

Factors that interfere with the response of nurses in the monitoring of clinical alarms

Fatores que interferem na resposta dos enfermeiros na monitorização dos alarmes clínicos
Factores que interfieren en la respuesta de los enfermeros en el monitoreo de las alarmas clínicas

Sónia Margarida Meireles Dinis¹, Isabel Cristina Mascarenhas Rabiais¹

¹Universidade Católica Portuguesa, Institute of Health Sciences. Lisbon, Portugal.

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ABSTRACT

The aim of the present study was to reflect on nursing practice regarding the monitoring of clinical alarms. **Objective:** The objective of the present study was to identify and synthesize the best empirical evidence found on factors that influence the response of nurses regarding clinical alarms. **Method:** An integrative literature review was conducted with searches undertaken in ten electronic databases restricted to the period from 2005 to 2016. **Results:** Eight articles were included by cross-checking the descriptors selected. **Conclusion:** In the analysis of the studies, the following possible factors that might interfere with the response of nurses in the monitoring of clinical alarms were found: high number of false alarms, inaudibility of alarms due to the competition of sounds, difficulty in distinguishing the urgency of alarms, and increase in noise caused by the raise in the number of alarms. **Descriptors:** Clinical Alarms; Noise; Nursing; Professional Competence; Safety.

RESUMO

O presente estudo tem como propósito refletir sobre a prática de enfermagem no que concerne à temática da monitorização dos alarmes clínicos. **Objetivo:** Pretendemos identificar e sintetizar, a melhor, a evidência empírica produzida sobre os fatores que influenciam a resposta dos enfermeiros perante os alarmes clínicos. **Método:** Perspetivou-se um estudo de revisão integrativa da literatura. Selecionámos um conjunto de dez bases de dados eletrónicas, delimitou-se a pesquisa ao período temporal de 2005 a 2016. **Resultados:** Por meio de uma estratégia de cruzamento dos descritores selecionados, foram incluídos oito artigos. **Conclusão:** Na análise dos estudos, reconhecemos como possíveis fatores que interferem na resposta dos enfermeiros na monitorização dos alarmes clínicos: o grande número de falsos alarmes, a inaudibilidade dos alarmes por causa da competição de sons, a dificuldade de distinguir a urgência dos alarmes e o aumento do ruído provocado pelo aumento do número de alarmes. **Descritores:** Alarmes Clínicos; Ruído; Enfermagem; Competência Profissional; Segurança.

RESUMEN

El presente estudio tiene como propósito reflexionar sobre la práctica de enfermería en lo que concierne a la temática del monitoreo de las alarmas clínicas. **Objetivo:** Pretendemos identificar y sintetizar, la mejor, la evidencia empírica producida sobre los factores que influyen la respuesta de los enfermeros frente a las alarmas clínicas. **Método:** Se tuvo una perspectiva de un estudio de revisión integradora de la literatura. Seleccionamos un conjunto de diez bases de datos electrónicos, se delimitó la pesquisa al periodo temporal de 2005 a 2016. **Resultados:** Por medio de una estrategia de cruzamiento de los descriptores seleccionados, fueron incluidos ocho artículos. **Conclusión:** En el análisis de los estudios, reconocemos como posibles factores que interfieren en la respuesta de los enfermeros en el monitoreo de las alarmas clínicas: el gran número de falsas alarmas, lo inaudible de las alarmas por causa de la competición de sonidos, la dificultad de distinguir la urgencia de las alarmas y el aumento de ruido provocado por el aumento del número de alarmas. **Descritores:** Alarmas Clínicas; Ruido; Enfermería; Competencia Profesional; Seguridad.

CORRESPONDING AUTHOR

Sónia Margarida Meireles Dinis

E-mail: margaridamdinis@gmail.com

INTRODUCTION

In recent years, there has been a significant increase in specialization of care and consequent acquisition of more technologically sophisticated equipment in hospitals. All this equipment is provided with optical and audible alarms that, in addition to the background noise of devices, create a potentially uncomfortable environment for patients and caregivers⁽¹⁾.

In most hospitals, noise levels exceed the levels recommended by the World Health Organization (WHO) of 40 decibels (dB) during the day and 30 dB during the night⁽²⁾. Cvach⁽³⁾ reinforces that noise levels in hospitals have increased significantly since 1960.

Nowadays, an endless number of devices that sound incessantly demands our attention. Cardiac monitors, ventilators, heating systems, feeding pumps, syringes and infusion pumps, among others, are appanage of daily practice.

Considering that nurses are professionals who are permanently close to patients, they are the population most exposed to noise coming from alarms, and both (nurses and patients) might be exposed to about 700 alarms of cardiac monitors per day⁽³⁾, which might represent occupational risks, compromise the safety of care, and affect patients' recovery.

The value of technology is allied with human competence, since clinical alarms are considered an essential and life-saving key tool. The Joint Commission on Accreditation of Healthcare Organizations defines clinical alarm as "any alarm that is intended to protect the individual receiving care or alert the staff that the individual is at increased risk and needs immediate assistance"⁽⁴⁾.

The purpose of equipment alarms is to alert professionals for potential problems and serious or dangerous situations. However, they might also compromise the quality of work of nurses and patient safety due to the abundance of false positives. False positive alarms are understood as those that do not assume clinical relevance at the time or are caused by technical problems or artifacts⁽⁵⁾. These may be generated not only by the equipment's hypersensitivity, but also by the inadequacy of the parameters' limits to the clinical condition of each patient. Therefore, unnecessary noise might lead to nurses' desensitization, thus making them ignore, silence or even disconnect alarms⁽⁶⁾.

The intensity and frequency of alarms in hospitals are of unquestionable importance. Many studies show that the increase in the number of alarms created a unsafe, noisy and annoying environment, especially in intensive care units and operating rooms⁽⁷⁾.

Considering that humans' cognitive abilities have limits, each time nurses respond to an alarm, their attention is redirected, and care related to other patients need to be reprogrammed. Several researchers described this phenomenon as the "cry wolf" effect, in which the human behavior in the response to alarms is adjusted according to the rate of false alarms perceived⁽⁸⁻⁹⁾. When there is a low rate of false alarms, human response is more appropriate, whereas with high rates of false alarms, natural human response is to respond with less frequency. This is an adaptive human mechanism triggered to manage the overload of cognitive resources and consequently of attention.

Therefore, the purpose of the present study was to reflect on nursing practice regarding the monitoring of clinical alarms based on the following guiding question: *Which factors interfere with the response of nurses in the monitoring of clinical alarms?*

OBJECTIVE

Identifying factors that interfere with the performance of nurses, as well as behavior changes that might be adopted in order to optimize the provision of care were considered important in this study. The choice for the topic is explained by the concern for the safety of critically ill patients, who depend on the continuous monitoring and surveillance of clinical alarms, for which nurses are responsible.

In addition to answering the research question, the objective of the present study was to *identify and synthesize the best empirical evidence found on factors that influence the response of nurses regarding clinical alarms.*

METHOD

Ethical aspects

No conflicts of interest were found. It is worth mentioning that the authors who provided scientific support throughout the development of the study were identified, as well as the citation of their references, in order to value and support their intellectual property.

Study design

Considering the topic and objectives of the present study, an integrative literature review was carried out.

Study protocol

Two descriptors were identified for the development of the present study: "Clinical alarms" and "Nurs*", validated by means of the Medical Subject Headings - MeSH. Subsequently, a set of ten electronic databases was selected: CINAHL Complete, MEDLINE Complete, Database of Abstracts of Reviews of Effects, Cochrane Central Register of Controlled Trials, Cochrane Database of Systematic Reviews, Cochrane Methodology Register, Library, Information Science & Technology Abstracts, MedicLatina, Health Technology Assessments, and NHS Economic Evaluation Database. The search was carried out in Portuguese and English languages and restricted to articles from 2005 to 2016. Data collection occurred between July and August 2016.

Sample and inclusion criteria

The PIC[J]OD method was used for definition of selection criteria and composition of the sample: participants (and clinical condition), intervention, outcomes, and design (type of study), as presented in Chart 1⁽¹⁰⁾.

The initial sample was made up of 156 studies. Later, they were evaluated and selected considering criteria established by means of their title and abstract. Full reading was carried out if justified by the abovementioned criteria.

Chart 1 – Inclusion criteria of the studies to be selected

Selection criteria	Inclusion criteria
Participants	Healthcare professionals, necessarily including nurses, and scientific articles.
Intervention	To identify which factors interfere with the response of nurses in the monitoring of clinical alarms.
Study design	Research studies, integrative or systematic literature reviews.
Results	Response of nurses; implications for practice and professionals' opinion; management/strategies to promote a less noisy environment.

In this study, descriptors were submitted to cross-checking among them, and the advanced search form available at the

forementioned databases was used as strategy, thus obtaining 156 articles (excluding repeated ones). Of the total, 71 were excluded by reading their titles, 63 by reading their abstracts, and 14 by reading the full articles. Therefore, eight articles were included. After that, analysis, evaluation, and synthesis of the empirical evidence were carried out, considering the aforementioned selection criteria as a guiding line. The information obtained was organized in order to highlight the most relevant aspects of the phenomenon in study.

RESULTS

The presentation of the scientific articles selected was outlined with the aim of organizing evidences produced (Chart 2). The results were categorized by title, year, country of origin, design/number of participants, interventions, and findings/main conclusions. The articles were organized based on the year of publication in order to evidence the most recent knowledge.

Chart 2 - Synthesis of the evidence found

Title	Year/ Country	Design/ number of participants	Interventions	Findings/main conclusions
Changes in default alarm settings and standard in-service are insufficient to improve alarm fatigue in an intensive care unit: a pilot project ⁽¹¹⁾	2016 USA	Qualitative study 39 nurses	Alteration of 17 parameters in default alarms of cardiac monitors	Altering the setting of default alarms and training in standard procedures for use of cardiac monitors is not enough to improve the safety of alarm systems.
Nurses' perspectives on clinical alarms ⁽¹²⁾	2015 USA	Qualitative study 406 nurses	The Krippendorff method for content analysis was used to analyze 790 comments on the perception of clinical alarms by 406 nurses.	Nurses are concerned about the impact of fatigue on nurses and patients caused by alarms. They recognize the importance of their role in the reduction of noise pollution and indicate some strategies that might lessen false alarms.
Attitudes and practices related to clinical alarms ⁽¹³⁾	2014 USA	Quantitative study 2005-2006 1327 responses 2011 4278 responses	To determine if practices and behaviors regarding clinical alarms have changed over time, by comparing results of studies conducted by the Healthcare Technology Foundation (HTF) in 2005-2006 and 2011.	The safety of clinical alarms has been a constant challenge and has received significant attention in recent years; however, slow measurable progress has been observed since 2005-2006, when the first study associated with this phenomenon was conducted. False alarms still contribute toward the noisy environment in hospitals. Sentinel events and fatigue to alarms reported in the first study remain.
Nurses' response to frequency and types of electrocardiography alarms in a non-critical care setting: a descriptive study ⁽¹⁴⁾	2014 USA	Observational, descriptive, and prospective study Nurses (n=9)	To describe routines associated with practices of nurses regarding the continuous monitoring of ECGs, types and frequencies of alarms, nursing interventions triggered, and their impact on care plan for patients.	Nurses responded to 46.8% of alarms. Routine practices related to monitoring still show gaps in the management of alarms. Comments also showed difficulty and complexity in managing alarm systems.
Reducing hospital noise: a review of medical device alarm management ⁽¹⁵⁾	2012 USA	Systematic literature review 27 articles	To identify practices that might reduce the number of false clinical alarms, in order to increase patient safety and provide a more peaceful environment for patients and professionals.	The main problems associated with clinical alarms were: the high number of false alarms; inaudibility of alarms due to the competition of sounds; difficulty in distinguishing the urgency of alarms; and the increase in noise caused by the raise in the number of alarms. The effects caused are: the increase in noise level, increase in irritability of patients and professionals, reduction in credibility of alarms systems, increase in response time to alarms, reduction in patient safety and professionals' performance, and increase in the number of adverse events.

To be continued

Box 1 (concluded)

Title	Year/ Country	Design/ number of participants	Interventions	Findings/main conclusions
Monitor alarm fatigue – an integrative review ⁽³⁾	2012 USA	Integrative review 72 articles	To determine if the amount of noise interferes with the response of nurses to alarms of cardiac monitors.	The results of the study were organized in 5 topics: 1) Excessive alarms and their effects on professionals; 2) Response of nurses to alarms - perceiving the urgency of alarms contributes to responses of nurses; 3) Sound of alarms and audibility - noise contributes to the stress of professionals and symptoms such as fatigue, problems with concentration and migraines from tension; 4) Technology to reduce false alarms; 5) Alarm notification system – wireless technologies might be a viable alternative to human monitoring.
Sound intensity and noise evaluation in critical care unit ⁽¹⁶⁾	2010 USA	Quantitative study n = 12	To measure the noise level to which patients are exposed in intensive care units.	Noise peaks of alarms inside patients' rooms are high and increased as the setting of alarm levels increased. Levels of these alarms, when measured in adjacent rooms, did not increase with the increase in alarm levels. The average noise level inside patients' rooms was mostly lower than 45 dB, but noise peaks were always higher than 85 dB. Closing the door of adjacent rooms did not reduce noise peaks. Peaks and the average noise levels did not differ systematically during 24 hours of measurement.
A national online survey on the effectiveness of clinical alarms ⁽⁹⁾	2008 USA	Quantitative study 1327 participants 51% nurses (n = 676) 49% other healthcare professionals (n = 651)	To determine problems associated with clinical alarms in a hospital context.	The effective management of clinical alarms depends on the equipment design, professionals (an active role in learning the use of all functions of the equipment), and hospitals (need to recognize the complexity of managing alarms and provide the required resources for the development of effective management systems).

DISCUSSION

The results from the phenomenon in study were discussed towards a critical reflection guided by its objectives. In order to enhance this analysis, not only studies from the sample selected were discussed, but also others from the same thematic area, which were considered relevant, even though they did not meet the selection criteria.

Among the eight articles selected, which were all extracted from scientific journals, three used a quantitative methodological approach, three had a qualitative approach, one was an integrative review, and one was a systematic literature review. All articles selected were international. During the research, national studies referring to this theme were not found, which might demonstrate the little interest existing in the management of alarms by healthcare professionals. Of the total search results, most articles were not associated with the objectives of this study, which is the reason why they were disregarded.

The reduced size of the sample might suggest that practices of nurses regarding clinical alarms were not a topic much studied in the last ten years.

In hospitals, the number of special care units, such as intensive care units and operating rooms is increasing. These

are environments where patients are connected to ventilatory devices and surrounded by a high number of medical equipment that produces different types of alarms, according to the condition of patients and the equipment.

Studies such as the one by Korniewicz et al.⁽⁹⁾ showed that adverse events (incidents that result in harm for patients) associated with alarms still occur, in spite of the abundance of alarms in devices. In the comments of the 406 nurses who participated in the study of Honan et al., one adverse event (caused by the lack of attention to alarms, and which resulted in a patient's death) and six near-miss events (incident that did not cause injury, illness or harm - but had potential to do it) were found⁽¹²⁾.

The complexity in the management of clinical alarms might be one of the explanations for the alarming frequency of adverse events, which shows the importance in identifying factors that interfere with the response of professionals to alarms.

In the analysis of the studies selected, the following possible factors that might interfere with the response of nurses in the monitoring of clinical alarms were found: high number of false alarms; inaudibility of alarms due to the competition of sounds; difficulty in distinguishing the urgency of alarms; and increase in noise caused by the raise in the number of alarms.

Therefore, a brief analysis of the aforementioned factors was carried out.

Increase in noise caused by the raise in the number of alarms

The review by Konkani et al.⁽¹⁵⁾ mentions a study by Sengpiel in 2011, which showed that the sound of most equipment alarms ranges in the interval of 60 to 70 dB and some exceed 80 dB - the equivalent to the sound heard from 25 meters of a busy freeway.

Intensive care patients and professionals report that the noise in these units is high, and studies confirm this. There are several noise sources; however, conversation among healthcare professionals (reaching values between 59 and 90 dB) and equipment alarms are often mentioned as the most disturbing for patients. The study by Lawson et al.⁽¹⁶⁾ showed that noise peaks of alarms inside patients' rooms are high and they increase as the level of alarm volume increases. It is worth mentioning that, although there was an increase in the noise in rooms, a corresponding increase in noise in adjacent rooms was not found. In the measurements, the average noise level inside patients' rooms was mostly lower than 45 dB. Noise peaks were always higher than 85 dB. Closing the door of adjacent rooms did not reduce noise peaks. Peaks and average noise levels did not differ systematically during 24 hours of measurement.

Honan et al. mention in their study that patients and their families described continuous alarms as "disturbing", "frightful", and inducing unnecessary panic. In the same study, nurses reported that "noise pollution", resulting partly from the high number of alarms, might be associated with comorbidities, such as "increase in patients' anxiety", "lack of sleep", "ICU psychoses" and "delirium"⁽¹²⁾.

The high number of false alarms

Alarm systems are highly sensitive, but with little specificity, resulting in high rates of false alarms (about 99.4%). The proliferation of monitoring equipment and the frequency of sensory overload caused by the noise of alarms represent a risk for the development of desensitization of professionals to alarms and consequently for their silencing or even deactivation, as ways to alleviate the problem⁽¹⁴⁾.

Parallel to the high sensitivity, if limit levels of the monitored parameter are defined with a very short interval, true but clinically insignificant alarms might occur. These alarms are known as "nuisance" alarms. The study by Sowan et al. showed that most nurses interviewed strongly agreed that "nuisance" alarms are frequent, interrupt the care provided to patients, and reduce the reliability of alarms⁽¹¹⁾. When alarms are considered that way, professionals might disconnect and silence them, or ignore the warning that is intended to make a safer environment. Instead of creating a safer environment, a high number of "nuisance" alarms assumes the opposite effect, resulting in desensitization^(3,11).

This problem assumes special attention regarding low-priority alarms. For example, alarms of ECG electrodes wrongly applied or that unstuck, or alarms of oximeter sensors that accidentally dislocate, typically have tones that are less audible than high-priority alarms. Nurses might not notice and consequently not respond to these alarms, and the non-monitoring of a particular parameter may lead to an eventual non-detection of patients'

critical conditions. Sometimes, professionals might act improperly to avoid frequent "nuisance" alarms, such as by reducing the volume of alarms, extending the limits of alarms beyond the acceptable interval, or even deactivating them⁽⁹⁾.

In most situations, alarms distract and interfere with the ability of professionals in effectively performing other critical activities. Alarms also contribute to the desensitization of nurses to devices; in such a way that alarms for "true" events have less probability of calling the attention of the staff. In the study by Korniewicz et al., 77% of the participants agreed, or strongly agreed that "nuisance" alarms interrupt the sequence of care practice. A high number of false alarms is often observed and they contribute to desensitization, lack of reliability, and lack of response from professional caregivers (Cvach⁽³⁾, citing Lawless).

Studies support the idea that the increase in the number of alarms reduces "faith" of healthcare professionals in alarms, at the same time it increases the noise level in the hospital environment⁽¹⁵⁾.

The study by Gazarian⁽¹⁴⁾ showed that practices of nurses regarding the management of alarms is an area with significant weaknesses. The practice in verifying parameters and volume of alarms at the beginning of shifts ensures that parameters are pre-set and audible. Not following this procedure at the beginning of shifts might have consequences. In the abovementioned study, in 7 of the 18 observations, this procedure was neglected. These observations also showed the difficulty and complexity in managing alarm systems, as well as limitations of nurses in managing several alarms and tasks that compete with these regarding priority.

During observations of monitors' data and alarms triggered, the author found that these alarms had a minimum impact on the care plan of patients. In 53 of the 161 alarms triggered, the alarm was artifact. This not only results in data without meaning, but also represents a noisy sound and possible interruption of nurses' regular work, probably withdrawing them from a more significant care procedure.

Inaudibility of alarms and competition of sounds

An alarm is considered audible when it can be heard by healthcare professionals in their environment, which includes background noise such as ventilators, feeding pumps, and people talking. On the other hand, alarms from different equipment compete among each other when triggered at the same time. This range of situations makes the hearing of alarms difficult. Another aspect that must be considered is the identification of alarms regarding their type (for example, if it is about low blood pressure or high heart rate) and the equipment's source that generates them. However, identifying the urgency of alarms is also necessary. Nurses have to distinguish and correctly identify which equipment is generating the alarm (source), with regard to each specific alarm and its urgency. All these aspects must be considered by equipment manufacturers for their standardization, thus making them more effective and universal among manufacturers⁽¹⁵⁾.

The IEC 60601-1-8 standard that manufacturers must follow, regarding the sound and function of alarms, suggests simple and melodic alarm sounds that enable the distinction of

eight different alarm sources (meeting the ability of humans in distinguishing from 5 to 7 categories of sound) and their classification as high-, medium- or low-priority⁽¹⁷⁾. However, some studies suggest the review of this standard, indicating that melodic alarm sounds are difficult to identify and distinguish when tasks overlap. These studies concluded that the capture of alarms with melodic sounds is weak and that nurses react faster and more accurately to medium-priority alarms, even though high-priority alarms sound more urgent⁽³⁾.

In a study about the audibility of alarms of infusion pumps, the author concluded that these alarms are audible enough and might compete with the environmental noise when the doors of rooms are opened. However, their audibility becomes significantly reduced when the doors of rooms are closed or when there is higher background noise. Therefore, it is important to have signaling devices of adjunct alarms to ensure their audibility⁽³⁾.

In the study by Funk et al.⁽¹³⁾, statements such as "difficulty in identifying the alarm source" and "difficulty in hearing alarms when triggered" increased regarding the degree of importance in the questionnaire undertaken in 2011, compared to that undertaken in 2005-2006. The increase in the importance of these two dimensions might be associated with the increase in the number of patients monitored, lack of standardized alarms, and increasing use of equipment with alarms. The authors also indicated the high background noise in hospitals as a factor that contributes to inaudibility.

There is a false argument that the increase in volume levels of alarm sounds facilitates their hearing in adjacent rooms, mostly assisted by the design of some units (where nursing rooms are adjacent to patients' units). However, Lawson et al.⁽¹⁶⁾ concluded that levels of these alarms, when measured in adjacent rooms, do not register a higher level of hearing of alarms, thus only causing noise for patients and inaudibility for nurses.

Difficulty in distinguishing the urgency of alarms

The urgency of alarms perceived contributes to the response of nurses to alarms. However, nurses use additional strategies to determine their responses, including the severity rate of patients, signal duration, rare occurrence of alarms, and their workload⁽³⁾.

Cited by Cvach⁽³⁾, Bitan found that professionals' probability of response is directly proportional to the alarm response, which is based on the perception rate of alarms as true. If an alarm system is perceived as 90% reliable, the response rate will be approximately 90%; if the alarm system is perceived as 10% reliable, the response rate will be approximately 10%.

Nurses respond to alarms for different reasons and not only because they trigger. Nurses prioritize their interventions through the evaluation of the urgency of alarms regarding the severity rate of patients and have a greater tendency to react to alarms of longer duration and those considered rare. As workload or the complexity of interventions and care to be provided increase, the response to alarms and performance of interventions decline. Therefore, the duration of signals assumes an important influence; however, workload, severity of

patients, and complexity of interventions might lead to other reaction/response strategies⁽³⁾.

Both the design of devices' alarm systems and the level of knowledge of professionals contribute to the inappropriate setting of alarms, which justify effective and continuous training reinforced by the study by Sowan et al., in which 50% of nurses reported the need for training on cardiac monitors⁽¹¹⁾. Although many alarm systems seem apparently easy, their functioning is not well understood by the staff. A specific case is the existence of several ways to deceive alarm systems of physiological monitoring. An action can silence an existing alarm; another can deactivate all alarms simultaneously; or another can also deactivate alarms indefinitely. The misunderstanding of these differences might lead to inappropriate actions for given circumstances, a situation that might trigger adverse events and affect patient safety⁽⁹⁾.

Studies such as those by Mackenzie and Galbrun⁽¹⁸⁾, Funk et al.⁽¹³⁾, and Honan et al.⁽¹²⁾ show that hospitals became noisy, thus hearing and identifying the sound of an alarm and providing an appropriate response in due time can sometimes become a difficult problem to solve.

Measures to reduce false alarms

Nurses can implement strategies to reduce the number of unnecessary alarms such as: to improve the preparation of patients' skin before the application of electrodes; substitute electrodes daily, as well as equipment batteries; proceed with the interruption of alarms for a short period of time before providing some specific care; customize limits of alarms to patients to prevent not operable alarms; and consider the establishment of standard limits specific for the unit. They should also make informed decisions regarding the time when monitoring begins and ends, in order to prevent unnecessary monitoring associated with false alarms^(3,12-13).

The setting of alarms to the real needs of patients ensures their validity and provides an early warning for potential critical conditions. Registering alarm parameters in the clinical process of patients proved to be an effective intervention to improve compliance regarding alarms settings^(3,14).

Hospitals must have appropriate policies to ensure training of healthcare professionals in the correct use of devices and alarm systems. The design of intensive care units must be thought and structured in a way that alarms can always be heard by the staff^(9,11).

Reduction of false alarms must result in a significant decrease in the frequency of alarms, with proportional increase in relevant clinical alarms. With less alarms, the response time of nurses to those clinically relevant will be shorter. The future impact will probably be a more effective use of the time by nurses, a more peaceful environment, and less sentinel events associated with monitoring alarms⁽¹³⁾.

Limitations of the study

The present study presented as limitation the lack of studies associated with the theme explored.

Similarly, the choice of descriptors, databases, and languages for the development of the study might have affected the results obtained.

CONCLUSION

Monitoring of clinical alarms has the purpose of previously warning changes in the clinical condition of patients. However, excessive false alarms might lead to desensitization of professionals, as well as to the interruption of work dynamics. Nurses, through care practice, are one of the professional groups most exposed to the problem of clinical alarms, given their continuous performance with patients.

Based on the research undertaken, critical factors that interfere with the efficiency in the performance of alarms include artifacts of sensors, the reduced consideration for the human factor

in equipment design, complexity of alarm systems, inappropriate design of facilities, environmental noise, and little training/knowledge of the staff regarding alarms and equipment with alarms.

Several studies on alarms in the hospital environment agree regarding the existence of excessive low-priority and false alarms that pollute the sound environment, interfere with communication, reduce concentration, increase the probability of errors, and reduce the response rate to alarms.

The development of observational studies and behavioral analysis of nurses regarding clinical alarms are suggested for further studies, with the purpose of optimizing patient safety, thus contributing to the continuous improvement in quality of care.

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