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# Evaluation of usability of an infusion pump in the Intensive Care Center: contributions to patient safety

Evaluación de la usabilidad de una bomba de infusión en el Centro de Cuidados Intensivos: contribuciones a la seguridad del paciente

Avaliação de usabilidade de bomba infusora no Centro de Terapia Intensiva: contribuições para segurança do paciente

## ABSTRACT

**Objectives:** to evaluate the degree of satisfaction, knowledge and the located usability of the infusion pump used in the general adult intensive care center of a university hospital; identify what nursing professionals know about the infusion pump they operate; analyze the usability attributes of the infusion pump from the users' perspective; verify the degree of user satisfaction as a usability attribute in relation to infusion pumps. **Method:** This is a descriptive study, with a quantitative approach, carried out in the general adult intensive care unit of a university hospital in Rio de Janeiro, with 41 nursing professionals and residents, through a questionnaire. **Result:** 75.6% know the infusion pump used in the sector, and most consider it to be easy to handle. 38 professionals claim to have a good knowledge of the equipment. **Conclusion:** This research reflects the importance of evaluating in a real scenario the issues related to the usability of medical assistance equipment, considering the satisfaction of the users who handle this equipment.

**DESCRIPTORS:** Infusion Pumps; Nursing; Critical Care; Usability.

## RESUMEN

**Objetivos:** evaluar el grado de satisfacción, conocimiento y la facilidad de uso localizada de la bomba de infusión utilizada en el centro general de cuidados intensivos para adultos de un hospital universitario; identificar lo que los profesionales de enfermería saben sobre la bomba de infusión que operan; analizar los atributos de usabilidad de la bomba de infusión desde la perspectiva de los usuarios; verificar el grado de satisfacción del usuario como un atributo de usabilidad en relación con las bombas de infusión. **Método:** Estudio descriptivo, con enfoque cuantitativo, realizado en la unidad general de cuidados intensivos para adultos de un hospital universitario de Río de Janeiro, con 41 profesionales de enfermería y residentes, a través de un cuestionario. **Resultado:** el 75,6% conoce la bomba de infusión utilizada en el sector, y la mayoría considera que es fácil de manejar. 38 profesionales afirman tener un buen conocimiento del equipo. **Conclusión:** Esta investigación refleja la importancia de evaluar en un escenario real los problemas relacionados con la usabilidad del equipo de asistencia médica, considerando la satisfacción de los usuarios que manejan este equipo.

**DESCRIPTORES:** Bombas de Infusión; Enfermería; Cuidados Críticos Usabilidad.

## RESUMO

**Objetivos:** avaliar o grau de satisfação, conhecimento e a usabilidade situada da bomba infusora utilizada no Centro de Terapia Intensiva geral adulto de um hospital universitário; identificar o que sabem os profissionais de enfermagem acerca da bomba de infusão que operam; analisar os atributos de usabilidade da bomba infusora na perspectiva dos usuários; verificar o grau de satisfação do usuário como atributo de usabilidade em relação às bombas de infusão. **Método:** Trata-se de estudo descritivo, com abordagem quantitativa, realizado na unidade de Terapia Intensiva geral adulto de um hospital universitário do Rio de Janeiro, com 41 profissionais e residentes de enfermagem, através de um questionário. **Resultado:** 75,6% conhecem a bomba infusora utilizada no setor, e a maioria a considera de fácil manuseio. 38 profissionais afirmam ter um conhecimento bom do equipamento. **Conclusão:** Esta pesquisa traduz a importância de avaliar em cenário real as questões relacionadas à usabilidade dos equipamentos médico-assistenciais, considerando a satisfação dos usuários que manuseiam este equipamento.

**DESCRIPTORES:** Bombas de Infusão; Enfermagem; Cuidados Críticos; Usabilidade.

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**INTRODUCTION**

Technological acquisition in public and private health services, especially for intensive care units, represents an advance in care for critically ill patients. However, in view of the need to improve the quality of health services provided to patients, health professionals are faced with increasingly complex medical-assistance equipment that is essential to assistance.

In the intensive care setting, in order to maintain life and recover health, in addition to direct care for patients, theoretical and practical knowledge of the handling of machines is essential to understand their operation and interpret data, which can guarantee reliability of results and the direction of assistance.

Therefore, these technologies that collaborated in the treatment and diagnosis of patients admitted to an intensive care unit can be harmful with direct consequences for patient safety, if the user is not familiar with its functionality<sup>(1)</sup>. A good example of these technologies is the use of infusion pumps. Essential equipment in

intensive care to perform medications that need to be dosed with strict control, such as amines, sedatives, among others. A lack of knowledge in the process of manipulating these technologies may lead the patient to important adverse events.

Health technology assessment assists managers in the public and private health sectors to make rational decisions in choosing which technologies should be made available and in planning the allocation of financial resources in health, considering performance, maintenance cost, unnecessary adoption, index repair, misuse and obsolescence of equipment<sup>(2)</sup>.

Technological equipment is more present in the sectors of health services and, therefore, health professionals must deal with the adjustments and must be trained in the use and better interpretation of the results obtained. Emphasizing that with the incorporation of new medical-assistance equipment within intensive care units, which are characterized by complex care, it can change the cognitive load of these professionals during their ac-

tivities, compromising efficiency in performing tasks<sup>(3)</sup>.

In this scenario, the use of technologies in infusion systems stands out, which is constantly showing progress, while this must be accompanied with adequate usability of the equipment within the units, and which can guarantee patient safety and user satisfaction.

In view of the above, we outline as a question of this study: Does the usability of the infusion pump by the nursing staff of the intensive care unit reduce errors in nursing care?

The primary outcome is the satisfaction and knowledge of the infusion pump by nursing professionals in a general adult ICU; and the secondary is the usability of the infusion pump in a general adult ICU.

Thus, the objectives of this study are: to assess the degree of satisfaction, knowledge and usability of the infusion pump used in the general adult intensive care center of a university hospital; identify the profile of nursing professionals working in the general adult ICU; and check users' satisfaction and knowledge about infusion pumps.

## METHODOLOGY

This research is descriptive in nature, with a quantitative approach. With health technology assessment, choosing the usability of the infusion pump.

The setting in which this research was carried out is the General Adult Intensive Care Center of the Pedro Ernesto University Hospital, in the city of Rio de Janeiro, which has 10 beds. In this unit the infusion pump equipment used is the Infusomat® compact B BRAUN.

As participants in this research, it is the nursing professionals who work in the intensive care unit sector, including nursing residents. With a total of 69 users, 12 nurses, 14 residents and 43 nursing technicians.

This research evaluated the following variables: characteristics of the activities developed by the users; make, model and technical characteristics of the infusion pump; infusion pump parameters; difficulties encountered by users in using the EMA; user satisfaction with the infusion pump.

The application of an electronic questionnaire to the participants was used, comprising in two stages: knowing the profile of the nursing professionals who work in the general ICU; evaluate user satisfaction and knowledge regarding the use of the infusion pump. The data obtained were categorized by variables and analyzed using simple descriptive statistics.

Considering ethical issues, this research was submitted and approved by the Research Ethics Committee of the State University of Rio de Janeiro, under opinion No. 3,138,283 - February 8, 2019.

## RESULTS AND DISCUSSION

The data were collected from May to July 2019. The survey included a total of 41 participants, nursing professionals who use the infusion pump, 21 nurses and 20 nursing technicians. The

data were obtained in two stages: (1) characterization of the profile of users of the infusion pump; (2) handling of the infusion pump.

### Characterization of the profile of infusion pump users

The description and characterization of the profile of users of the infusion pump who work in the general adult ICU was carried out based on the identification of characteristics such as sex/ gender, professional training, age, years of professional experience, work shift and number of employment relationships.

As for the profile of users, we list data referring to the sex/ gender of professionals working in the unit, with 29 (70.7%) female professionals, a fact that corroborates the global profile of nursing professionals who, in their majority, are female<sup>(4)</sup>. Regarding professional training, the category of nurses who answered the questionnaire was more quantitative than that of nursing technicians. This fact is justified by the larger number of nurses in the study setting, and because it is a university hospital, 11 (53%) of these nurses who responded to the survey are residents of the intensive care nursing program.

The age of users in this study was predominant between 20 to 29 years old, and 30 to 39 years old, with an average age of 35.2 years with a maximum age of 57 years and a minimum of 20 years. It is a team of professionals that still represents a class of new workers, in a logic of life expectancy. If we think that this category, which is exposed to several risks, specifically in the care of intensive patients, requires a very intense physical effort from the professional, in addition to the degree of agility, dexterity and energy. We believe that this age range can be beneficial for carrying out activities and maintaining the quality of care provided<sup>(3,5)</sup>.

By relating the age variable of this user to the usability of the infusion

pump, we can analyze the issue of handling new technologies, which is more efficient when used by younger professionals, as they have less difficulty in handling it<sup>(3)</sup>.

Another factor that can generate more benefits to safe and quality care is the fact that these young professionals work together with professionals with more experience. This meeting enables a collective construction of a current and safe practice based on technology and patient safety.

About professional performance, 21 (51.2%) professionals have more than 10 years of experience. This data shows us that the team has appropriate knowledge for handling care and technologies present in the sector. The fact that leads us to think that these professionals may have used innumerable infusion pumps of different brands and types, and less current technologies than the technology under evaluation. A study emphasizes that professionals with more experience are better prepared in the face of several situations already experienced, involving the assistance to critical patients in intensive care units and, based on their experiences, they act more resolutely within the critical care scenario<sup>(6)</sup>.

The total of participating users, 31 (75.6%) know other brands and models of infusion pump, of these 10 (32.3%) consider that other models are easier to handle than the one available in the unit. It is related to the satisfaction of the user of the impaired technology, as most of them have trouble in handling the technology.

The results show that the unit has a team made up of experienced professionals, an important factor when it comes to intensive care, as there are specificities in the assistance demanding from its workers the high standard of technical and scientific knowledge, in addition to several other skills for the team work<sup>(1,3)</sup>.

The variable of distribution of professionals from the work shift showed

that the majority, 25 professionals work in the day and night service (61%), and 16 (39%) work only in the day service. Regarding the number of employment relationships, most of them work in 1 (51.2%) or 2 (46.3%) employment relationships.

In a study about the characterization of adverse events in intensive care units, it points out that the adverse events with the highest incidence occur in the morning shift, and that they may be related to a greater number of procedures<sup>(7)</sup>. It is noteworthy that the professionals who work at night are related to a greater number of hours of work compared to other shifts that can lead to the professionals' stress and fatigue; and the underreporting of events can be a factor for evaluation.

### Infusion pump handling

In addition to the characterization, the study presents variables that investigate and identify those that are related to the handling of the infusion pump, such as: knowledge and familiarity that the user has to identify problems and / or take action; the issue of in-service training in handling the pump; the degree of usability and user satisfaction.

In the analysis of the user satisfaction variable regarding the usability of the infusion pump, with regard to knowing the make and model of the pump available in the unit, 85.4% (n = 35) know how to inform the infusion pump data, of these, 43.9% were nurses and 41.5%, nursing technicians.

Understanding familiarity as the user's ability to understand and operate all features without difficulty, 85.7% (n = 18) of nurses and 100% (n = 20) of nursing technicians claim to be familiar with the infusion pump. This result portrays the profile of a resolute team working at the unit, which can minimize the occurrence of adverse events related to the use of the equipment.

The infusion pump is highlighted as a technology that represents safety

among medical assistance equipment, however, the use of this equipment is not a guarantee for the nonoccurrence of an adverse event, since the technology depends on human intervention in its programming<sup>(8)</sup>.

Figure 1 shows the degree of knowledge of users of the infusion pump resources. The data show that the study subjects claim to have knowledge of the available resources. This aspect is positive for the minimization of risks involving the use of the equipment. This knowledge may be related to the fact that we have many professionals with more than 10 years of experience, a fact that increases the probability of having already met such technology.

Study points out the importance of implementing systematization and routines protocols to provide quality care, focusing on patient safety<sup>(9)</sup>. While the implementation of routines is associated with the awareness and cognitive issues of this professional user who handles the infusion pump, guided by responsible adherence and the use of available resources.

The usability of the infusion pump by users was assessed by some questions that directly address how they perceive this technology and whether it is a

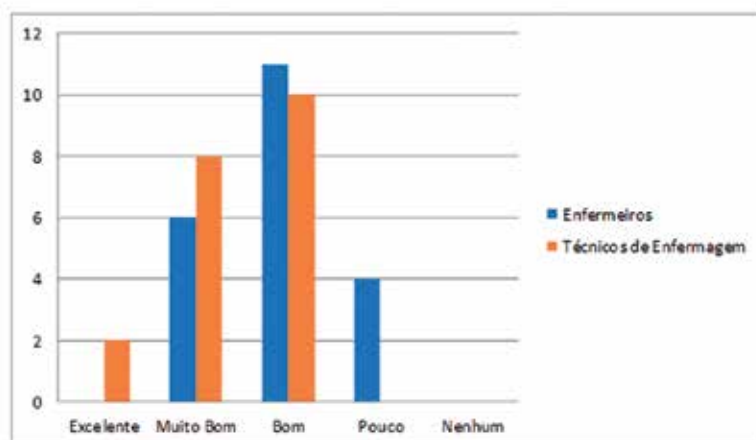
technology that contributes positively to assistance. In the item that measures how much users know how to operate, considering that the professional knows how to understand the messages and information provided on the display or the luminous and audible alarms emitted by the pump properly, of the 41 professionals, 4 nurses and 1 nursing technician refer to difficulty in operating the infusion pump.

When users are asked whether they know how to interpret the messages on the display or the audible and/or light alarms provided by the pump, only 1 nurse indicated that he did not know how to identify and understand in order to make a decisive decision.

Regarding the possible difficulties reported by the users of this study in relation to unfamiliarity with the device, they refer to the display screen and the configuration. This result corroborates with the study that points out the main difficulties of the functionalities: the display screen, settings, understanding the alarm and display messages<sup>(3)</sup>.

Regarding infusion pump alarms, 10 nurses (47.6%) and 14 nursing technicians (70%) consider that pump alarms are essential for practice. And then, the

Figure 1. Level of knowledge of infusion pump resources by users. Rio de Janeiro, RJ, Brazil, 2019.



nurses (n = 7) also consider that the team does not value the alarm.

In a developed study, which refers to alarms by the infusion pump and the characterization of alarms, there was more evidence of the “end of infusion” alarm (41.7%), a fact that can be considered a risk for the patient; second evidence was “manipulation of infusion pumps” (29.2%) that generates noise and alarms that can have negative implications for patients and the professionals who handle this equipment<sup>(10)</sup>.

The alarms generated by the infusion pump can be a risk factor for professionals and make it difficult for patients to recover. Studies show that noise contributes to stress symptoms such as personal fatigue, problems with concentration and tension<sup>(1,10)</sup>.

When users report their experience with the use of the infusion pump, there was 1 (2.4%) nurse user who reported a negative experience with the

equipment, justifying that alarms stress the team.

Although only 1 user (2.4%) indicated a negative experience with handling the equipment, there were four users (9.7%) who considered that they were not satisfied with the pump available in the unit.

To evaluate the satisfaction of users of the infusion pump in the intensive care unit, a numerical scale from 0 to 10 was applied, in which 0 represents totally dissatisfied and 10, totally satisfied. It can be seen from the data produced that users indicate a good level of satisfaction, with an average of 7.97.

The usability of the infusion pump in intensive care units, the expressive lack of adherence to training and the professional's ability to ignore or even circumvent the resources available by medical-assistance equipment are the main obstacles to reducing alarm fatigue and, consequently, for the pro-

vision of quality nursing care, which prioritizes patient safety.

## CONCLUSION

This research reflects the importance of evaluating in a real scenario the issues related to the usability of medical assistance equipment, considering the satisfaction of the users who handle this equipment. It is understood that the proposed objectives were achieved through a method that allowed the assessment of the usability of the infusion pump and the degree of satisfaction by nursing professionals.

The results found related to the usability of the infusion pump proved to be significantly positive, whereas the user's satisfaction with the equipment also presents a significant result, configuring by the possibility of handling this infusion pump, in comparison to other models. ■

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