors (individually), the team, the task, the environment and the organization as a whole.

According to the report by the Institute of Medicine (IOM) published in 1999, it was estimated that 44,000 to 98,000 American die each year victims of errors in health care. These figures provided visibility to the problem and since then this is the focus of studies in various areas of knowledge (Seitz, 2013). In the view of Werner *et al.* (2012), it is important to develop and apply new ways of reducing medication errors because of the high cost to the healthcare system and mainly for the patient's well-being and safety¹.

¹ According to World Health Organization, patient safety is the absence of adverse and avoidable events during the healthcare process (WHO, 2016).

This scenario has as one of the causes the complexity of interrelationships existing in a hospital system, which involves numerous health professionals, patients specifics and their interaction and communication with their families and caregivers. This complexity of interrelations requires a range of solutions and integrated systems that act as allies in the humanization of the services provided in the hospital setting (Skrabe, 2010). In this context, usability and ergonomics are considered a rich source of concepts and methods that enable the design or correction harmoniously with the health system (Reid *et al.*, 2005; Seranheira *et al.*, 2010).

From this context, of the complexity of relationships and interrelationships experienced in everyday hospital network, it is observed that the need for professionals to find solutions that depart from a holistic, dynamic and multidisciplinary view. As Lucio and Paschoarelli (2007) argue, the integration between the various fields of knowledge such as accessibility, anthropometry, ergonomic design, universal design, ergonomics and usability corroborate the use of more suitable solutions to the real needs of users, allowing to contemplate the different potentials, which would not be adequately addressed under a single view.

Upon this issue is that this research is developed, which took as its starting point the realization of a first visit to the inpatient unit of a teaching hospital in Florianópolis, in which was observed the complexity existing in the flow of medication, standing out as a relevant area for this study. Thus, the general objective of this paper is to perform a diagnosis of usability in the inpatient unit of a teaching hospital in Florianópolis, in order to identify the main problems in the flow of medication to eliminate or minimize errors in this process. Here the flow of medication is understood as the route traveled from prescription to administration to the patient.

Materials and methods

This research is characterized as basic in its nature because it has no practical application envisaged, and exploratory about its goals, as these target a closer proximity to the topic in order to make a diagnosis of the phenomenon (Prodanov and Freitas, 2013). As for its approach, this ranks as qualitative because the surveys will constitute subjective data, starting from an analysis of the researcher on the information collected, and will not be translated into numbers nor will be measurable, and the data are analyzed inductively (Silva and Menezes, 2005). Thus, the research is divided into four steps: knowing, observing, diagnosing and identifying (Figure 1).

The step 'knowing' covers the literature as to the themes: service design, usability, errors in the hospital setting and errors in medication flow. In the following step, 'observing', two field visits to the inpatient unit and Pharmacy of a teaching hospital in Florianópolis were held, whereupon unsystematic observations were made in order to understand the functioning and interrelationships existing in the flow of medication. For reasons of confidentiality and constraint, was employed a non-empirical method on the visits, conducting just user observations without their direct involvement (non-participant observation). The first visit was guided by the chief nurse of the hospital that showed all steps of the medication. The second visit aimed to know the medication journey, since the prescription to the medication administration. At the end of the stage it was possible to define who is the user of this system, which activities they perform and the context in which these activities are conducted.

In the step 'diagnosing', based on the previous observation made, were mapped the steps, actions, artifacts and physical environments involved in the logistics of the drugs. In addition, there was the study of the causes of errors in each step, defined through consultation of the literature and analysis of observations made in the field visits. Finally, the usability principles proposed by Jordan (1998) were applied to assess the relationship of the users (health professionals) with the activities performed along the flow of medication.

In the last step, 'identifying', an assessment of the severity of usability problems identified were the diagnosis took place. For Liljegren (2006), the severity of the usability problems is a combination of three factors: frequency (number of times the problem arises in usability assessment), impact (ease with which the user has to overcome this problem) and persistence (how long the user would bear the recurrence of the error). According to the author, the frequency analysis can take place by counting the number of times that the problem appears in the description of the usability analysis. As for the impact and persistence factors, generally they are not assessed, unless the analysis is performed in order to cover those parts of the task. Thus, for this study, was used only the frequency analysis. Through this procedure it was possible to identify the critical points of usability in the flow of medication in question.

This research consists of a multidisciplinary team and is part of a larger project called 'Human error in health: the case with high-alert intravenously medications', according to the criteria approved by the Ethics Committee for Research in Humans of the Federal university of Santa Catarina in October 2013 under number 20248813.8.0000.0121.

Knowing	Observing	Diagnosing	Identifying
Bibliographic search -Error in hospital environment; -Medication errors; -Design and usability.	- Observe the users activities and context.	To map -The steps of the medication; -The causes of errors in each step. To assess -Usability in the flow of medications.	-The severity of the usability problems; -Frequency of occurrence of the usability problems

Figure 1. Research method divided in four stages: knowing, observing, diagnosing and identifying.

Knowing errors in the hospital environment and in medications

An error is commonly understood as the occurrence deviated from the standard set, i.e., the activity as described was not successful for some reason, and has not reached its goal (Pedrassani, 2000; Reason, 1990). According to Jordan (1998), errors can be categorized in various ways, considering the causes and severity. The most basic division is between lapse and mistake. The error occurs when the user knows how to perform the task, but accidentally something wrong occurs during the task execution. As for the error, it occurs when the user has the wrong knowledge of the task execution and therefore makes mistakes.

For Leape *et al.* (1995), the lapse occurs when related to automatic mental dynamics and is caused by fatigue, anxiety, noise, or other factors that distract the individual's attention. The error, in turn, results from processes developed from problem solving, but there may be a lack of knowledge (knowledge-based deception) or misinterpretation of the problem to be solved (rule-based mistake).

According to Sell (2002), increasing the risk of error is associated with the occurrence of variation in behavior beyond what is acceptable for a given task; therefore, when the limits of this range are exceeded, the risk of accidents is increased. This change in behavior, in turn, is caused by internal (environmental) and external (individual) factors, as elucidated in Table 1.

Thus, the error is associated not only to human cognitive processes but also environmental and ergonomic aspects. Thus, the error can be analyzed from two points of view, the system and the people. When centered in the system, it is believed that the people fail due to errors in the process, this being a consequence and not the cause. Thus, when the error occurs, no matter who made it but what caused or induced them to make it. When people-centered, the error is related to inattention, lack of motivation, negligence or recklessness, focusing on measures to control human behavior and moral attitudes (Reason, 2000).

De Keyser (2005) corroborates this view, which highlights the increasing incidence of human error in today's modern systems, based on continuous processes, exhibiting characteristics of complex systems with many variables that interact and evolve rapidly in time. The hospital environment, because it is a complex system of information and inter-relationships, becomes a breeding place of the occurrence of errors, both of systems and of people. "In complex systems, a component of the system interacts with other multiple components that often oc-

cur unexpectedly or invisibly" (Kohn *et al.*, 2000). Despite the need to consider ways to combat error, according to Edmondson (2013), this is unusual because of the discomfort and emotional constraints by whom is analyzed; moreover, organizations wishing to analyze such failures must be open to questions, have patience and accept the causal ambiguities. What follows is the study of errors that turn out not to provide an accurate diagnosis of the situation, being held in a limited way, and unfaithful to reality (Edmondson, 2013).

Thus, it is possible to understand that the error, both in health as in other areas, is mainly related to the proper configuration of their systems; therefore, a study in order to understand these interrelationships will allow minimization of errors in the health system. According to Kohn *et al.* (2000), preventing errors and improving safety for patients require a systems approach in order to change the conditions that contribute to errors. So the issue is not that people are bad but that the system needs to be safer. The Joint Commission believes that Hospitals are complex environments that depend on strong leadership to support an integrated patient safety system, that need to work together with staffs and leaders to "eliminate complacency, promote collective mindfulness, treat each other with respect and compassion, and learn from their patient safety events, including close calls and other system failures that have not yet led to patient harm" (Joint Commission, 2016, p. 2).

Regarding medication, the incidence of errors can generate prolonged hospitalization, increased costs of hospitalization, need for additional treatments, exams and extra procedures, as well as pain, suffering, consequences and death. Moreover, they can affect not only the patient but also the hospital organization, tarnishing its image, generating mistrust and increased costs, and health professionals, who have administrative (layoffs) and psychological (guilt) consequences (Kohn *et al.*, 2000).

According to the National Coordinating Council for Medication Error Reporting and Prevention (NCCMERP), errors in medication are a preventable event that may cause or lead to inappropriate medication administration and patient injury, which may be related to professional practice, to health products, procedures, systems, prescription, communication, product labeling, packaging, dispensation, distribution, monitoring, use, among others (NCCMERP, 2013). Werner *et al.* (2012), explain that medication errors occurs during any part of the medication process. It can starts with the prescription, goes through the person who transcribes, dispenses and administers the medication.

Table 1. Internal and external factors responsible for variation in human behavior.

Factors	Internal	External
Causes of errors	Insufficient or unnecessary possibilities for action; wrong, conflicting or incomplete information or instructions; difficulties to receive information (poor lighting, high noise level, noise); misinterpretation of information received, among others.	Lack of knowledge, lack of training; lack of skills; fatigue by requiring too much; monotony by requiring less; lack of motivation; among others.

Source: adapted from Sell (2002).

Moura and Magalhães (2013) argue that from the assessment of the causes of errors in drug administration, it is possible to prevent and avoid such occurrences, considering the human and structural factors involved in the process in order to implement barriers (solutions) that reduce risks and ensure greater security for patients. Despite the evident importance of diagnosing the causes of errors and correct them, it happens that, due to shame, fear and punishment, these are hidden. This, according to Rosa and Perini (2003), is due to an individualistic approach, which considers the errors unsafe acts committed by careless, unprepared and unmotivated people. Ideally, there would be a systemic approach including improving the system where safety barriers are created and the characteristics, human capabilities and limitations are taken into account for its construction (Rosa and Perini, 2003; Edmondson, 2013).

Design and usability within hospitals

As already explained, the hospital environment comprises a complex network of interrelationships. The complexity, according to De Mores (2010), is characterized by recurring interrelation of information in abundance; if these are available in a disconnected way, they can generate many problems; thus, the complexity tends to create unpredictable and contradictory tensions, which require continuous adjustments and reorganizations of the system to establish a new order. The author also points out that rather than wait for the consolidation of a complex scenario, one should always be prepared for these changes, being ready to interpret, anticipate or even propose new scenarios.

According to the definition of the International Council of Societies of Industrial Design (ICSID, 2013), the design is a creative activity whose purpose is to establish the multi-faceted qualities throughout the life cycle of a product, its processes, services and systems. De Moraes (2010) points out that the design, as an activity capable of interacting transversely with disciplines that are less and less objective and exact, beginning to relate to others in the course of human behavior, the sensations and psychological factors, taking into account the values of esteem, perceived quality and user experience, is able to act dynamically in these complex and fluid scenarios. As one of the fields that can act in conjunction with the design, the usability is highlighted here.

Usability, according to ISO 9241 (ABNT, 2011), can be measured, specified and assessed according to the user's satisfaction and performance with regard to the product as to its effectiveness, efficiency and satisfaction. According to Jordan (1998), usability can be understood as the ease of use of a product and, for Moraes (2001), usability is about product-task suitability, involving the user who will use the product, the context and environment of use. In this sense, usability, according to Nielsen (1993), includes all aspects of a system with which the user can interact, through which the author identified five attributes: ease of learning, efficiency, ease of memorization, low error rate and satisfaction. In addition to the system being easy to learn and use, the author also argues that in some cases it is possible to train the user in the correct use of the product or service.

Jordan (1998) defined ten principles for assessing usability:

- (i) Consistency: designing for the user to perform similar tasks in similar ways;
- (ii) Compatibility: the operation of the product should be compatible with the user's expectations and experiences;
- (iii) Capacity: designing respecting the capabilities and limitations of the user, so that they are not deleted nor neglected;
- (iv) Feedback: the user should receive response information when performing an action;
- (v) Prevention and correction of errors: designing to minimize the chances of errors and allow the user to correct any errors quickly and easily;
- (vi) User control: the user must have the maximum possible control over their actions and may modify and adapt as needed;
- (vii) Visual clarity: the information should be provided in a clear and objective manner, without causing confusion or misinterpretation. Functioning and operation of the action must be explicit to the user;
- (viii) Prioritization of the function and information: actions must be executed easily and affordably, prioritizing the most important functions;
- (ix) Appropriate technology transfer: make use of technologies developed in other areas to benefit and improve the user's actions;
- (x) Evidence: the user must clearly understand how to use and operate the actions.

Each principle must be analyzed from the point of view of the relationship between the user and the system analyzed. Considering the context of use, the products that surround it and the user that uses it. According to Jordan (1998), besides the commercial implications acting on productivity and service quality, usability also contributes to user's satisfaction and safety. Therefore, to ensure user's safety in performing tasks protects their life, as well as other people's.

With regard to the assessment methods of usability, this can be by empirical means (user's participation) or non-empirical (without user's participation). Most methods involve user's participation, since nothing replaces the analysis from the user's experience with the system or product. However, in some cases, when there is a need for confidentiality and difficulties in finding the appropriate participants, the empirical methods cannot be used (Jordan, 1998).

According to Silva (2008), the achievement of a consistent usability assessment in a hospital setting needs to use a set of assessment techniques, because there is no one who can point out all the problems in the system or product. According to Lijegren (2006), the assessment of usability should consist of three steps: finding the problems, determining the severity and proposing solutions. Thus, with planning and selection of the appropriate assessment methods, analysis of usability in products and systems can facilitate learning, memorization, reduce the incidence of errors and be efficient and suitable for the user (Nielsen, 1993).

Results

The hospital visited is located in Florianópolis and has been operating since 1980. Its structure consists of four basic areas (medical, surgical, pediatric and obstetrics and gynecology clinics), besides the 24-hour service, which serves daily an average of 400 patients.

The field research conducted in the premises of this hospital covered the inpatient units, both surgical and medical. In both units, the medication flow is the same. Each unit accommodates the number of 30 beds distributed in 15 rooms with 2 beds each. The number of professionals per unit is around 6, being 4 nursing technicians, 1 day shift and 1 night shift nurses. Therefore, each nurse technician responsible for the administration of medication serves an average of 7 patients per day.

Flow of medication in the inpatient unit

The field observation adhered to the flow of medication of the inpatient unit, where were observed in an unsystematic way: the route of the drug since its prescription to the administration of the same patient; objects and environments participating in this logistics; interactions between professionals during the process and methods of communication and flow control of medication. Thus, it was possible to understand the ways that the drug runs, the ones involved in the process, the necessary objects

and the quality of the information that goes through all the steps.

The logistics of medication begins with the prescription by the doctor in the Nursing Station; from this requirement a copy is placed in plastic bags identified with the room number and the patient's bed. Therefore, when all the plastic bags are gathered (according to number of beds occupied in the unit) with their respective prescriptions within, the unit sends the basket containing these bags to the pharmacy, which are stored in a bin. In the pharmacy, the nurse removes the basket from the bin and checks each prescription regarding the drug name, dosage and its method of administration (oral, intravenous, topical, among others). After this verification, the unit basket is routed to the Dispensation Room, where the dispenser performs the reading of the prescription and the separation of the corresponding drugs, placing them inside the plastic bag regarding the room and bed of the prescription.

The basket remains in the pharmacy for the average period of two hours until the moment that the clerk of the unit searches the basket in the pharmacy. Before taking it to the unit, the clerk performs the reading of the prescription and checks with the drug present in the plastic bag. Only after this reading the clerk takes the basket to the unit, removes the prescriptions from the plastic bags and organizes on a clipboard that is left in the counter in the Medication Room. The medicaments

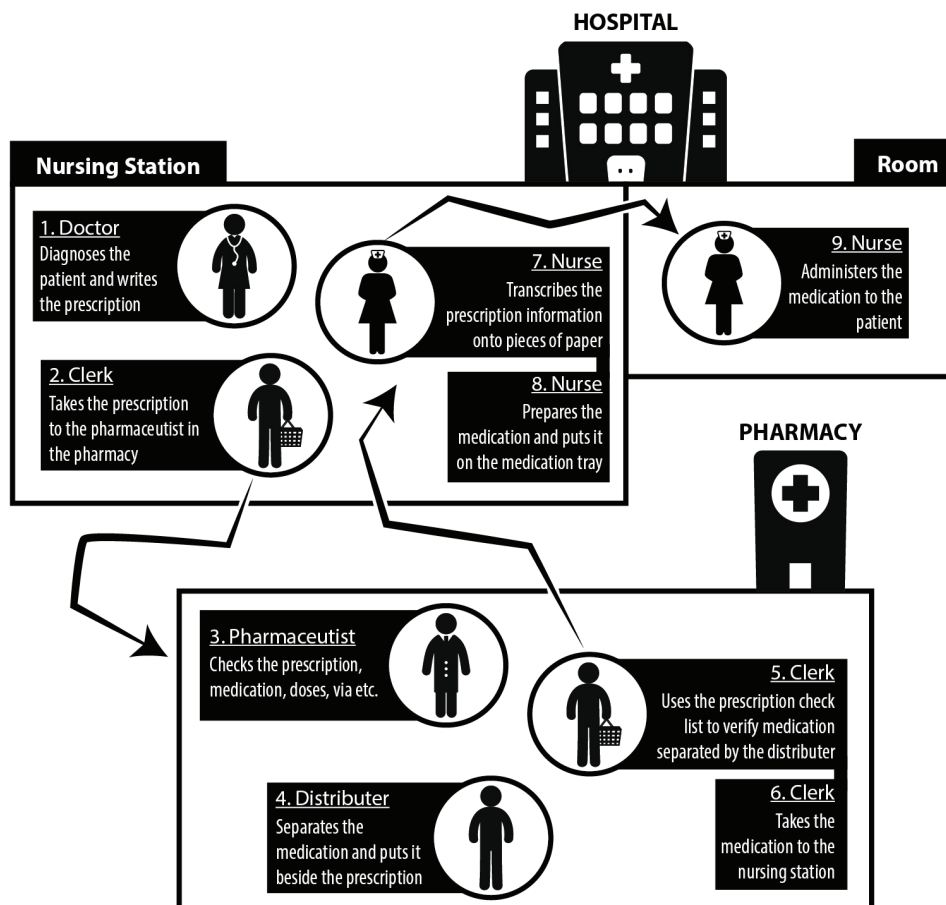


Figure 2. Flow of medication from the hospital visited.

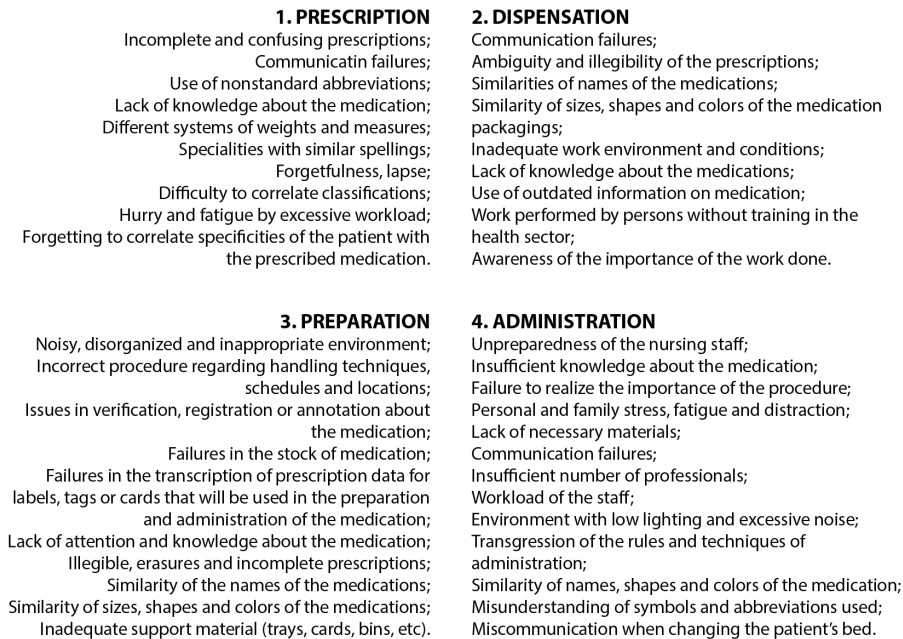


Figure 3. Causes of errors in the four stages in the flow of medication: Prescription, dispensation, preparation and administration.

of the plastic bags are stored in bins corresponding to the patient's room and bedside.

When the nursing technician arrives for their shift, they grab the prescriptions relating to their patients in the clipboard and transfers this information to scraps of paper. This information is called five certainties: patient's name (i), patient's room and bed (ii), drug name (iii), dosage and method of taking (iv), and the time of administration of the medication to the patient (v). When approaching the time of drug administration, the nursing technician prepares and organizes them into a tray of medicines regarding their patients.

At this time, the nursing technician must perform three readings, which are: verify the drug name when removing from the bin, verify the drug name while preparing (removing the dragee from the packaging, for example) and verify the name of the drug when the package is discarded. In the tray organized according to the three readings, medications are placed side by side, positioning below each drug group the scrap of paper with the five certainties, where is found the patient's information taken from the prescription. At the moment of the administration, the nursing technician carries the tray to the patient's bed and before the administration compares the patient's data in the headboard with the information present in the scrap of paper. The drug is then administered to the patient, completing the flow of medication. Figure 2 shows a graph representation of the flow of medication described.

Therefore, the flow of medication comprises a complex process, fraught of inter-relationships among professionals, where one depends on the other's well done job. This systemic view revalidates the issue of the error being associated with problems in the system, which lead the professional to make the mistake. According to Reason (2000), the analyzes and solutions are from the point of view of the system and not the people. Thus, based on

the mappings shown, it will be possible to perform the analysis of usability of the system which involves the flow of drugs.

Diagnosing usability analysis in the flow of medication

The flow of medication can be divided into four major phases: prescription, dispensation, preparation and administration. Each step contains errors and specific causes. In Figure 3 there is the description of the causes of errors in the four stages in the flow of medication. These causes were taken from the literature (Silva, 2008; Anacleto *et al.*, 2005; Miasso *et al.*, 2006; Fuqua and Stevens, 1988) and the analysis of the observation of the field visit.

As seen in the figure, the problems are numerous, ranging from environmental issues (space, temperature, light, etc.), but also human issues (fatigue, stress, lack of attention), organizational (lack of training, materials, motivation) and communication (illegibility, misunderstanding of symbols and abbreviations, etc). With the survey performed, it was possible to observe that in all stages of the flow of medication errors may occur, even though these may occur more in one step than in others.

According to Miasso *et al.* (2006), 39% of medication errors occur in prescription, 12% in transcription, 11% in dispensation and the remaining 38% in the preparation and administration of medications. In the flow of medication of the teaching hospital, the transcription step does not take place anymore due to the copy of the prescription being taken at the same time of the prescription using a carbon paper between the pages. Therefore, the action of transcription was removed from the process, assisting in reducing errors in this step. Mathaiyan *et al.* (2016) carried out a study in an Oncology hospital and detected that errors occur more frequently in stages of prescription

(54.8%), followed by transcription (24.5%) and administration (20.7%). Ruiz *et al.* (2016), identified in a neonatal unit that the most commonly reported errors occur in the administration (68.1%) and in the prescription (39.5%).

From the knowledge of the causes of errors present in each step were applied usability principles in each one in order to identify usability difficulties in the medication system by users (doctor, pharmacist, dispensed, clerk and nursing technicians). Thus, each step was analyzed for the ten principles of Jordan (1998): consistency, compatibility, capacity, feedback, error prevention and correction, user control, visual clarity, functionality and prioritization of information, adequate transfer of technology and evidence. In Figure 4 shows the assessment performed, where each principle was examined based on usability principles, identifying the requirements that the step meets, partially meets and that does not meet.

Figure 4 shows the four steps of the flow of medication showed poor usability in the development of the tasks. Being the steps of dispensation, preparation and administration the most critical.

Feedback and correction and prevention of errors

The principles of feedback, correction and prevention of errors were not met in any step of the flow of medication because the system does not have any means to alert the user about errors. These often happen but are identified only at the end of the process when the drug has been administered to the patient and has damaged this one. Thus, as the system does not report the occurrence of an error or unsafe act, the detection and correction must come from the professional. In the case of the dispensation step, the verification of the prescription is held by pharmacist that stays in the pharmacy, outside the hospital building. Therefore, for the correction of possible error, the pharmacist should go to the hospital and check the prescription with the doctor. Also, another complicating for correcting

errors is the exchange of shifts, i.e., the prescription may have been prepared by a physician who is no longer in the hospital, making the correction time-consuming and even dangerous. In the stages of preparation and administration, the only way to prevent errors are the five certainties and three readings. However, the system does not inform (through an alert or beep) the occurrence of an error. Therefore, its correction should also be from the detection and correction by the professionals themselves, who often hide the occurrence in order to not be penalized. And this, coupled with the lack of knowledge about drugs and lag regarding the information of the drugs identified as causes of errors in these steps, hardly the professional can detect and fix errors of this nature.

Capacity

The third principle with the worst rating concerned the capacity, which in the prescription stage is partially met and in the other stages is not satisfied. In the prescription, as it is an activity that involves only one professional, the doctor, it presents no major problems. Regarding the dispensation step, there is the presence of professionals who are not in the health sector and often are not familiar with the drugs, abbreviations and measures agreed by the area. Thus, the activity exceeds the capacity of these professionals, making the verification of the prescription an act executed only once and by the pharmacist. In the stages of preparation and administration, it occurs in some cases that the professional is outdated regarding information about the medication (adverse reactions, for example), being unable to assess or decide for the suspension of any medication due to sudden changes in the patient's situation (presence of fever, high blood pressure, etc.).

Consistency and Compatibility

As for the principles of consistency and compatibility, in the prescription was assessed that the step meets them,

	Prescription	Dispensation	Preparation	Administration
Consistency	■	□	□	■
Compatibility	■	□	□	□
Capacity	■	□	□	□
Feedback	□	□	□	□
Prevention and correction of errors	□	□	□	□
User control	■	■	■	■
Visual clarity	■	■	□	□
Prioritization of the function and information	■	□	□	□
Appropriate technology transfer	■	□	□	□
Evidence	■	□	□	□
Caption	■ Meets	■ Meets partially	□ Does not meets	

Figure 4. Results of the assessment of usability principles in the flow of medication of the teaching hospital analyzed.

since, as previously mentioned, the prescription is made by a single professional, a doctor, and this one just fills the fields with the patient data and informs about the list of prescription drugs the way they see fit. And it does not present major problems for this professional. But when this prescription is forwarded to the subsequent steps, problems are identified. In the dispensation step, because of the use of nonstandard abbreviations, different systems of weight and measures and the difficulty of correlating classifications, the prescription information turns out to be inconsistent and incompatible with the knowledge and conventions of the other professionals who interact in the process, especially because it involves professionals who are not in the health care sector.

In the preparation stage, in the same way, these principles are not met. The consistency, because of the freedom of each nursing technician able to define their procedures for the annotation of information, is not a standard practice for all professionals. And compatibility due to problems of similarity of shapes, classifications and colors of drugs that make difficult and time-consuming the activity of preparation, for all the time it is necessary to ensure that the professional is preparing the right drug and in the right way (Figure 5). This same problem is also seen in the steps of dispensation and administration. The stage of management still has compatibility issues in terms of the patient's information that should be available on the headboard. However, this does not always occur, making difficult the verification of the five certainties. As for consistency, the step of administering meets the principle, for all technicians should strictly follow the given procedures, being the activities always performed in the same way.

Indications

The problems highlighted in the previous principles (consistency and compatibility), also apply to the principle of evidence, which was assessed as not met in three steps of the medication: dispensation, preparation and administration. The main reason again is the similarity of classifications, colors and forms of the drugs that hinder the immediate recognition of them by the professionals, resulting in confusion and deception (Figure 5).

In the preparation stage, in particular, this principle has an aggravating because of the freedom of choice of the embodiment of the preparation activity by the nursing technicians. Thus there is a lack of evidence of this activity in the workspace (medication room).

Prioritization of the function and information

Regarding the prioritization of the function and information, the most recurrent problem is the way the product information is arranged and displayed on the packaging. This problem directly affects the activities in the stages of dispensation and preparation. Furthermore, the environments where these drugs are stored (dispensation) and kept (prepared) are inappropriate and poorly organized, especially in the preparation stage (Figure 6).

In the administration stage, the use of small scraps of paper with the five certainties is a way to prioritize information and it assists in the preparation and administration process of the medication, even when performed in a very poor way and with little security (Figure 6). Another problem regarding the prioritization of the information in the administration step stems from improper disposal and poor presentation of information from the patient in bed, making it difficult to check the five certainties in the act of the medication.

Inadequate technology transfer

With respect to inadequate technology transfer, although the prescription is electronic, the hospital has not yet implemented the online prescription, which would activate the process and minimize errors due to interference, erasures and wear of the printed prescription. Regarding the stages of preparation and administration, there are already technologies such as reading bar code, which aids in the verification process of the drug at the time of preparation, and the patient with the drug at the time of administration, but this technology is not yet used in the teaching hospital analyzed.

The implementation of electronic prescription, which in this hospital is now held for 15 years, promoted improvements in the aspect of readability, but the font is still pretty small, which can lead to misunderstandings in the steps of dispensation and preparation. Thus, the visual clarity in these steps is jeopardized. Added to this, there are the problems of identifying classifications, shapes, sizes and colors of the medicines due to their similarity in both the dispensation step and the administration. Another problem regarding visual clarity in the administration stage are the drugs taken orally (dragees) that in the preparation stage are removed from their original packaging, and a sticker with the product information is pasted on the back of the medicine, but the font used is very small and difficult to read (Figure 7).

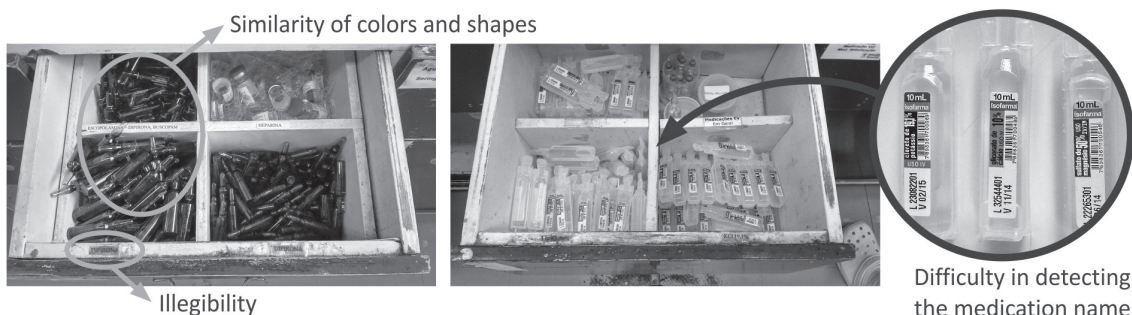


Figure 5. Photographic records of the medicines drawers in the Medication Room.

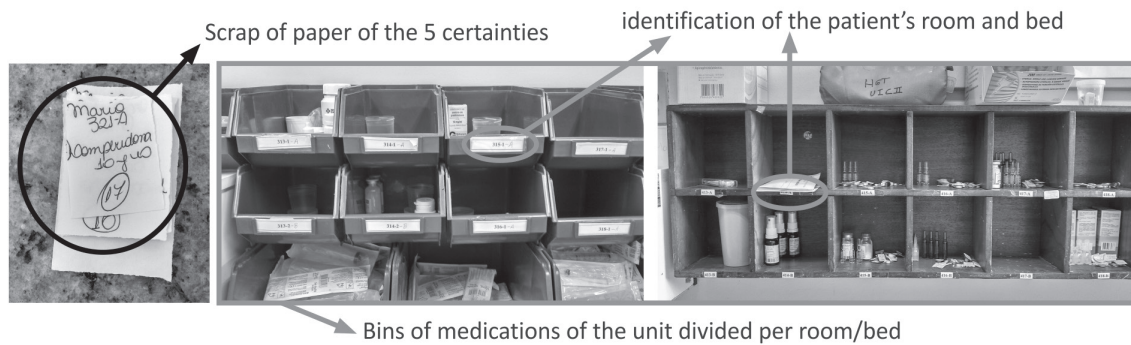


Figure 6. Scrap of paper of the 5 certainties (left) and drug bins of the unit divided by room and bed.

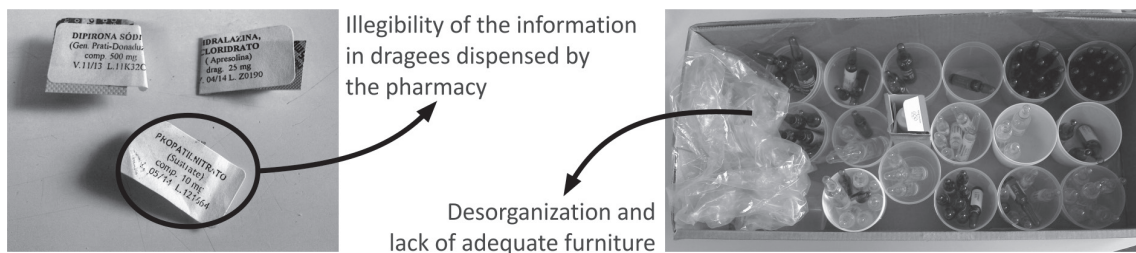


Figure 7. Dragees packaging with an adhesive label for information about the medication (left) and the packaging of medications for the preparation in the Medication Room.

Usability problems	Number of occurrences			
Use of nonstandard abbreviations	2			
Different systems of weights and measures	2			
Difficulty to correlate classifications	2			
Lack of error alert system	4			
Inadequate transfer of technology (online prescription)	3			
Illegibility	4			
Physical distance to make corrections in the prescription	1			
Not allow adaptation of the system to individual user needs	1			
similarity of names, colors and shapes of medication packaging	7			
Disorganization of the medications	1			
Difficulty to read the informations on the medication label	1			
Lack of standardization of the preparation process (transcription of the 5 certainties)	2			
Professional outdated regarding information on the medication (adverse reactions, for example)	4			
Errors detection and correction by the professional	2			
No communication of system errors, fear of punishment	2			
Lack of suitable furniture and artifacts for practicing the activity	3			
Frequency	Low	Medium	High	

Figure 8. Frequency of occurrence of the usability problems in the flow of medication.

User's control

Finally, the principle of user's control, showed average performance in the stages of prescription, preparation and administration. In these steps the professional responsible for the activity controls its execution, but some measures and rules need to be followed, preventing the user to act in the complete adaptation of the procedures. In the dispensation step, it was assessed that the step does not meet the requirement of the user's control, since the prescription is entered by the physician and remains so until the preparation stage.

Identifying the severity of the usability problems in the flow of medications

From the analysis of complete usability was designed an overview of the severity of usability problems identified in the diagnosis of the flow of medication, which resulted from the counting of the number of recurrence of the problem throughout the stages (Figure 8).

As a result, was obtained the highest number of occurrences (7 occurrences), the problem of similarity of names, colors and shapes of the packaging of the medicines. The problems that also showed four instances, include the lack of warnings system for the user about the occurrence of errors in performing the activity, the illegibility (both of the prescription and of the packaging of the medicines) and the downgrade of the professionals regarding the information about the medications (adverse reactions, components of the formula, etc.). The only problem that showed three events comes from inadequate technology transfer, present in the four stages of the drug. The rest of the problems identified was less than two occurrences, and is considered a low level of severity in this review.

From the identification of the usability problems with higher recurrence, it becomes possible to establish an order for the resolution of problems in the flow of medication, making the performance of the activities more efficient, effective and satisfactory. Optimizing the means of carrying out the activities by the professionals responsible for the drug directly contributes to the reduction of errors and oversights, thus reducing the occurrence of errors.

Conclusion

The use of the usability analysis enabled a diagnosis of the problems faced by professionals in the flow of medication of the hospital of the Florianópolis. Based on this diagnosis, the stage that had more usability problems was the preparation of the medicines, followed by the steps of dispensation, administration and prescription.

In the step of identification of the veracity of usability problems, the most recurrent problem was related to the similarity of names, colors and shapes of the medical packaging, as this directly affects three stages of medication, dispensation, preparation and administration. The other most frequent problems were: lack of a warning system for errors in the activities, illegibility of the prescriptions and information about the medications and the outdated situation of the professionals about the

information of the drugs with four, inadequate transfer of technology and the lack of furniture and artifacts suitable for carrying out the activities.

Thus, the importance of diagnosing usability as a way to prioritize solutions that will make the flow of medication more effective, efficient and satisfying for professionals is emphasized, thus minimizing the incidence of errors and consequent harm to patients. Furthermore, a diagnosis of usability thoroughly evaluated and analyzed, promotes greater reliability of hospital organizations in funding changes that may actually cause a positive effect on the services provided.

As future studies is highlighted the inclusion of the healthcare professionals and users of the system as participants of the next steps of usability evaluation. The inclusion of this participants, especially the healthcare professionals, considered the experts in this process, can contribute to the development of practical solutions to the problems presented. Moreover, with the diagnosis and identification of the most severe usability problems in the medication service, numerous possibilities for action of the designer in solving these problems are opened, which can occur by means of graphics solutions, product interface, among others.

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