Evaluation of alarm fatigue in nurses working in intensive care units

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ABSTRACT

Aims: This study aimed to investigate alarm fatigue, which has a negative impact on nurses working in intensive care units.

Methods: A questionnaire of 20 questions consisting of the alarm fatigue scale in nursing and sociodemographic questions prepared on Google Forms was sent to the nurses working in intensive care units as a social messaging platform and e-mail between 1 January-1 February 2022.

Results: 219 nurses provided feedback. Nurses working in adult intensive care units participated with 70.6%. It was observed that alarm fatigue scores decreased as the duration of working in the intensive care unit and the duration of profession of the nurse increased.

Conclusion: As the age and professional experience of the nurses increase, the fatigue caused by the alarms decreases. Since this situation may pose a danger to the safety of patients who followed by the younger or nurses in the early years of their professions, it would be appropriate to develop nurses' methods of coping with alarms.

Keywords: Alarm, noise level, intensive care nursing, stress

INTRODUCTION

Intensive care units (ICU) are special treatment units with high technological equipment, developed for the follow-up and treatment of life-threatening organ failures seen in the course of both acute diseases and chronic diseases, with a high number of health professionals per patient for close observation and rapid intervention.[1] The existing oxygen-air system, bedside monitor, drug and food infusion devices, mechanical ventilator, patient warming-cooling device and, when necessary, dialysis device, telephone and computers in these units cause the noise level to reach 90 decibels.[2] The addition of medical device alarms, which are detected to ring an average of 170 times per bed, to these sounds further increases the noise problem.[3]

Alarms are an essential detection and warning tool that alerts nurses. Potentially dangerous changes in the patient's clinical condition or equipment failures can threat patient safety. An excessive number of out-of-process and false alarm signals from medical devices produces alarm fatigue. Alarm fatigue is a cognitive state that results in insecure solutions, such as delayed response time to alarms, disabled alarms, turning the alarm volume down to inaudible, limiting parameters set to unsafe values, or turning off the warning message without reason. Alarm fatigue is a patient safety issue.[4] Alarm fatigue is a phenomenon that occurs when nurses work in a clinical environment where alarm sounds are frequently heard.

Alarm fatigue can negatively affect nurses' productivity and concentration. In addition, the physical and mental health of employees who are constantly affected by their environment may also be affected.[3]

For this reason, it is crucial to determine and inform nurses about the effects of alarms. For this purpose, the Nurses' Alarm Fatigue Scale (NAFS) was developed and translated into Turkish for validity and reliability.[5]

This study aims to determine the alarm fatigue of nurses working in intensive care units and guide the measures that can be taken in this direction.

METHODS

The study was carried out with the permission of Bursa Yüksek İhtisas Training and Research Hospital Clinical Researches Ethics Committee (Date: 29.12.2021, Decision No: 2011-KAEK-25 2021/12-08). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

The participant questionnaire and scale form, consisting of 2 sections and a total of 20 questions, prepared with Google Forms, was sent to the nurses working in the different intensive care units in various hospitals in Turkey between January 1, 2022 and February 1, 2022 via e-mail and social

messaging platform. The questionnaire form used in our study was translated into Turkish and validated in Turkish by Kahraman et al.[5] Permission to use it in the study was obtained from the authors. The sample size of the study, in which the convenience sampling method was used, consisted of volunteer nurses who worked in the intensive care units between January 1, 2022 and February 1, 2022. The first 11-question part of the questionnaire consists of demographic data. The second part is the nurses' alarm fatigue scale consisting of 9 questions.[5] There is no specific cut-off value for the alarm fatigue questionnaire. The participants' alarm fatigue scores were evaluated sequentially based on their answers to the questions in the questionnaire.

Statistical Methods

The Jamovi (The jamovi project (2022). jamovi (Version 2.3)) package program was used for the statistical calculations of the data obtained from the research. Continuous variables were obtained by measurements mean±standard deviation; categorical variables in sociodemographic and clinical data were expressed as percentages and numbers. The data were obtained by Post Hoc Tukey HSD analysis after the analysis of variance was significant and homogeneous distribution was determined after One Way ANOVA analysis, p<0.05 was considered statistically significant.

RESULTS

The questionnaires sent were returned by 219 intensive care nurses. The participants' demographic data and their answers to the questionnaire are presented in **Table 1**. 70 % of the participants were women, 68 % of them had graduated from university and half of them were married. More than half of the group was between 25 and 44 years old.

Significant differences in NAFS were found between the age groups of 25-34 and over 45 years (p=0.003), 19-24 and 35-44 (p=0.024); 19-24 to 45 and above (p=0.0001).

According to the duration of the occupation, a significant difference was found between the NAFS scores of the nurses with a working period of 1-5 years and more than 15 years (p=0.008).

In the statistical analysis performed between NAFS (**Table 2**) according to the length of work in the intensive care unit, less than one year and more than 15 years (p=0.002); A significant difference was found in nurses with a working time of 1-5 years and more than 15 years (p=0.034).

Table 2. Nurses' Alarm Fatigue Questionnaire Scores by Age Groups	
NAFS scores (mean±SD)	
Age (year)	
19-24	15.81±6.1
25-34	14.79±5.8
35-44	11.88±5.7
45 +	9.94±4.3
Intensive care working length (year)	
< 1	15.87±4.8
1-5	14.41±5.6
6-14	13.14±6.5
15 +	10.24±4.8
Occupational length (year)	
<1	13.06±4.9
1-5	15.69±6.1
6-14	13.97±5.3
15 +	11.52±6.1
Shifts	
Night	11.44±4.9
Day	14.2±5.9
Day/night	13.98±6.1

Table 1. Demographic Data and Alarm Fatigue Evaluation Questionnaire					
	n:219 (%)				
Gender	**Male**			**Female**	
	29.7			70.3	
Age	19-24	25-34		35-44	>45
	16.4	49.8		26.5	7.3
Marriage	**Married**			**Single**	
	58.9			41.1	
Degree	**Highschool**	**Pre-degree**		**Degree**	**High-degree**
	11.4	12.3		68.9	7.3
Occupational length(year)	<1	1-5		6-14	>15
	5.5	36.5		30.6	36.5
ICU working length(year)	<1	1-5		6-14	>15
	7.8	52.1		30.6	9.6
Facility	**University**	**State**		**Private**	
	25.1	66.2		8.7	
Intensive care unit	**General**	**Surgical**	**Medical**	**Child**	
	70.6	5	15.1	3.7	
Shifts	**Day**	**Night**		**Day-Night**	
	8.7	4.1		87.2	
Chronic illness	**present**			**Absent**	
	22.4			77.6	
Alarm Fatigue Evaluation (%)					
	Always	**Usually**	**Occasionally**	**Seldom**	**Never**
I turn off alarms at the beginning of every shift	4.6	11	9.1	12.3	63.3
I usually hear a certain amount of noise in the environment/clinic	37.7	43.8	11.4	4.6	3.2
The heavy workload in some shifts prevents my quick response to alarms	9.1	20.5	37	22.8	10.5
when alarms go off again and again, I become insensible	0.5	0.9	12.3	22.4	63.9
Alarm sounds make me angry	7.3	21.9	30.1	25.1	15.5
When I am sad and nervous, I am more sensitive to alarm sounds	14.6	29.7	30.6	14.2	11
When alarms sound repeatedly and continuously, I lose my patience	4.1	16	23.7	30.1	26
Alarm sounds prevent me from focusing on my professional tasks	3.7	16.4	23.3	22.8	33.8
I pay less attention to the alarms of the equipment during visiting hours	1.8	3.7	11	20.5	63

Statistical analysis could not be performed, as a homogeneous distribution could not be achieved between the groups in the NAFS scores (**Table 2**) according to the working hours in the intensive care unit.

DISCUSSION

Intensive care units (ICUs) are hospital departments that are constantly exposed to loud noise. Many factors contribute to the high sound intensity in ICUs. In addition to these, alarms reporting changes in the physiological parameters of patients or faults in machines cause this sound intensity to increase even more. This situation inevitably causes adverse effects on employee health, employee productivity and patient safety.[6]

The alarm fatigue assessment questionnaire was created by Torabizadeh to evaluate the alarm fatigue of nurses.[7] Its validity and reliability were established by Kahraman et al.[5] This questionnaire aims to measure alarm fatigue by evaluating the attitudes and behaviors of nurses working in the intensive care unit towards alarms. No cut-off value is defined for alarm fatigue. However, high values are associated with higher levels of fatigue. Since the purpose of the study was to investigate the alarm fatigue, the answers to the questions were evaluated and reviewed individually. Therefore, the aim is to make corrective suggestions when the causes are uncovered. In assessing alarm fatigue among nurses in our country, it is more important to define under what conditions it increases and how it can be prevented than to state "there is alarm fatigue".

Alarm fatigue occurs when the nurses are desensitized to alarms and lead to negative results in terms of patient safety.[8,9] Depending on alarm fatigue, nurses may try to silence alarms, decrease the volume of the alarm, delay responding to the alarm by judging that the alarm is false, or try to turn off the alarm permanently without evaluating the patient.[9] "When alarms go off, again and again, I become insensible"63.9% of them answered as "never", and the high rate of this is critical and pleasing in terms of patient safety. Along with this question, "I usually hear a certain amount of noise in the environment/clinic," 89.9% of the participants answered that they heard a noise. When alarms are added to the basal sound level in ICUs, it increases to 90-110 decibels. Considering this, the nurses who are constantly in the ICU are exposed to loud noise. In addition to the employees, this situation also negatively affects the patients hospitalized in the ICU. This loudness may cause sleep disturbance and delirium in patients. It is therefore vital to control the volume and alarms.

There was a significant relationship between the age groups and alarm fatigue scores of the nurses participating in our study. Contrary to expectations, it was observed that alarm fatigue scores decreased with age. There was a significant difference between the scores of the groups aged 19-24 and 25-34 years and those over 45 years old. At the same time, a significant difference was found between the 19-24 age group scores and the 35-44 age group. There was a significant difference in alarm fatigue scores between nurses with a 1-5 years working history and nurses working in the intensive care unit for more than 15 years. Age, duration of profession years, duration of work in the intensive care unit and alarm fatigue score showed significant differences. It has been thought that this situation may be due to the increase in experience, knowledge and skill level, and the fact that it is easier to cope with the alarm management process, or it may also be due to occupational desensitization to alarms, which is a more dangerous situation, and it has not been possible to distinguish it. When the answers given to all the questions were evaluated, we concluded that advancing age and increasing professional experience enabled nurses to cope with alarm fatigue more successfully.

To the question "I turn off alarms at the beginning of every shift" in the alarm fatigue survey, 63% of the participants answered that they do not turn them off. This indicates that although alarm fatigue is present, nurses in the intensive care unit still act by alarm management. In the study of Akturan et al.[10] in which they evaluated the alarm fatigue of nurses working in COVID-19 intensive care units, they stated that nurses were more sensitive to the alarms of some patients whose clinical condition worsened and to the alarms of some devices during night shifts (such as being more sensitive to mechanical ventilators than to the sound of the infusion pump). It has also been suggested that nurses who work overtime and are less active on the night shift compared to the day shift may cause them to hear alarms more and react negatively. There was no meaningful difference between the groups since the nurses who answered our questionnaire, who were working night, day, night/day, were not homogeneously distributed among the groups. However, when the alarm fatigue score averages of the groups are examined, the average score of the group working only at night was found to be lower than the group working only during the day and day/night working group. According to the study of Şanlıtürk et al.[11] nurses working on the night shift experienced a significantly higher level of stress. It has been reported that night shift nurses are under more stress as a result of being more sensitive to alarms, and they experience the anxiety that "something can happen to the patient at any moment".[12] Reducing the working hours of night shifts can be effective in reducing this anxiety.

"The heavy workload in some shifts prevents my quick response to alarms" 66.6% of the participants answered this question as heavy workload sometimes-usually-always prevents them from responding to alarms. In the study of Akturan et al.[10] "the necessity to wear personal protective equipment" was determined as a factor that increases alarm fatigue in a process such as a pandemic where workload increases. The international patient safety commission has made some recommendations by setting targets for 'Improving Clinical Alarm Systems. It has been stated that alarm fatigue can be reduced by re-adjusting alarm limits according to the patient's condition before each shift, changing ECG electrodes, and re-adjusting alarms according to the situation when a new patient arrives. For basic monitoring in ICU, pulse rate, respiratory rate, blood pressure, and oxygen saturation (SpO_2) are monitored. According to the study of Eskin et al.[1] SpO_2 alarm is frequently encountered in hospitalized patients. Despite this, it was determined that the alarm settings were the least appropriate parameter according to the patient's clinic. It is thought that the alarm settings may be left in an inappropriately wide range since the saturation probe comes off easily from the finger, is challenging to fix, and more frequent alarms are activated due to other reasons.

It has been revealed that the nurses, who make up a total rate of 84.4% of the question "Alarm sounds make me angry", are angry because of alarms. This may be due to the anxiety created by the alarms, or it may be due to the noise alone. "When I am sad and nervous, I am more sensitive to alarm sounds". Mindfulness training and cognitive-behavioral therapies are recommended to reduce the rate of burnout in nurses.[13] "When alarms sound repeatedly and continuously, I lose my patience" 20.1% of the participants stated that the repeating of alarms often and always causes them to lose their patience. Since it will be difficult for intensive care nurses to develop appropriate behaviors for alarm management, appropriate approaches should be developed to support this team.[10] Improving working hours and conditions in institutions, establishing the alarm management process, inter professional cooperation and timely intervention of the technical support team can reduce this problem. "I pay less attention to the alarms of the equipment during visiting hours" was answered as "never" at a rate of 63%, which can be interpreted as the intensive care nurses continuing the alarm management process despite all their fatigue and ensuring patient safety.

According to the study of Akturan et al.[10] being a university and high school graduate led to significant differences in the alarm fatigue scores of nurses. The university graduate group showed better positive practices to reduce alarm fatigue.[14] In this sense, it is recommended to provide training to explain the conditions and effects of intensive care nursing in the pre-graduation period.[10] Although nurses do not have any suggestions to reduce the effects of alarms in their social lives, social and artistic activities can reduce the effects of alarms by diverting their attention. In addition, institutions should consider how they organize social and artistic events. On the contrary, manufacturers can develop solutions to monitor and track by specifying a different sound for each device. As it is known, the shortage of nurses is a significant problem worldwide. Salary improvements and rewards are among the things that need to be done to reduce the effects of this situation.[14] For the same purpose, economic improvements and social support for children and families are practices that managers should do.[10]

It is urgently necessary for patient safety and employee satisfaction to reduce the rate of respondents who answered the question "Alarm sounds prevent me from focusing on my professional duties" as always-usually.[15] Alarm management is a complex issue that can reduce alarm fatigue and positively impact the clinical aspect of patient safety.[16] Recognizing and preventing the deterioration in the patient's condition is also the nurse's responsibility.[17] For this purpose, nurses should be aware of the risks of inappropriate alarm settings and should be equipped to respond appropriately.[18] Effective alarm management is a challenging issue for nurses that requires knowledge and practice skills in alarm safety.[19] Studies indicate that personnel training is essential to increase alarm awareness for this purpose.[20]

CONCLUSION

Nurses are the health workers who work at the patient's bedside for the longest time. For this reason, they are the healthcare workers who are most exposed to alarms, although many of them are false. Establishing alarm management protocols to avoid alarm fatigue, establishing a multidisciplinary team including the medical device manufacturer, arranging alarm settings according to the patient, and developing appropriate strategies to avoid alarm fatigue will help increase the quality and safety of patient care by reducing stress exposure and fatigue of nurses.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Bursa Yüksek İhtisas Training and Research Hospital Clinical Researches Ethics Committee (Date: 29.12.2021, Decision No: 2011-KAEK-25 2021/12-08).

Informed Consent: All participants signed the free and informed consent form.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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