SAFETY IN THE USE OF INFUSOR PUMPS: ANALYSIS OF ALARMS
SEGURANÇA NA UTILIZAÇÃO DE BOMBAS INFUSORAS: ANÁLISE DOS ALARMES
SEGURIDAD EN LA UTILIZACIÓN DE BOMBAS INFUSORAS: ANÁLISIS DE LAS ALARMAS

Andreza Serpa Franco¹, Aline Affonso Luna², Flavia Giron Camerini³, Danielle de Mendonça Henrique⁴, Luana Ferreira Almeida⁵, Roberto Carlos Lyra da Silva⁶

ABSTRACT

Objective: to analyze the profile of the infusion pump alarms in an intensive unit. **Method:** this is a quantitative, descriptive, observational, cross-sectional and sectional study carried out in an intensive cardiogenic unit with a sample of 72 alarms fired from infusion pumps, collected in a structured instrument. The analysis was performed with tabulation and statistical treatment in SPSS® software version 2.1. and presented in figures. **Results:** it was observed that the alarms triggered by the infusion pumps are related to the end of infusion (41.7%) and the manipulation by the team (29.2%). Regarding the time of the alarms, the average of 109.8 seconds was identified, characterized by four alarms with more time: “pre-alarm end of infusion”, “low flow”, “end of standby” and “end of infusion”. **Conclusion:** the characterization of the alarms helps the nurse to plan actions to minimize the stimulus-response time, improving the quality of the nursing care and increasing the safety for the patient. **Descriptors:** Nursing Care; Patient Safety; Clinical Alarms; Nursing; Infusion Pumps; Healthcare.

RESUMO

Objetivo: analisar o perfil dos alarmes de bombas infusoras em uma unidade intensiva. **Método:** estudo quantitativo, descritivo, observacional, transversal e seccional, realizado em uma unidade cardíaca intensiva, com amostra de 72 alarmes disparados de bombas infusoras, coletados em instrumento estruturado. Análise realizada com tabulação e tratamento estatístico no programa SPSS® versão 2.1. e apresentados em figuras. **Resultados:** observou-se que os alarmes mais disparados pelas bombas infusoras estão relacionados ao fim de infusão (41,7%) e o de manipulação pela equipe (29,2%). Em relação aos tempos dos alarmes, identificou-se a média de 109,8 segundos, caracterizados por quatro alarmes com maior tempo: “pré-alarma fim de infusão”, “fluxo baixo”, “fim de *stand by*” e “fim de infusão”. **Conclusão:** a caracterização dos alarmes auxilia o enfermeiro a planejar ações para minimizar o tempo estímulo - resposta, com a finalidade de melhorar a qualidade da assistência de enfermagem e de aumentar a segurança para o paciente. **Descritores:** Cuidados de Enfermagem; Segurança do Paciente; Alarmes Clínicos; Enfermagem; Bombas de Infusão.

RESUMEN

Objetivo: analizar el perfil de las alarmas de bombas de infusión en una unidad intensiva. **Método:** estudio cuantitativo, descriptivo, observacional, transversal y seccional, realizado en una unidad cardio-intensiva, con muestra de 72 alarmas disparadas de bombas de infusión, recolegidas en instrumento estructurado. El análisis fue realizado con tabulación y tratamiento estadístico en el programa SPSS® versión 2.1. y presentados en figuras. **Resultados:** se observó que las alarmas más disparadas por las bombas de infusión están relacionadas al fin de infusión (41,7%) y la de manipulación por el equipo (29,2%). En relación a los tiempos de las alarmas, se identificó la media de 109,8 segundos, caracterizados por cuatro alarmas con mayor tiempo: “pre-alarma fin de infusión”, “flujo bajo”, “fin de *stand by*” y “fin de infusión”. **Conclusão:** la caracterización de las alarmas auxilia al enfermero a planear acciones para minimizar el tiempo estímulo - respuesta, con la finalidad de mejorar la calidad de la asistencia de enfermería y de aumentar la seguridad para el paciente. **Descriptor:** Atención de Enfermería; Seguridad del Paciente; Alarmas Clínicas; Enfermería; Bombas de Infusión.

¹Master degree, University of Rio de Janeiro State/UERJ. Rio de Janeiro (RJ), Brazil. E-mail: dezza.franco@gmail.com ORCID iD: <http://orcid.org/0000-0001-5008-1345>; ²Master degree, University of Rio de Janeiro State/UERJ. Rio de Janeiro (RJ), Brazil. E-Mail: aline-luna@hotmail.com ORCID iD: <http://orcid.org/0000-0002-7648-8634>; ³Ph.D., University of Rio de Janeiro State/UERJ. Rio de Janeiro (RJ), Brazil. E-mail: fcamerini@gmail.com ORCID iD: <http://orcid.org/0000-0002-4330-953X>; ⁴Ph.D., University of Rio de Janeiro State/UERJ. Rio de Janeiro (RJ), Brazil. E-mail: danimendh@gmail.com ORCID iD: <http://orcid.org/0000-0002-0656-1680>; ⁵Ph.D., University of Rio de Janeiro State/UERJ. Rio de Janeiro (RJ), Brazil. E-mail: luana.almeida3011@gmail.com ORCID iD: <http://orcid.org/0000-0001-8433-4160>; ⁶Ph.D., Federal University of Rio de Janeiro State/UFRJ. Rio de Janeiro (RJ), Brazil. E-mail: profunirio@gmail.com ORCID iD: <http://orcid.org/0000-0003-4715-8836>

INTRODUCTION

In the perspective of analyzing the profile of Medical Assistance Equipment (EMA) alarms, the literature points out a high number of alarms related to the infusion pump, which generated interest and the need to carry out a research to identify the problems and implications of fatigue of alarms in infusion pumps.¹

The concept of alarm fatigue is a phenomenon frequently observed in Intensive Care Units (ICUs) that are characterized by the delay in time or the lack of response of the health professionals to the alarms, among others. This phenomenon occurs due to an excessive number of alarms, resulting in sensory overload and desensitization, which generates a negative impact of care and may compromise patient safety.²

In a study carried out in 2013, the alarms of multiparameter monitors of a coronary unit were characterized, measuring the time in which the professionals responded to the alarms in the unit. A total of 426 triggered alarms were reported, of which 115 represented alarms from the infusion pumps, that is almost 27% of all alarms were related to the intravenous infusion device.³

In general, the alarms aim to signal to professionals when patients need attention. Specifically, the alarms of the fired infusion pumps alert to some problem with the solutions infused or notify the proximity of its term. Most of the alarms that sound in the ICU are considered as inconsistent alarms or with limited utility and may cause the professionals to fail the alarms, that is, they do not value and do not respond to the alert.⁴

The alarm is a feature of EMAs to ensure the safety of patients who need constant monitoring when hospitalized. The alarms have the function of signaling the situations of risks that the patients may be presenting clinically or devices used for therapeutic resources that signal the malfunction. In situations where there is a failure of pump alarms, these can have serious implications on the clinical status of ICU patients causing damage, including irreversible damage.

EMA alarms also have been described as relative risks when they do not receive the priority they deserve. The Emergency Care Research Institute placed the danger of the alarms among the 10 highest patient safety risks in 2011 to 2017 consecutively, which demonstrates the relevance and concern with the use of EMAs and their alarms.⁵

Considering the importance of this issue, it is necessary to seek, in our reality, results capable of supporting strategies for the best manipulation of infusion pumps and for the minimization of alarm fatigue, making the practice of medication administration more objective and safe.

OBJECTIVE

- To analyze the profile of infusion pump alarms in an intensive unit.

METHOD

This is a quantitative, descriptive, observational, cross-sectional and sectional study. The research scenario was the postoperative unit of cardiac surgery in a large federal hospital specialized in cardiology, reference in the state of Rio de Janeiro. The health team is composed of 124 professionals with 81 are nursing, 13 physiotherapists, and 32 doctors.

The subjects of the research were the health professionals working in the unit at the moment of data collection and who accepted to participate in the study and signed the Informed Consent Term (TCLE). The only inclusion criterion adopted was the use of an infusion pump at the time of collection. Data collection occurred from December 2014 to May 2015.

The infusion pump model observed in this study is Volumat Agilia®, from Fresenius-Kabi. The audible alarms available in this model are as follows: Install equipment, open door, set air sensor, air bubble, air alarm, pre-alarm end of infusion, infusion end alarm, occlusion pre-alarm, lower occlusion, upper occlusion, battery pre-alarm, battery alarm, battery discharged, connect drop sensor, without drop sensor, low flow, high flow, uncontrolled flow.⁶

For data collection, an instrument was used in which the investigator recorded the sequence of the alarms, the characteristic of the alarm (defined for this study as the reason for which the alarm was triggered) and the time of alarm sounding by the infusion pump.

It is noteworthy that the researchers stopped timing the alarms when they exceeded the five minutes of sounding, considering fatigued alarms. The limit of five minutes was defined, since it is a cardiorespiratory arrest (CRP), a situation of absolute emergency common among severe patients, the longer the response to the alarm in these cases and the delay in the immediate onset of cardiopulmonary resuscitation maneuvers, the worse the neurological outcome for the patient with a decrease in

their survival rate.⁷⁻⁸ Therefore, alarms that exceeded the five-minute limit were considered fatigued.

A total of 40 hours of observation were observed by the researchers, in the scenario of the production of the research data.

The data treatment was done through tabulation in the Microsoft Excel® version 2010 program and statistical treatment in the SPSS® version 21 program.

The research project was approved by the Research Ethics Committee of the institution on December 11, 2013, under a CAAE 488996.

RESULTS

During the production of the data, it was verified that the number of alarms triggered by the infusion pump during the collection period was 72, totaling 100% of the sample. The alarms triggered by infusion pumps are related to the end of infusion (41.7%) when the programmed solution has already been infused, and the manipulation by the team (29.2%) is triggered during a procedure performed by the nursing team, as shown in figure 1.

Figure 1. Profile of the infusion pump alarms. Rio de Janeiro (RJ), Brazil, 2014

When dealing with alarm response times, an average of 109.8 seconds was identified, a median of 50 seconds and the standard deviation of 146.4 seconds of the 72 alarms triggered. However, 67 did not show alarm fatigue and five showed alarm fatigue. The dispersion of the alarm times in seconds is shown in figure 2.

It is important to note four of these five alarms that presented alarm fatigue were identified as “end of infusion” with equal times of 600 seconds (10 minutes) and a fatigued “pre-alarm end of infusion” with a time of 416 seconds (6 minutes and 56 seconds).

When analyzing the average time of the alarms sounded by the pump infuser from the profile of the alarms already presented, it was decided to use the time in minutes to facilitate the reading and to have the understanding with greater clarity. From this point, only non-fatigued alarms (n=67) were analyzed.

Figure 2. Mean of the sounding time of alarms related to the profile triggered by the infusion pump. Rio de Janeiro (RJ), Brazil, 2014.

Regarding the average time of the alarms triggered by the infusion pump, it was identified that the four alarms with the longest time were “pre-alarm end of infusion” (3.07min), “low flow” (2.37min), “end of standby” (2.05min), “end of infusion” (2.04min), as described in figure 2.

DISCUSSION

When characterizing the profile of the infusion pump alarms, it was observed that the “end of infusion” alarm was the most evident, representing 41.7% of the sample. This fact is worrying since in the postoperative period of cardiac surgery the use of vasoactive amines, sedatives, and other high-risk drugs are routine. Abrupt interruption or delay in the solution replacement is a risk for the patient since in many cases the medications are not only used as a support but for the maintenance of their life.

Another frequently identified alarm was the “manipulation of infusion pumps” (29.2%), this alarm is generated when a professional opens the infusion pumps for exchange or withdrawal of a medication. Handling generates a sound similar to other alarms generated by the infusion pump. In this sense, with respect to the acoustic profile, this generates more noise and may have negative implications for the patient and the professionals.⁹

Following the analysis, the alarms related to the occurrence of “air in the pump” (9.7%) and “occlusion” (6.9%) also presented high frequencies, which characterizes an alarming condition since they are situations that leave to infuse the drug continuously, providing vulnerabilities and risks to patients.⁹

It is also possible to verify that alarms classified as “pre-alarm end of infusion” with 5.6%, “end of standby” with 4.2% and “low flow” with 2.7% presented low percentages

when compared to the whole. However, when the sum of the three alarms was reached, the result was 12.5% of the sample. It is believed that if these alarms were met, a significant portion would not sound, minimizing the noise in the unit, avoiding to compete with more relevant alarms, as well as contribute significantly to the health of workers and patients.⁹⁻¹⁰

Noises generated by alarms can lead to occupational risks and hamper patient recovery.¹⁰ Noise contributes to stress symptoms such as personal fatigue, concentration problems, and tension. The decibel level (dB) of the alarms should be adjusted according to the ambient noise level.

In a recent study on alarms, it is a reflection on noise in an Intensive Care Unit, reinforcing that the demands of ICU work in the face of noise increase the negative psychic load due to surveillance, effort, and displacement effects. Technological noise substantially affects the nursing team.^{2,10}

The “pre-alarm end of infusion” is an intelligent alarm to draw the attention of the professional to the approach of the end of infusion of a medicine, and together with the “end of infusion” alarm, they represented two important alarms with high time averages. Considering postoperative cardiac surgery patients who make expressive use of vasoactive amines and inotropic agents, the “pre-alarm end of infusion” is an alert that would minimize adverse events related to abrupt interruption of the drug.¹¹⁻²

It is understood that the medications used to sustain life may end up becoming risks to the safety of the patient if its administration and continuous infusion are not done rigorously.¹³⁻⁴

The “end of infusion” alarm with the meantime/stimulus-response of 1.64 minutes is an important alarm, because although the

cessation of the drug infusion or delay of care does not mean possibility of harm to the patient, it continues to ring, bringing competition for other clinically relevant alarms, and may fatigue the professional.

It is evidenced that although the purpose of the alarms is to alert nursing professionals to changes that the patient may present, their excess can cause the team to become indifferent, masking the clinically relevant alarms and, therefore, bringing risks to these patients.^{2,10}

During the data collection, the high frequency and volume of this alarm is observed in particular, since the administration of prophylactic antibiotic therapy for one hour is performed postoperatively for cardiac surgery to prevent infections of the surgical area,¹⁵ and according with the time when this alarm sounds, the professionals show that they are conditioned not to worry that they already know it is the end of the infusion of an antibiotic, taking time to assist them.

The “low flow” alarm indicates that the infusion rate detected by the droplet sensor is below the set infusion rate and may be caused by the equipment clamp setting or droop sensor mismatch, and upon firing, it stops the infusion. This is an important alarm for the study since a mean high response time (2.37 minutes) was identified when compared to other studies.¹⁶

The “end of standby” alarm is a common alarm in intensive care units because intermittent solutions are infused. The observed infusion pump model has a standby of 286 minutes and after that time, the equipment returns to alarm. It is believed that better management and planning of all medications that are in standby by analyzing their termination, discontinuity or continuity of the infusion may allow the team to update the standby function or to finalize it.¹⁷

Although a short average time has been identified for the handling of alarms referring to the manipulation of the infusion pump in the data collection (0.73 minutes), it is worth noting that at that moment, the professional is very close to the device and at the moment that this alarm sounds, it silences it until the end of the manipulation. This type of excessive alarm is characterized by care providers as irritating or stressful noise.^{10,18}

The “air in the pump” alarms, as well as “pump occlusion” are two alarms of little expression for the study and they were attended quickly, but they constitute important data, since the staff attended in a

satisfactory time, minimizing the risks to the patient.

Alarm-related risks are described as number one cause in a listing of ten health technology risks,¹⁴ and too many alarms can overwhelm professionals because there are not enough staff to assist everyone who sounds simultaneously, being a distraction in the other important procedures for patient care.

It is understood that this study has limitations because it was performed in only one institution and sector, and it is not possible to compare the profiles and the alarms, but it is believed that it can contribute with new research related to fatigue and alarm profile and that can instigating change in practice and implementation of new strategies.

CONCLUSION

It was observed that the alarms most triggered by the infusion pumps are related to the end of infusion (41.7%) and the manipulation by the team (29.2%). The characterization of the alarms most touched helps to identify the profile of the alarms of greater clinical relevance, with the objective of informing the nurse in clinical practice.

Regarding the alarm times, the mean of 109.8 seconds, characterized by four alarms with a longer time, was identified. They were: “pre-alarm end of infusion” (3.07), “low flow” (2.37), “end of standby” (2.05), and “end of infusion” (2.04).

Although most alarms do not present fatigue, the nurse must pay attention to the noise of the intensive therapy, because, clinically relevant alarms may be unnoticed, which can generate risks for the critical patient. In this sense, planning actions to minimize stimulus-response time, use intelligent infusion pumps, and correctly program infusion pumps are nursing care that, in addition to increasing patient safety, it improves the quality of nursing care.

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Corresponding Address

Flavia Giron Camerini
Departamento de Enfermagem Médico-
Cirúrgica
Rua Boulevard 28 de Setembro, 157
Bairro Vila Isabel
CEP: 20551-030 – Rio de Janeiro (RJ), Brazil