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RESEARCH

Alarmes de monitorização invasiva da pressão arterial: damos a atenção necessária?

Alarm of monitoring invasive of blood pressure: are we giving the attention required?

Monitoreo de alarma arterial invasiva presión: ¿estamos dando atención necesaria?

Adele Kuckartz Pergher ¹, Roberto Carlos Lyra da Silva ²

ABSTRACT

Objective: To identify the cause of the invasive blood pressure alarms (PAI) have sounded and the staff response time; to describe the conduct set out to address them. **Method:** Descriptive study of quantitative/qualitative approach. The observation occurred in an adult ICU of a military hospital in Rio de Janeiro. The Research Ethics Committee of the Federal University of Rio de Janeiro (CAAE 03284612.4.3001.5250) approved it. We considered as fatigued the alarms that had not been attended in 10 minutes or stop pedringing before they are attended. **Results:** Were corded 76-PAI alarms; 21 (28%) were seen on average at 2.45 min. 55 (72%) were considered alarms fatigued. **Conclusion:** The high number of outworn alarms that represent risk. It is a challenge to respond to all alarms considering the relation between the nurse/patient imposed by ANVISA. **Descriptors:** Clinical alarms, Fatigue, Patient safety, Intensive care, Critical nursing care, Blood pressure monitors.

RESUMO

Objetivo: Identificar porque soam os alarmes de pressão arterial invasiva (PAI) e o tempo de resposta da equipe; descrever as condutas estabelecidas para saná-los. **Método:** Pesquisa descritiva de abordagem quanti/qualitativa. A observação ocorreu em uma UTI adulto de um hospital militar no Rio de Janeiro. Foi aprovada pelo Comitê de Ética em Pesquisa da Universidade Federal do Estado do Rio de Janeiro (CAAE 03284612.4.3001.5250). Considerou-se fatigados alarmes não atendidos em 10 minutos, ou que paravam de soar antes de terem sidos atendidos. **Resultados:** Registraram-se 76 alarmes de PAI; 21 (28%) foram atendidos, em média em 2,45 min. 55 (72%) alarmes foram considerados fatigados. **Conclusão:** O elevado número de alarmes fatigados representam risco. É um desafio responder a todos os alarmes considerando a relação enfermeiro/ paciente imposta pela ANVISA. **Descritores:** Alarmes clínicos, Fadiga, Segurança do paciente, Terapia intensiva, Enfermagem de cuidados críticos, Monitores de pressão arterial.

RESUMEN

Objetivo: Identificar por qué suenan las alarmas de la presión arterial invasiva (PAI) y el tiempo de respuesta del equipo; describir la conducta establecida para abordarlos. **Método:** Estudio descriptivo de enfoque cuantitativo/cualitativo. La observación se produjo en una UCI de adultos de un hospital militar de Río de Janeiro. Fue aprobado por el Comité Ético de Investigación de la Universidad Federal del Estado de Río de Janeiro (CAAE 03284612.4.3001.5250). Se consideró alarmas fatigados no cubiertas en 10 minutos o se dejó de sonar antes de ser atendidos. **Resultados:** Se registraron 76 - PAI alarmas; 21 (28%) fueron mayores en promedio a 2,45 min. 55 (72%) se consideraron alarmas fatigados. **Conclusión:** El alto número de alarmas fatigados representan riesgo. Es uno desafío de responder a todas las alarmas se considerando la relación enfermera/paciente impuesta por la ANVISA. **Descriptor:** Alarmas clínicas, Fatiga, Seguridad del paciente, Cuidados intensivos, Enfermería de cuidados críticos, Monitores de presión sanguínea.

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INTRODUCTION

The development of new technologies has increased the number of audible and visual alarms in the ICU. These alarms alert professionals of the patient's conditions and equipment failures, ensuring their safety and quality of care.¹

Although alarms are important and usually lifesaving, often false alarms, alarms without clinical or inconsistent relevance can compromise patient safety. The high number of these alarms takes the team to a reduced alertness, which can result in failure to respond to relevant alarm in time they require.² The term "alarm fatigue" was coined to denote a reduction in clinical sensitivity systems alarms and as a consequence security compromise in monitoring and follow-up.^{3,4}

The ECRI (Emergency Care Research Institute) - a non-profit organization that is dedicated to applied scientific research to find out which processes are the best and safest for the patient - annually publishes a list of 10 dangers of technologies used in health care (TOP 10). In 2012, 2013 and 2014 alarms were the number one of its list.⁵

In April of 2013 the JCAHO (Joint Commission on Accreditation of Health Care Organizations), an organization that inspects health services and considered the standard reported 98 events sentinels related to alarms, and 80 of them resulted in death and 13 in permanent damage. This fact motivated the International Joint Commission to review the National Patient Safety Goal - NPSG.06.01.01 that put the alarm management as a priority for 2014/2016.⁶

On the national scene, the National Health Surveillance Agency (ANVISA) estimates that one in ten patients admitted to hospitals suffer some kind of adverse event, among the listed events, is the misuse of medical devices and equipment. In this context, it was published Collegiate Board Resolution (RDC) 36/2013 establishing the National Program for Patient Safety, in order to contribute to the improvement of care processes and the use of technologies in health.⁷

Among the physiological variables monitored in the ICU the invasive blood pressure have stood out. Specifically in the sector, invasive blood pressure monitoring (PAI) is often used, being the most suitable for critically ill patients, as their fidelity.^{8,9} A delay in the response time to an alarm PAI also represents a delay in implementation of conduct with a view to solving the problem reported by the monitor, with the possibility of an unfavorable outcome. This is a critical situation if we think of patients using vasoactive drugs, monitored with arterial catheter, focus of this study.^{9,10}

We intend with this study to help filling a gap in relation to the study of fatigue alarms in Brazil. The data produced could point the way to minimize this phenomenon in intensive care units, and hence provide more security for patients. The following objectives were: a) to identify why the sound of monitoring alarms of invasive blood pressure; b) to identify the time health team answer to these PAI alarms and to describe what are the conducts established to address them.

METHOD

It is a descriptive research, a case study of quantitative/qualitative approach. The case study is a detailed investigation of an institution, which gives descriptive information and explore phenomena that have not been rigorously studied and can generate hypotheses to be tested in future researches.¹¹

For data collection, we used structured observation technique that provides for the use of instruments and formal protocols about what should be observed, the time that the observation should last and how data will be registered.¹¹

The survey was conducted in an adult ICU of a military hospital located in the city of Rio de Janeiro. The unit has 14 beds, serves medical and surgical patients and has a multidisciplinary team of physicians, medical residents, medical and physiotherapy students, nurses, nursing technicians, physiotherapists, dentists and pharmacists.

The project was approved by the Ethics Committee of the Federal University of Rio de Janeiro-UNIRIO State 17/08/2012 under number 76370.

The criteria for inclusion of subjects were: being at the intensive care unit during the moment chosen for observation and agreeing in participating. The inclusion criteria of beds/patients was to be in use for invasive monitoring of blood pressure during periods of observation field, which took place between January and June 2013.

The observation of the alarms was performed with the aid of an instrument containing the following variables: generating cause of the alarm, the professional response time, which was the professional who responded to the alarm and what was the conduct established to remedy it.

The response time from the professional to the invasive blood pressure alarm was measured with a stopwatch, the researcher triggered it as soon as the alarm fired, and paused at the time that the trader was going to the bedside; at that time it was observed what was the established conduct.

We considered fatigued alarms that have not been met after 10 minutes or stopped ringing before they have solid attended by staff (in these situations the blood pressure values returned to normal even before there was any intervention by the professional).

As for the generating causes of alarms of PAI we have considered three situations: patient-related factors, such as increases and decreases in PA; manipulation of the patient by the team during vacuuming, changing position, RX, etc.; and technical problems, such as system disconnection.

For the record the established patterns, the researcher ran up to the bed where the alarm had sounded and she watched the conduct established by professional, recording one of the following: altered dose of vasoactive drugs, hung vasoactive drugs, resumed vasoactive drugs, altered limit alarm, set the system (washing, positioning, silence), called another professional, no reaction.

RESULTS AND DISCUSSION

It was performed 60 hours of observation, where 76 alarms of invasive blood pressure, or an average of 1.26 PAI alarms per hour. Among the alarms observed, 21 (28%) have been met, with an average response time of 2.45 Min. 12 Fifty-five (72%) alarms were considered fatigued, given that they were more than 10 minutes without response or stopped ringing before the professional answer.

Regarding the 21 alarms of invasive blood pressure seen, Figure 1 shows which professionals were responsible for meeting these alarms:

Figure 1: Alarms attended by professional category

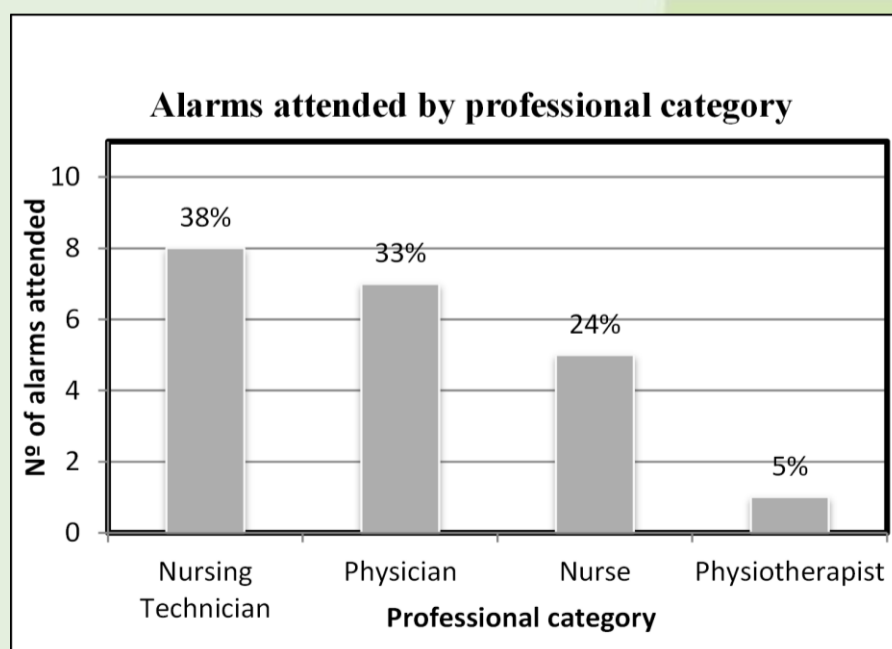


Figure 1 - Number of PAI alarms attended by each professional category. Rio de Janeiro, RJ, January 2013 to March 2013. Source: Research data.

The nursing staff (nurses and technicians) were the professionals who most met the PAI alarms, totaling 62% of cases.

As for the generating causes of PAI alarms, the following situations were (shown in Figure 2):

Figure 2: Causes of generating alarms

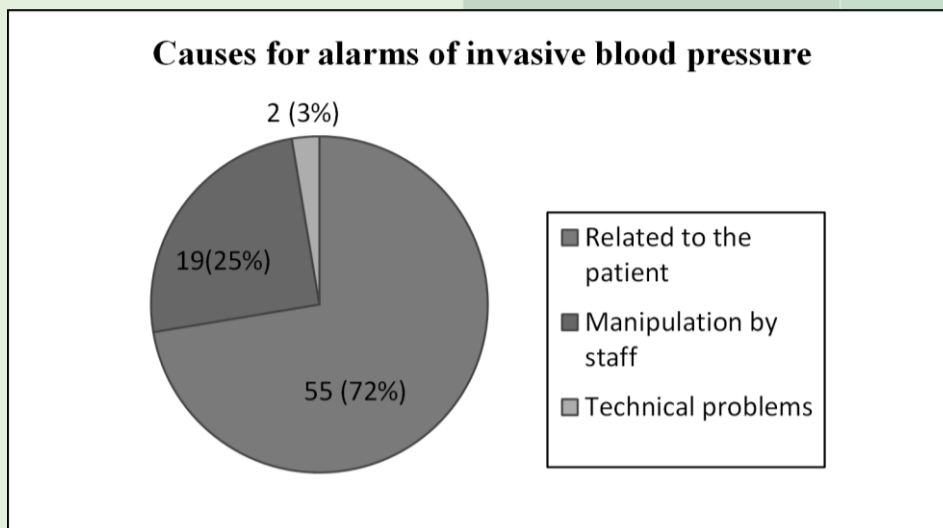


Figure 2-Causes that generate PAI alarms observed in the unit. Rio de Janeiro, January 2013 to March 2013. Source: Research data.

Therefore, most of the alarms occurred by factors related to the patient, or drew attention to relevant changes in blood pressure. However, many alarms were not met as in Figure 3 shows that the causes for PAI alarms comparing it among those attended by health professionals and those who were considered fatigued.

Figure 3: Relationship between cause of alarm and care by staff

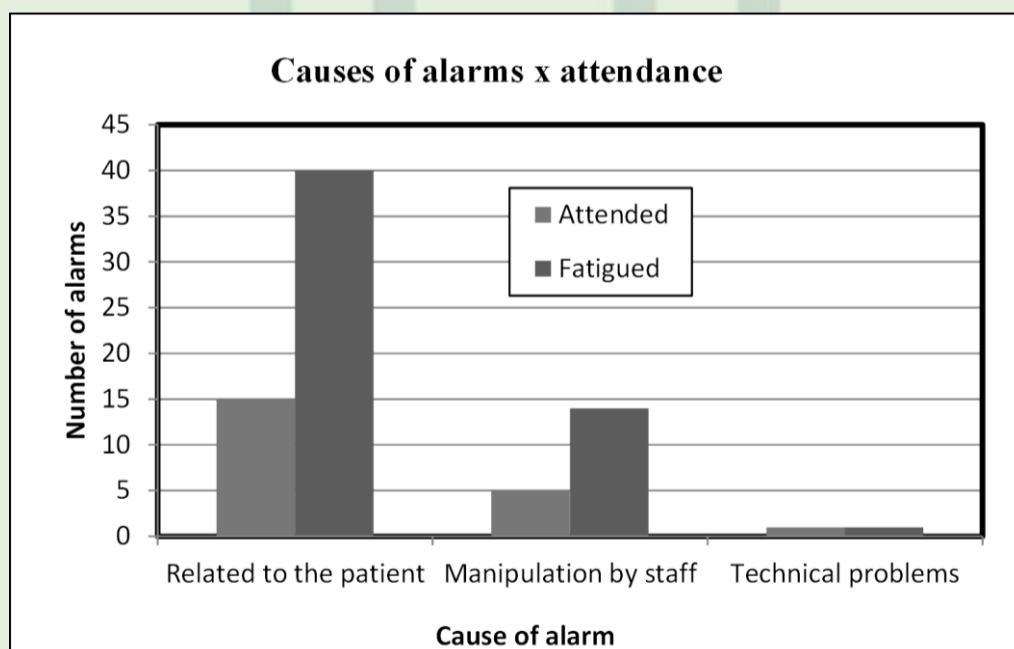


Figure 3-Relation between the causes of PAI alarms and the health care team. Rio de Janeiro, RJ, January 2013 to March 2013. Source: Research data.

It can be seen that 55 (72%) were considered fatigued alarms, and most of them (40 alarms) was related to changes in blood pressure of patients (limit alarms). Therefore, it seems that these alarms had clinical relevance, requiring immediate intervention team.

Nineteen (25%) of PAI alarms occurred due to manipulation of the patient by the team (vacuum, decubitus change, RX, etc.). These alarms may be classified non-actionable, so they are alarms that do not require clinical intervention or they are the result of deliberate actions. They distract the attention of the staff unnecessarily, and therefore they are a nuisance.¹³ In most cases these short alarm is self-correcting. In our survey from the 52 alarms that were not attended, 32 (61.5%) stopped ringing before being answered by the team, i.e., they corrected themselves.

Among the 21 alarms of invasive blood pressure that we met, the conduct of professionals to address them is described in Figure 4:

Figure 4: Conduct established by professional about the alarms of invasive blood pressure

| Conduct established | n | % |
|----------------------------------|----|------|
| System setup | 8 | 38% |
| Calls another professional | 4 | 19% |
| Changes dose of vasoactive drugs | 3 | 14% |
| No conduct | 2 | 10% |
| Turn off vasoactive drugs | 1 | 5% |
| Restarts vasoactive drugs | 1 | 5% |
| Other | 2 | 10% |
| Total | 21 | 100% |

Figure 4-Conduct established by health professionals who face the alarms of invasive blood pressure. Rio de Janeiro, RJ, from January 2013 to March 2013. Source: Research data.

A significant number of professionals (38%) was the patient's bed and held system settings (washing, pressurizing the pressure bag, patient's limb repositioning, reset the system or change alarm limits).

Figure 5 shows the behaviors of different professionals established when the alarm of invasive blood pressure sounds.

Figure 5: Conduct established by professional category.

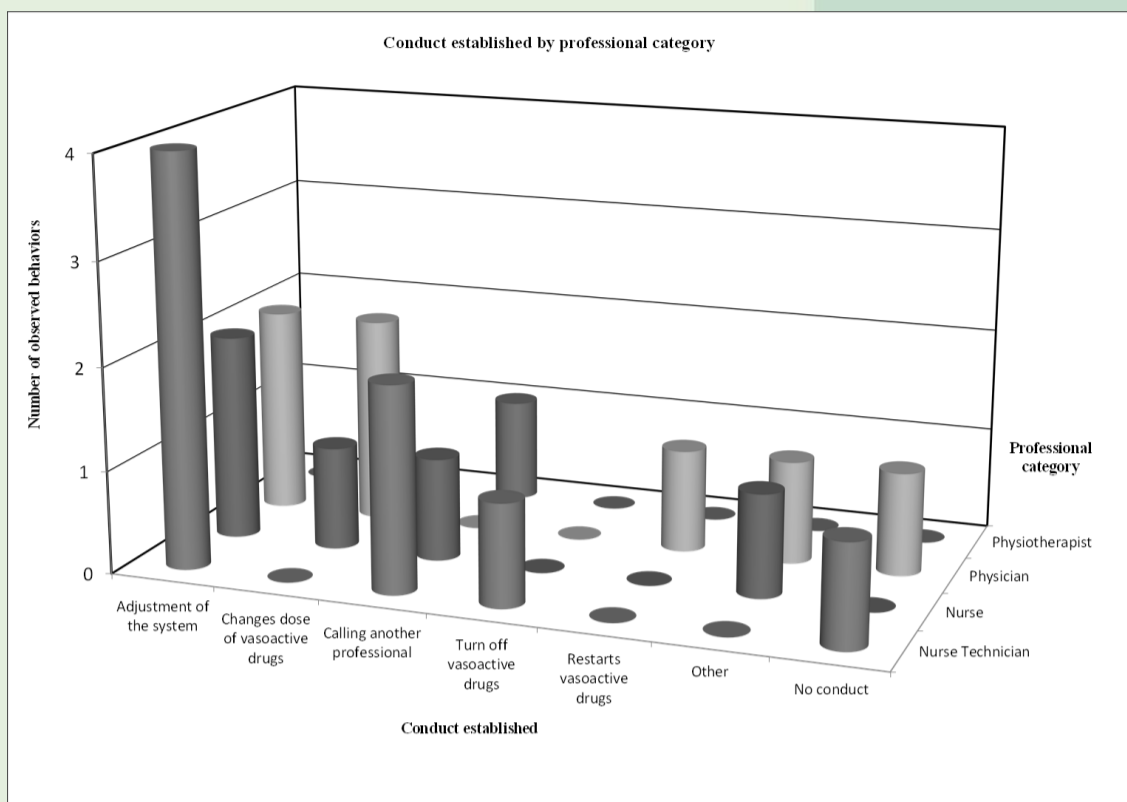


Figure 5-Conduct established to remedy the PAI alarms by professional category. Rio de Janeiro, RJ, January 2013 to March 2013. Source: Research data.

Much of the established patterns were related to the use of vasoactive drugs (change in dosage, shut down or restart the drug), indicating the severity and instability of patients who were monitored with invasive blood pressure. Moreover, a non-medical professional often held such conduct, what could compromise patient safety. In these circumstances, we believe that nurses should attend these alarms when a doctor could not do it. No other professional, as well as doctors and nurses, would be better able to respond to these alarms, which could result in changing therapeutic approaches immediately. When a physical therapist answered the alarm, the conduct in 100% of cases was "to call other professional."

Attended alarms X fatigued and the health team

It was observed that especially in the afternoon when there are less people hanging out in the sector, the nursing staff is primarily responsible for the monitoring of patients. The number of physicians in the unit in the morning shift is higher than that recommended by ANVISA, so this disproportion between doctors and nurses can explain why these professionals treated more alarms than nurses did. When we analyze the unit study setting, we realized in context a quantitative of nursing staff different from what is recommended by Resolution - RDC N°. 26 of May 11, 2012.¹⁴

The responses from nurses to alarms depend on the severity of the patient, the sound duration, rarity of alarm and the workload.¹⁵ Nursing is the main link between technology and the human element and they are who stays 24 hours with the patient.¹ In this context, the nursing staff constitutes the last barrier of protection against the occurrence of errors and unexpected events.¹⁶

In 2013, a study also conducted in Rio de Janeiro found that from the attended alarms, 82% ones were attended by a nurse.¹⁷ Compared to PAI alarms observed in the scenario, there is a discrepancy, possibly related to nurse ratio per patient that is most inadequate in the institution of our research. The personnel deficit is also concern in other countries, as described in the survey conducted in 2005 in EUA.¹

The fact that the professional is mostly busy while he is caring directly patients and has to stop their activities to attend the alarm was also found in this national study in 2013¹⁷. These interruptions have a number of developments in care, they hinder and modify the teamwork process and their activities and they may interfere with the professional attention span, leading to possible errors.

In a survey conducted in 2004, when alarms and behaviors were observed in a neonatal intensive care unit, they detected alarms 16.74 per hour. Considering the number of patients and time it was necessary to remedy each alarm, the authors concluded that nurses respond to all alarms, it would be almost impossible to conduct any further routine task.¹⁸

Causes of PAI alarms X implications for security

Most alarms sounded because of the triggering factors related to the patient, indicating an increase or decrease of the PA outside of the preset values; therefore, they are considered limit alarms. These alarms may be classified as actionable; in such cases, it is necessary timely intervention to prevent an adverse event. The response time for these alarms becomes critical to making decision.¹³

In prospective observational study conducted in 2010, they found that most alarms generated (70%) were threshold/limits and mainly related to systolic blood pressure (45%), considered by the authors as technically true.¹⁹

Faced with the result that 72% of the alarms were not attended, the risk of occurrence of an incident is notorious. To the World Health Organization, an adverse event related to equipment occurs when any incident during the use of medical equipment can result in an adverse outcome for the patient.²⁰ Adverse events related to clinical alarms are still underreported in Brazil, which may be justified by miscommunication or adoption of institutions in punitive and individual acts on the issue.

It is necessary to question what consequences of non-compliance to an invasive pressure alarm may result. In the case of hypotension, a persistent shock generates an inadequate tissue perfusion, the systems begin to decompensation due to lack of blood supply, resulting in the impairment of organs and the patient's failure to respond to treatment, even in situations of survival⁸. In severe hypertension, target organ damage may occur, such as encephalopathy, acute myocardial infarction, unstable angina, acute pulmonary edema, eclampsia, stroke.²¹

In cardiac arrest situations (which could be detected by monitoring the PAI), the time-response to alarms in these cases becomes imperative, recommendations for the start of the maneuvers in the 1st minute increase survival of patients, mainly in refers to neurological sequelae¹⁰. In 2014, the Joint Commission included as safe use strategy of alarms that

institutions have response protocols, so that the patient receives the necessary intervention at the appropriate time⁶.

Regarding the 19 alarms induced by manipulation of patients by the team, the majority could be avoided if the professional silenced the alarm before the activity. Activities at the bedside can generate non-actionable alarms. The team have to carry out care at the bedside, which can lead to non-actionable alarms, observe the patient and, if indicated, turn off the alarm momentarily, while the care is provided, avoiding an increase of noise in the unit. It is also noteworthy that disabling the alarm or removing the monitoring for longer care such as bathing in bed, deep puncture (arterial or venous), among others, can lead to adverse events for complications that were not detected.¹³

Some studies have observed that there is an excessive number of alarms in the ICU, many of them are false alarms^{2,5,17,19}. When alarms are true, they are often clinically insignificant. The programming and configuration of alarms individually are essential because they give credibility to the team towards emergency alarm when they sound.¹⁷

Conduct demanded by alarms

With regard to established patterns, the large number of situations "system setup" may indicate that professionals need to confirm the information provided by the system because it is very sensitive and can easily generate false positive alarms. This behavior before the alarms triggered aims to reduce the number of false alarms and unnecessary in the unit.

So that the monitors have utility in monitoring and patient safety, it is worth noting that there is no point to the limits of these devices are not properly adjusted. We found that there was no setting or adjustment of the monitors by the team as a routine, the setting is carried out individually by some professionals or before any need of the moment, in a timely manner. This attitude was also observed in a North American study published in 2010, when the nurses used to change the parameters of the monitors only when the alarms start ringing continuously and not in a prospective way³. The authors performed a task force to reduce alarms at ICU and obtained a reduction of 43% with measures that included the individual adjustment of the alarm limits.

Therefore, the setting individually for each patient, using values that are within a range which usually generate interventions by the team, is one of the strategies to reduce false alarms.¹⁶

In 2004, a study found that nurses did not seem to respond immediately on hearing the alarm, but they recorded the occurrence, assessed the urgency of the problem and eventually acted to remedy it during daily activities¹⁸. This sense can be justified because 10% of the professionals had no visible conduit to move to the box of the patient; they could indeed be observing and evaluating the patient if the alarm that sounded had represented the clinical condition of the same.

CONCLUSION

We do not take into consideration in this study, for example, what were the borderline values adjusted for each patient on their monitors; so it may be that some important cases have not been detected after the alarm signal trigger.

We also show, as in the literature, that is the nursing staff that "lookout" patients within 24 hours and they are more related to monitoring systems for patients and with alarms of these systems, therefore, they are the category that is more involved in the phenomenon of "fatigue alarms". It is a challenge for the nursing staff to respond to all alarms that sound on the unit, especially if we consider the relationship nurse x patient imposed by the RDC 26. In this way, we should look for alternatives that allow us a safer and more effective use of alarm systems.

Therefore, in-service training for the best use of the equipment and its alarm systems becomes imperative, saves staff time, optimizes the use and handling, and ensures patient safety that uses it.

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