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Determinants of Alarm Fatigue among Nurses Working in Thika Level 5 Hospital, Kenya

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Introduction: One of the main sources of health technology risks is clinical alarms, such as those for cardiac monitors and mechanical ventilation. Alarm Fatigue is the cause of these risks. Alarm weariness is the psychological result of too many alarms going off in a medical setting, which makes Nurses miss real alarms that are clinically meaningful, hence the objectives of this study was to assess the level of alarm fatigue among Nurses working and assess Alarm Management strategies utilized by Nurses working at Thika Level 5 Hospital, Kiambu Kenya.
Methodology: The study design that was employed in this study is descriptive cross-sectional design. Structured self-administrated questionnaires were used to collect data. The researcher used census sampling where the entire population Registered Nurses working in the renal, theatre, casualty and emergency and critical care department. The data was analyzed using SPSS version

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25.0. The findings were presented in tables, graphs and figures. The analysis comprised of descriptive statistics, frequencies, mean, and standard deviations. Inferential statistics included chi-square test for independence (X^2).

Results: The study participants consisted of 56 Nurses and the response rate in this study was 82.1%. The majority of respondents were female, constituting 76.1% of the respondents. The age group of 31-40 years comprises the majority of respondents, accounting for 78.3% of the total. The overwhelming majority of respondents rated mechanical ventilators as having the highest alarm frequency (95.7%) followed by 58.7% of the respondents monitors as the main source of alarms. 73.9% of participants identified mechanical ventilator alarms as the most challenging to troubleshoot or operate. Nearly half of the respondents (47.8%) indicated that they are likely to trust clinical alarms to some extent.

Discussion: Majority of nurses (95.7%) encountered clinical alarms during their work shifts. Mechanical ventilators and cardiac monitors were rated as having the highest alarm frequency, while patient call systems and electrical beds were perceived to have the lowest alarm frequency.

Recommendations: Offering training on alarm management, optimizing staffing levels, and streamlining equipment interfaces to mitigate alarm fatigue and enhance patient care quality.

Keywords: Clinical alarm; alarm fatigue; nurses and alarm; critical care and alarms.

1. INTRODUCTION

Today's critical care environment has patients attached to more Physiological devices with alarms than they have ever been. Critical care nursing is highly complex, and errors in practice have resulted in injury or death [1]. A slow or failed response to alarms can result in a lethal outcome for the patient. Alarm Fatigue is not a recent problem. TJC released a sentinel alert in 2015 involving individuals getting mechanical ventilation who later suffered injury or died as a result of improper management of ventilator alarms. Sentinel Event No. 50, Medical Device Alarm Safety in Hospitals, was released by the TJC in April 2013 in response to complaints of numerous adverse events connected to a dearth of information [1].

In a study by Cheung et al. [2], Each bed had 5.35 cardiac and technical alarms every hour, or 128.4 per day [2]. In a different study, 426 alarms were recorded over the course of forty hours; multi-parametric monitors generated 227 alarms, whilst other devices generated 199 alarms, indicating an average rate of 10.6 alarms per hour. According to the study, it is necessary to adjust the alarms in intensive care units in order to minimize workflow disruptions by managing alarms properly. The author came to the conclusion that improper management of alarms in the critical care unit leads to a false sense of security and that most of them are disregarded or turned off by the nurses [3].

A mechanism that emits an auditory, visual, or other alarm signal to notify someone of a situation that needs immediate attention is known as an alarm device. Medical equipment and monitoring systems that have built-in or attached alarm systems that are activated by physiological changes in the patient, changes in the parameters being measured, or technical difficulties [4-11]. Clinical alarms from various medical devices are becoming an ongoing issue in critical care units with the improved development and use of medical technology. This new alarm hazard issue is being brought on by these clinical alarms [12]. In 1983 there were only up to six different types of alarms from a single critically ill patient, but as of 2011 there were at least 40 different types of clinical alarms. Clinical alert harm reduction became a national patient safety goal of the Joint Commission to emphasize the importance of this issue [13-19]. Patient monitors, mechanical ventilators, continuous renal replacement therapy devices, hemodialysis machines, syringe pumps and infusion pumps are the main alarm-triggering devices. In a study by Zhao et al. [20], a 56-bed ICU recorded 2,184 alarms for the 48 patients over the course of 48 hours, or an average of 45.5 alarms. 70% of alarms were silenced or ignored with no action taken. Many different medical equipment, each with its own distinct features and few of which are synchronized in the clinical setting, produce alarms. The distribution of alarms varies depending on the type of device, manufacturer, and alarm configuration settings, as well as the care unit. True (actionable or non-actionable) and false alarms are terms that can be utilised to classify these alarms.

For an adverse Patient outcome to be avoided, actionable alarms demand prompt attention. It is necessary to determine the key characteristics of an alert that are likely to cause harm in order to define actionable alarms. It is important to consider the response time. Persistence is a characteristic of actionable physiological alarms. Most consistently high or low vital indicators are cases of actionable alarms [20]

An exception to this rule are life-threatening alarms such as asystole or apnea. Alarms are used by infusion pumps to remind users to complete tasks or to let them know when a drug delivery setting is unacceptable. Examples include KVO rate, IV catheter placement, and infusion completion. These alarms are not dependent on persistence, although they may benefit from additional contextual data to distinguish non-actionable occurrences. Different medical devices have different qualities and each has specific hazards that may arise [21-26]. Identifying the contextual variables that must be present for an avoidable adverse event to occur is necessary to distinguish between actionable and non-actionable alarms. Setting overly sensitive conditions can result in unnecessary alarms. Alternatively, if the constraints are set too loosely, false negative events can occur [27].

True alarms that do not require clinical intervention or are the result of intentional activities are referred to as non-actionable alarms. They annoy clinicians and unnecessarily divert their focus. These short-term alarms usually clear themselves [28-30]. Low oxygen saturation short-term alarms and heart rate alarms are two examples. Both situations occur regularly, with the frightening vital gauge quickly returning to normal. Although recording these changes can be critical to patient care plans, and recurring patterns can be a sign of an imminent alarm condition, an audible announcement does not always require an immediate response [3].

Additional context may be required for other non-actionable alarms. Deliberate actions by qualified clinical personnel at the patient's bedside may trigger non-operable alarms. For example, suctioning an intubated patient may trigger a ventilator alarm that requires no adjustment of settings, but the occurrence of audible alarms adds environmental stimulation to all nearby physicians. The majority of nuisance alarms are caused by non-actionable alarms. Alarm annoyance can be significantly decreased by adding audio alarm delays [31].

Bad or missing data might cause false alarms to be produced. False alarms are often caused by patient movement, poor sensor placement, faulty cables, and errors in the device's alarm detection algorithm. Manufacturers have improved sensor design and detection algorithms, yet false alarms will continue to occur if medical devices are not used or maintained appropriately [32-35]. Through routine testing and inspection of medical devices, biomedical departments can significantly reduce false alarms. To keep lower prices from leading to more false alarms, purchasing departments need to weigh the savings of cheaper or remanufactured sensors against their performance to lessen bothersome ECG alarms, participants in the AAMI Summit suggested replacing ECG electrodes every day [36].

Traditional definitions of false alarms include alarms that have no clinical or therapeutic repercussions. The notion of "better safe than sorry" is still used in the design of monitoring systems today. False alarms are accepted far more frequently than they should be they are accepted in vast numbers rather than taking the chance of missing a few legitimate ones [37-43]. Alarms can be divided into clinically relevant/clinically irrelevant and technically correct/technically erroneous categories. If an alarm is based on a technically correct measurement, it is considered technically correct. Technically, false alarms are not based on an accurate measurement (e.g., ambient light interfering with pulse oximetry). Technically sound alarms can be further categorized as clinically relevant or irrelevant as not all of them are clinically relevant (e.g. insufficient thresholds) [44].

A major concern in patient safety is alarm fatigue. Alarm fatigue is the psychological result of too many alarms going off in a therapeutic setting, causing professionals to miss real alarms of clinical importance. Alarms can interrupt and distract caregiving [45,46]. Distractions and interruptions are frequent causes of potential errors that endanger nurses' well-being and ability to do their jobs [3,20]. Additionally, excessive alert exposure causes alarm fatigue, a desensitization to alarms that raises the possibility of a missed or delayed diagnosis of patient deterioration [47-51].

Patient injury has been documented in earlier investigations as a result of ignored or delayed alarm responses. According to a review of

unfavourable events By the FDA/USA Databases, 500 reports of patient deaths involving physiologic monitoring systems were received between January1, 2015 and December31, 2020. Many of these reports claim that the system failed to raise an alarm in the event of a critical change in a patient's clinical condition. Missed alarms were among the top 10 health technology risks of 2016, according to the ECRI Institute, a US nonprofit organization that studies medical procedures, devices, drugs and processes.

Recent research suggests that 94% of all alarms in a paediatric intensive care unit (PICU) were clinically unnecessary, according to researchers like Lawless. The investigation of false alarms is an ongoing issue in critical care; Observing on a PICU, Tsien and Fackler discovered that 92% of the alarms were false alarms. On the other hand, research by Goepfert et al. [46] found that 8 out of 1,455 alarms were triggered by potentially fatal circumstances [46]. They noted that these results are not limited to the PICU. Only 17% of the alarms were meaningful and 44% were technically incorrect, according to digital records of all alarms for 38 patients in a 12-bed medical intensive care unit. Recent research has disputed this, showing that 26 percent of alarms had insignificant effects, e.g. B. the forced relocation of some sensors. Only 6% of the alarms led to an emergency call. They also found that 17% was due to technical issues and 24% to staff manipulation.

In a recent observational study in emergency departments, observers monitored the number and types of alarms that were triggered by patients and the response time by nurses to alarms that were activated. The literature is void of randomized, controlled studies on alarm fatigue; however, there are review articles of the implementation of guidelines developed by individual hospitals and their Implementation on practice changes that have shown the decrease in alarm triggers [4]. According to research, the effects of nurse fatigue include decreased judgment, poor decision-making, a slower reaction time and lack of concentration, absenteeism, clinical errors, failure to perform rescues, nodding off while driving home, and interpersonal effects, such as poorer quality interactions with patients and coworkers. To understand alarm fatigue, it is important to evaluate Clinical Alarms and what their magnitude, this will improve nurses wellbeing and enhance work performance.

2. MATERIALS SAND METHODS

2.1 Study Design

This study was descriptive cross sectional design. It was conducted from 5 April2023 to 6 July 2023.

2.2 Study Siting

It was conducted at Thika Level 5 Hospital county referral hospital located in Kiambu County, Thika West District, Thika Municipality division in Biashara sub-location along the General Kago Road. The hospital has a staff 265 Staff Nurses. Thika Level 5 Hospital holds a busy Intensive Care Unit with a 6-bed capacity, and three which are isolated. A team of experienced Nurses supports the Critical Care Department. The nurse to patient ration in ICU was 1:2 while in HDU was 1:3.

2.3 Objectives of the Study

1. To assess the level of alarm fatigue among Nurses working at Thika Level 5 Hospital, Kiambu, Kenya.
2. To assess Alarm Management strategies utilized by Nurses working at Thika Level 5 Hospital, Kiambu Kenya.

2.4 Sampling Procedure and Techniques

The study made use of a census which is also known as complete coverage where every member of the target population who satisfied the inclusion criteria was include in this study. According to Etikan, Musa, & Alkassim, this method is used whenever the study population is too small to subjected to other sampling methods [52].

2.5 Inclusion and Exclusion Criteria

Registered Nurses with ICU and non-ICU training who have worked for at least one month in the ICU at the Thika Level 5 Hospital were included in the study. The researcher excluded all registered nurses working in the Critical care Departments who were not on duty during the time of study.

2.6 Sample Size Determination and Sampling Frame

The total of 56 registered nurses working in the critical care, renal, high dependent, casualty

and emergency and operating theatre department were sampled as follow in the Table 1.

2.7 Data Collection Methods

A self-administered questionnaire on Microsoft forms, accessible through mobile phones and computer interface was developed. This Tool was based on modified version of alarm fatigue evaluation instrument questionnaire survey by Sowan Azizeh. Five professionals with expertise in the study's topic evaluated the content validity and cronbach's alpha was used to determine the tool's reliability. The questionnaire had section A requested demographic information, section B inquired about the Nurses' level of alarm fatigue. A 4-point Likert scale with the options strongly agree, agree, disagree, and strongly disagree was used to gauge the respondents' opinions and Section C evaluated alarm management strategies utilized by Nurses.

2.8 Pretesting of Tool

The pilot study was conducted at Kiambu county referral hospital, where 6 Nurses representing 10% of the Population who have sample characteristic was involved. The Kiambu county referral Hospital, was chosen because of its striking similarity with the Thika Level 5 Hospital critical care Units. Nurses work in environment that simulate Thika Level 5 Hospital; equally, Patients are monitored in the same design and manner. The pretest was used to ensure the clarity of the questionnaire, identify the obstacles and the problems that may be encountered in data collection and estimate the time needed to fill the questionnaire, test the questionnaires validity and whether they are well structured so as to enable the researcher to elicit the required information.

2.9 Data Collection Methods

Data was gathered for six weeks from April 5 2023 to July 6 2023. Microsoft Forms were used to collect data. After getting ethical permission and agreement from hospital management, the researcher employed research assistants who scheduled meetings with the unit managers to describe the present study's objectives and request access to the intensive care nurses. According to the approval of the hospital administration, the surveys were distributed during working hours.

Table 1. Sampling frame

Sampling Frame		
Hospital	**Critical Care Units**	**Number of nurses per Unit**
Thika L5H	Intensive Care Unit (ICU)	18
	Renal Unit	10
	High Dependency Unit (HDU	8
	Casualty and emergency	6
	Operating Theatre	20
Total	6	56

2.10 Data Analysis

On Microsoft Forms, information was put into an electronic web-based database. The data was then exported to Statistical Package for Social Sciences (SPSS) version 25.0 for analysis. The data was analyzed using descriptive statistics and presented by bar graphs, pie charts, and relative frequency tables. The Chi-square test was used to determine if there were significant association between categorical variables.

3. RESULTS

The response rate in this study was 82.1%. The study participants consisted of 56 Nurses; 46 complete responses was received. This suggests that the sample size is robust and likely provides a representative understanding of the target population.

3.1 Socio-Demographic Characteristic

The majority of respondents were female, constituting 76.1% of the respondents. The age group of 31-40 years comprises the majority of respondents, accounting for 78.3% of the total. Most respondents had 11-20 years of practice, making up 63.0% of the total. The majority of respondents had a Post basic Diploma in Nursing, constituting 52.2% of the sample. The largest proportion of respondents were not specialized in any area, accounting for 41.3% of the sample. The majority of respondents worked in the Intensive Care Unit (ICU), representing 43.5% of the sample. These key findings provide valuable insights into the demographic profile of the surveyed nurses, offering context for interpreting the study results and understanding the characteristics of the sample population as presented in the Table 2.

3.2 Level of Alarm Fatigue among Nurses

The nurses indicated whether they encounter clinical alarms as shown in Fig. 1. The findings indicate that the majority of nurses (95.7%) encounter clinical alarms in their work environments. Only a small percentage (4.3%) reported not encountering clinical alarms during their work shifts.

The nurses indicated the most common sources of alarms in ICU as presented in Fig. 1.

Cardiac monitors emerged as the most common source of alarms encountered by healthcare workers, with over half of the respondents (58.7%) indicating their frequent use. These devices are vital for monitoring patients' heart rhythms and detecting abnormalities, making them a primary source of alarms in clinical settings.

The respondents provided their views on the rating on the equipment by the amount of Alarms Produced as presented in Fig. 2.

Table 2. Socio-demographic characteristic

	Category	Frequency (n)	Percentage (5%)
Gender	Female	35	76.1
	Male	11	23.9
Age	21-30	5	10.9
	31-40	36	78.3
	41-50	3	6.5
	50 and Above	2	4.3
Years of practice as a Nurse	0-10 years	14	30.4
	11-20 years	29	63.0
	21years and above	3	6.5
Level of Training	Bachelors Degree in Nursing	8	17.4
	Diploma in Nursing	13	28.3
	Master's Degree in Nursing	1	2.2
	Post basic Diploma In Nursing	24	52.2
Area of specialization	Adult Critical Care Nursing	12	26.1
	None	19	41.3
	Perioperative (Theatre) Nursing	o9	19.6
	Renal (Nephrology) Nursing	6	13.0
Unit / department of work	Intensive Care Unit - ICU	20	43.5
	Renal Unit	8	17.4
	Theatre/PACU	18	39.1

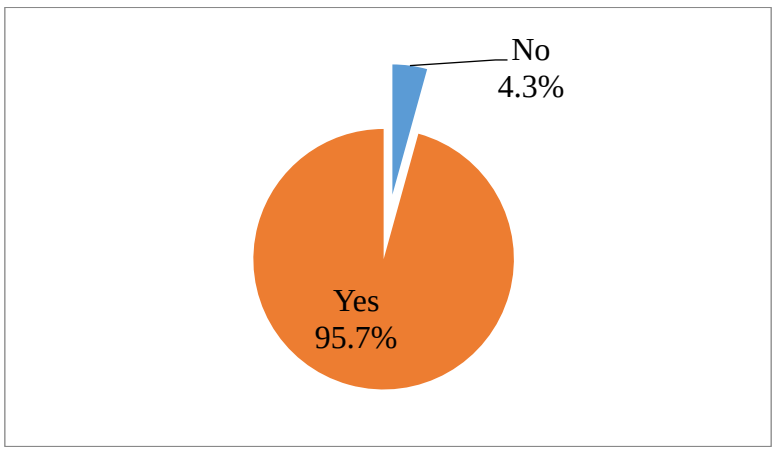

Fig. 1. Clinical alarms encounter

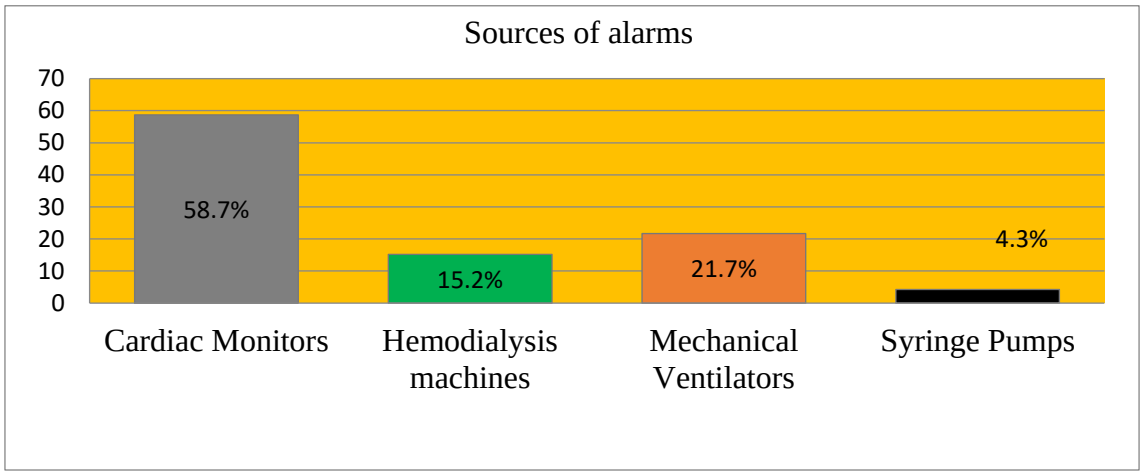

Fig. 2. Most common sources of alarms in ICU

3.3 Rating on the Equipment by the amount of Alarms Produced

The most notable rating for infusion pumps was 'Not Applicable' (34.8%) indicating that a significant proportion of respondents did not provide a rating for alarm frequency, potentially due to a lack of experience or exposure to alarms associated with infusion pumps.

The highest proportion of respondents rated patient call systems as having the lowest alarm frequency (43.5%). This suggests that alarms associated with patient call systems are perceived to be relatively infrequent compared to other equipment.

Similar to patient call systems, electrical beds received the highest proportion of ratings for the lowest alarm frequency (50%). This indicates that alarms related to electrical beds are perceived to be minimal in frequency.

While a substantial proportion of respondents did not provide a rating for hemodialysis machine alarms (NA), the highest proportion of ratings indicated the lowest alarm frequency (30.4%). This suggests that alarms associated with hemodialysis machines are perceived to occur relatively infrequently.

The highest proportion of respondents rated syringe pumps as having the lowest alarm frequency (39.1%). However, a notable percentage of respondents also indicated NA, suggesting a lack of experience or exposure to syringe pump alarms among some respondents.

The majority of respondents rated cardiac monitors as having the highest alarm frequency (69.6%). This indicates that alarms associated with cardiac monitors are perceived to occur frequently and may potentially pose challenges in clinical settings due to alarm fatigue.

The overwhelming majority of respondents rated mechanical ventilators as having the highest alarm frequency (95.7%). This highlights the significant concern regarding alarm frequency and potential alarm fatigue associated with mechanical ventilators in healthcare settings.

The study sought to find out the most difficult physiologic alarms to troubleshoot/operate. The findings were as presented Table 3.

According to the data, the majority of respondents (73.9%) identified mechanical ventilator alarms as the most challenging to troubleshoot or operate. This suggests that healthcare professionals may encounter difficulties with managing mechanical ventilator alarms in clinical settings, potentially impacting patient care and safety.

The Charité Alarm Fatigue Score (CAFQa) is a metric used to assess and quantify alarm fatigue experienced by the nurses as presented in Fig. 3.

According to the data, the majority of respondents (73.9%) identified mechanical ventilator alarms as the most challenging to troubleshoot or operate. This suggests that healthcare professionals may encounter difficulties with managing mechanical ventilator alarms in clinical settings, potentially impacting patient care and safety.

Table 3. Rating on the equipment by the amount of alarms produced

	Lowest%	Low%	Moderate%	High%	Highest%	NA
Infusion Pumps	32.6	26.1	0	4.3	2.2	34.8
Patient Call systems	43.5	21.7	2.2	0	0	32.6
Electrical Beds	50	15.2	2.2	0	0	32.6
Hemodialysis Machine	30.4	15.2	10.9	0	0	30.4
Syringe Pumps	39.1	23.9	4.3	2.2	2.2	28.3
Cardiac monitors	2.2	2.2	6.5	15.2	69.6	4.3
Mechanical ventilators	2.2	13	32.6	47.8	95.7	4.3

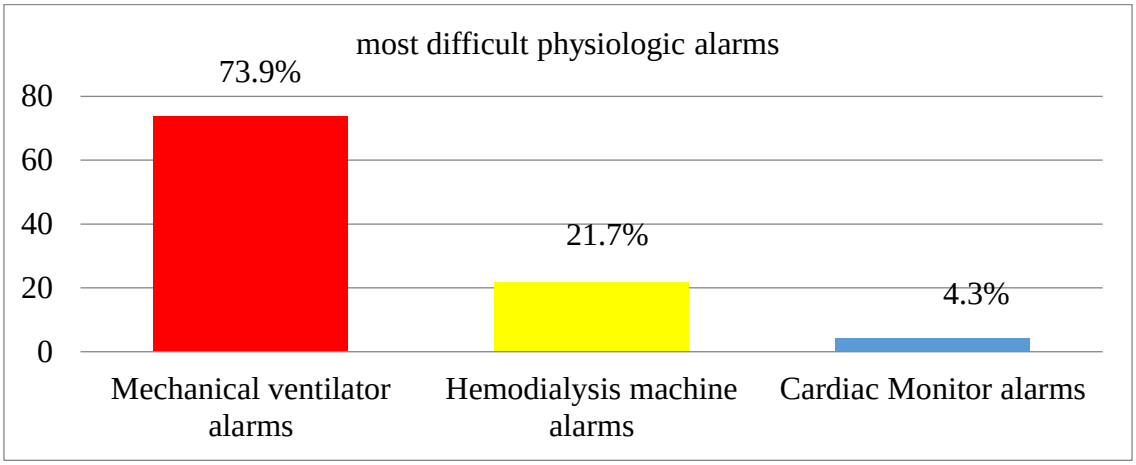

Fig. 3. Most difficult physiologic alarms to troubleshoot

3.4 CAFQa – Alarm Fatigue Score

The Charité Alarm Fatigue Score (CAFQa) is a metric used to assess and quantify alarm fatigue experienced by the nurses. The nurses moderately agree that alarm limits are regularly adjusted based on patients' clinical symptoms, showcasing a proactive approach to alarm management and patient safety (Mean=3.41). The nurses acknowledged that excessive alarms in their department can negatively impact their performance and motivation, agreeing in part with this statement (Mean=3.20). This indicates a potential burden on nurses' effectiveness and job satisfaction. Nurses sometimes feel confused by alarms, indicating occasional challenges in interpreting and responding to alarm signals accurately (Mean=3.35). Clearer alarm systems and standardized protocols may help mitigate confusion. Nurses find that audible and visual monitor alarms used in their department allow for clear assignment of patient, unit, and urgency, agreeing in part with this statement (Mean=3.22). This indicates satisfaction with the clarity and effectiveness of alarm systems. The Nurses recognized that alarms can diminish their ability to concentrate and pay attention to patient care tasks, agreeing in part with this statement (Mean=3.26). This highlights the potential for alarms to disrupt workflow and compromise patient safety. Nurses frequently experience interruptions in their workflow due to patient alarms or crisis alarms, agreeing in part with this statement (Mean=3.17). These interruptions may hinder nurses' efficiency and contribute to fragmented care delivery. A majority of the nurses agreed in part that they experience physical symptoms such as nervousness, headaches, and sleep disturbances due to the presence of too many alarms (Mean=2.96). This suggests that alarm overload may have adverse effects on nurses' well-being and health. Nurses generally perceive that responsible personnel respond quickly and appropriately to alarms, but agree in part with this statement (Mean=2.96). However, there is room for improvement in ensuring consistent and timely alarm response. However, a majority of nurses disagree that procedural instructions on dealing with alarms are regularly updated and shared with all staff in their ward, disagreeing in part with this statement (Mean=1.98). This suggests an

institutional effort to improve alarm management practices and enhance staff preparedness in Table 4.

3.5 Alarm Fatigue Score Classification

The alarm fatigue was further categorized into maximum and minimum. A greater majority if the nurses (89.1%) had a maximum alarm fatigue score, suggesting that a subset of nurses experienced significantly higher levels of alarm fatigue as shown in Fig. 4.

3.6 Symptoms Associated with Alarm Fatigue

A significant majority of respondents (71.7%) reported feeling bored by clinical alarms, indicating a potential symptom of alarm fatigue. Similar proportions of respondents (71.7%) indicated feeling irritated by the repetitiveness of clinical alarms, emphasizing the potentially bothersome nature of frequent alarms. Additionally, 58.7% of respondents reported feeling a lack of interest in clinical alarms, further suggesting a disengagement or desensitization to alarm signals. A significant majority of respondents (63%) reported knowing colleagues who have experienced alarm fatigue, highlighting the pervasiveness of the issue within healthcare environments. A slight majority of respondents (52.2%) reported suffering from alarm fatigue themselves, indicating personal experiences with the phenomenon. A similar proportion of respondents (52.2%) admitted to silencing alarms without paying attention to potential underlying problems. Nearly half of the respondents (43.5%) reported feeling indifferent to clinical alarms, indicating a lack of emotional response or investment in alarm signals. This indifference may reflect a degree of desensitization or apathy towards alarm signals, which could be indicative of alarm fatigue as indicated in Table 5.

Table 4. CAFQA – Alarm fatigue score

	N	Not agree at all%	Not agree%	Agree in part%	Agree%	Very much agree%	Mean	Std. Deviation
With too many alarms in my Department, My performance and motivation decreases	46	26.1	0	32.6	15.2	26.1	3.41	1.147
Too many alarms trigger physical symptoms for me, e.g., Nervousness, Headache, sleep disturbances	46	2.2	23.9	39.1	27.1	13	3.20	1.025
Alarms reduce my concentration and attention	46	2.2	15.2	47.8	23.9	10.9	3.26	.929
My/or neighboring patients' alarms or crisis alarms frequently interrupt my workflow.	46	4.3	10.9	54.3	23.9	6.5	3.17	.877
There are situations when alarms confuse me	46	4.3	4.3	52.2	30.4	8.7	3.35	.875
In my ward, a procedural instruction on how to deal with alarms is regularly updated and shared with all staff. *	46	52.2	13	23.9	6.5	4.3	1.98	1.202
Responsible personnel respond quickly and appropriately to alarms.*	46	10.9	15.2	50	15.2	8.7	2.96	1.053
The audible and visual	46	4.3	6.5	60.9	19.6	8.7	3.22	.867

	N	Not agree at all%	Not agree%	Agree in part%	Agree%	Very much agree%	Mean	Std. Deviation
monitor alarms used on my department allow me to clearly assign patient, unit, and urgency.*								
Alarm limits are regularly adjusted based on patients clinical symptoms(e.g blood pressure limits for condition after surgery)	46	2.2	8.7	54.3	15.2	19.6	3.41	.979
Valid N (listwise)	46							

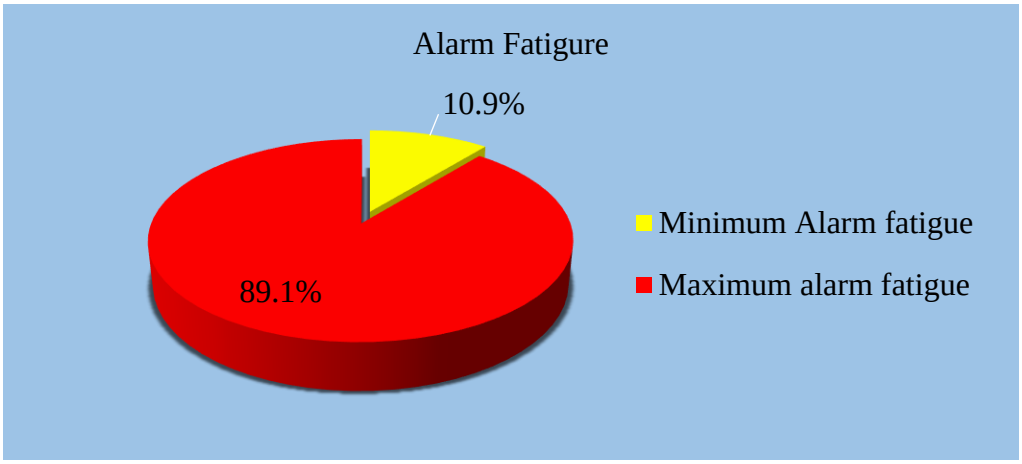

Fig. 4. Alarm fatigue score classification

Table 5. Symptoms associated with alarm fatigue

Symptoms	Yes		No	
	n	%	n	%
Do you feel bored by clinical alarms?	33	71.7	13	28.3
Do you feel lack of interest with clinical alarms?	27	58.7	19	41.3
Do you feel irritated by the repetitiveness of clinical alarms?	33	71.7	13	28.3
Do you feel indifferent to clinical alarms?	20	43.5	26	56.5
Do you suffer from alarm fatigue	24	52.2	22	47.8
Do you know colleagues who have experienced alarm fatigue	29	63	17	37
Do you silence alarms without attention to potential underlying problems?	24	52.2	22	47.8

Table 6. Likelihood to trust clinical alarms

	Frequency	Percent
Likely	22	47.8
Not Likely	13	28.3
Very Likely	8	17.4
Very Unlikely	3	6.5
Total	46	100.0

3.7 Likelihood to Trust Clinical Alarms

Nearly half of the respondents (47.8%) indicated that they are likely to trust clinical alarms to some extent. A notable portion of respondents (28.3%) reported that they are not likely to trust clinical alarms, suggesting a level of skepticism or concern about their reliability. Despite the skepticism, a substantial number of respondents (17.4%) expressed high confidence in clinical alarms, stating that they are very likely to trust them. A small minority of respondents (6.5%) indicated that they are very unlikely to trust clinical alarms, reflecting a level of distrust among a limited portion of the sample in the Table 6.

3.8 Nurses Perception of Alarms

A majority of nurses perceived consistent exposure to alarms as leading to fatigue, with the mean rating of 3.111 indicating agreement with this statement. Nurses, on average, agreed that much of the noise in the wards results from the alarms of monitoring equipment (mean=3.09). Nurses, on average, agreed that frequent false alarms reduce attention to patients, indicating concerns about patient care (mean=3.04). While there is agreement that alarms are a nuisance in critical care units, the mean rating (mean=2.74). Suggests a slightly lower level of concern compared to other statements. Nurses, on average, were indifferent that alarm sounds prevent them from focusing on their professional duties, indicating a significant impact on their work (mean=2.5). There was a disagreement, on average, that nurses raise alarm limits at the beginning of every shift, suggesting a proactive approach to alarm management (mean=2.43) as presented in the Table 7.

3.9 Alarm Management Strategies Utilized by Nurses

The most common strategy reported was assessing the source of alarms, with nearly half of the participants (47.8%) using this approach. Adjusting alarm limits was the second most common strategy, with 30.4% of participants employing this method. Silencing alarms was used by 15.2% of participants. The respondents rated their actions in operating alarms on the critical care devices.

Table 7. Nurses perception of alarms

	N	SD	D	A	SA	Mean	Std. Deviation
Alarms are a nuisance in the critical care units	46	4.3	39.1	34.8	21.7	2.74	.855
Consistent exposure to Alarms cause fatigue	46	2.2	6.5	69.6	21.7	3.11	.605
Frequent false alarms reduce attention to patient	46	2.2	15.2	58.7	23.9	3.04	.698
I raise alarm limits at the beginning of every shift	46	8.7	43.5	43.5	4.3	2.43	.720
I believe much of the noise in the wards is from the alarms of monitoring equipment	46	2.2	17.4	50	30.4	3.09	.755
Alarm sounds prevent me from focusing on my professional duties	46	6.5	50	30.4	13	2.50	.810
Valid N (listwise)	46						

Table 8. Strategies used to manage alarms

	Frequency	Percent
Adjust alarm limits	14	30.4
Asses the source of alarm	22	47.8
I call someone	1	2.2
I call someone who knows to check especially anaesthetist	1	2.2
Ignore alarms	1	2.2
Silence alarms	7	15.2
Total	46	100.0

Table 9. Actions in operating alarms on the critical care devices

	N	Very rare	rarely	Occasionally	Very frequent	Mean	Std. Deviation
I regularly readjust the limits of alarms based on the clinical symptoms	46		19.6	45.7	34.8	3.15	.729
Pause alarms and cancel the pause	46		4.3	78.3	17.4	3.13	.453
Silence alarms	46		23.9	47.8	28.3	3.04	.729
During my shift, I limit the number of alarms by disabling them	46	6.5	28.3	52.2	13	2.72	.779
Change alarm volume	46	2.2	8.7	65.2	23.9	3.11	.640
Change alarm limits safely (10-30%)	46	0	15.2	65.2	19.6	3.04	.595
Differentiate the source of each alarm (e.g., HRe Low alarm is from ECGf settings)	46	2.2	15.2	60.9	21.7	3.02	.683
Customize default settings to patient specific settings	46	2.2	13	56.5	28.3	3.11	.706
contact service personnel to correct difficult alarms	46	15.2	23.9	39.1	21	2.67	.990
Check alarm settings at the start of every shift, with any change in patient condition and with any change in caregiver	46	4.3	21.7	56.5	17.4	2.87	.749
Use proper oxygen saturation probes and placement	46	0	10.9	58.7	30.4	3.20	.619
Provide proper skin preparation for and placement of ECG electrodes	46	17.4	23.9	52.2	6.5	2.48	.863
I go to the patient's bedside immediately I hear alarms	46	0	8.7	54.3	37	3.28	.621
I have immediate reaction infusion and syringe Pump alarms	46	23.9	32.6	34.8	8.7	2.28	.935
I have immediate reaction to cardiac monitor alarms	46	2.2	4.3	37	56.5	3.48	.691
I have immediate reaction to ventilators	46	0	4.3	8.7	45.7	3.24	.794
I have immediate reaction To Hemodialysis Machines	46	0	58.7	30.4	10.9	2.52	.691
Valid N (listwise)	46						

3.10 Actions in Operating Alarms on the Critical Care Devices

Respondents indicated that they occasionally contact service personnel to correct difficult alarms, with a mean score of 2.67 and a standard deviation of 0.990. Respondents tend to react very frequently to cardiac monitor alarms, as indicated by a mean score of 3.48 and a standard deviation of 0.691. Similarly, respondents tend to react very frequently to ventilator alarms, with a mean score of 3.24 and a standard deviation of 0.794. Respondents tend to adhere to proper use and placement of oxygen saturation probes very frequently, with a mean score of 3.20 and a standard deviation of 0.619. Regularly readjusting alarm limits based on clinical symptoms is carried out occasionally by respondents, as indicated by a mean score of 3.15 and a standard deviation of 0.729. Respondents tend to pause alarms or cancel the pause occasionally, with a mean score of 3.13 and a standard deviation of 0.453. Respondents tend to change alarm volume occasionally, as indicated by a mean score of 3.11 and a standard deviation of 0.640. Respondents tend to customize default settings to patient-specific settings occasionally, with a mean score of 3.11 and a standard deviation of 0.706. Respondents tend to silence alarms occasionally, with a mean score of 3.04 and a standard deviation of 0.729. Similarly, respondents tend to change alarm limits within a safe range "occasionally", with a mean score of 3.04 and a standard deviation of 0.595. Respondents tend to differentiate the source of each alarm occasionally, with a mean score of 3.02 and a standard deviation of 0.683.

Checking alarm settings regularly is carried out occasionally by respondents, as indicated by a mean score of 2.87 and a standard deviation of 0.749. Respondents tend to limit the number of alarms by disabling them rarely, with a mean score of 2.72 and a standard deviation of 0.779. Respondents tend to react rarely to hemodialysis machine alarms, as indicated by a mean score of 2.52 and a standard deviation of 0.691. Providing proper skin preparation for and placement of ECG electrodes is carried out very rarely by respondents, as indicated by a mean score of 2.48 and a standard deviation of 0.863. Respondents tend to react very rarely to infusion and syringe pump alarms, with a mean score of 2.28 and a standard deviation of 0.935.

4. DISCUSSION OF FINDINGS

4.1 Level of Alarm Fatigue among Nurses

Majority of nurses (95.7%) encountered clinical alarms during their work shifts and this consistent with previous research of Cheung, Chau and Mak, [2] and Zhao et al. [20] which highlighted the prevalence of clinical alarms in critical care environments due to the increased use of physiological monitoring devices. In these findings, participants revealed that cardiac monitors were identified as the most common source of alarms which was also reported in the studies which emphasized that cardiac monitors as major contributors to alarm fatigue due to the frequent monitoring of patients' heart rhythms [2]. Mechanical ventilators and cardiac monitors were rated as having the highest alarm frequency, while patient call systems and electrical beds were perceived to have the lowest alarm frequency [52]. Corresponds with prior studies, Rodger et al. [45] and Goepfert and Reuter, [46] identify various medical devices as major alarm-triggering sources and emphasize the complexity and critical part of managing alarms, especially from equipment like mechanical ventilators.

Mechanical ventilator alarms were identified as the most challenging to troubleshoot or operate by the majority of respondents. The above findings were consistent with findings of Lawless et al. (2018) and The Joint Commission, [53] revealed the complexity and significance of mechanical ventilator alarms, improper management of which can have serious consequences for patient safety. The Nurses reported experiencing various alarm fatigue symptoms, such as feeling bored, irritated, and indifferent to clinical alarms. These findings corresponds with existing literature recognizing alarm fatigue as a significant patient safety concern, with adverse effects documented on nurses' well-being and job performance [45,44].

4.2 Alarm Management Strategies Utilized by Nurses

The study found that nurses employed various strategies to manage alarm fatigue effectively in clinical settings. Specifically, they commonly assessed the source of alarms and adjusted alarm limits as primary approaches. Additionally, silencing alarms emerged as a prevalent method among participants. These findings agreed with

previous study which highlighted the importance of proactive alarm management strategies [54].

When operating alarms on critical care devices, nurses demonstrated that it take most of their time during their activities. They consistently and promptly reacted to critical alarms from cardiac monitors and ventilators, underscoring the criticality of immediate responses to these alarms. This finding resonates with previous literature emphasizing the significance of timely intervention in critical care settings [55].

Moreover, nurses consistently adhered to proper use and placement of oxygen saturation probes, indicating a commitment to ensuring accurate monitoring. However, certain actions, such as providing proper skin preparation for and placement of ECG electrodes, were less commonly performed, suggesting potential areas for improvement in adherence to best practices. Similarly, some operational adjustments, like customizing default settings to patient-specific parameters and differentiating the source of each alarm, were carried out occasionally, indicating opportunities for enhancing consistency in alarm management practices. These findings corroborate existing literature emphasizing the importance of comprehensive alarm management strategies tailored to individual patient needs [56]. They also underscore the need for ongoing education and training to ensure nurses are equipped with the necessary skills to effectively manage alarms in critical care settings.

5. CONCLUSION

In conclusion, the study provides valuable insights into the alarm management strategies utilized by nurses to address alarm fatigue in clinical settings. Nurses employ various approaches, including assessing the source of alarms and adjusting alarm limits, to effectively manage alarm-related challenges. The findings underscore the importance of proactive and timely responses to critical alarms from cardiac monitors and ventilators, highlighting the critical role of nurses in patient monitoring and safety. Furthermore, the study identifies areas for improvement, such as ensuring proper skin preparation and placement of ECG electrodes, and enhancing consistency in operational adjustments like customizing default settings. These findings emphasize the need for ongoing education and training to equip nurses with the skills and knowledge necessary for optimal alarm management.

6. RECOMMENDATIONS

i. Implement regular training sessions and workshops for nurses on effective alarm management strategies, including how to prioritize and respond to alarms based on clinical urgency. This can help alleviate alarm fatigue by enhancing nurses' skills and confidence in managing alarms, hence improved patient nursing care.

ii. Introducing technology-assisted solutions, such as smart alarm systems or alarm fatigue monitoring tools, to assist nurses in filtering out non-actionable alarms and prioritizing critical alarms can help reduce the overall alarm burden and improve nurses' ability to focus on clinically relevant alarms which save the patients.

iii. Develop policies and guidelines that promote adequate rest breaks and work-life balance for nurses, particularly those working long hours in critical care settings. Implementing structured shift schedules and providing opportunities for rest can help mitigate the effects of prolonged working hours on alarm fatigue.

iv. Enhance interdisciplinary collaboration between nursing staff and biomedical teams to address equipment-related issues promptly and ensure the reliability of monitoring devices. Regular maintenance checks and troubleshooting protocols can help minimize equipment malfunctions and false alarms, reducing alarm fatigue among nurses.

v. Improve staffing levels and nurse-to-patient ratios in critical care units to alleviate workload pressures and enable nurses to respond more effectively to alarms. Adequate staffing can help prevent alarm fatigue by distributing the workload more evenly and allowing nurses to prioritize patient care.

vi. Enhance training programs and educational resources on alarm management for nursing staff, focusing on topics such as equipment operation, alarm troubleshooting, and adherence to institutional policies. Providing comprehensive training can empower nurses to better understand and manage alarms, reducing the likelihood of alarm fatigue.

vii. Implement standardized protocols and procedures for alarm management in clinical settings, outlining best practices for adjusting alarm limits, prioritizing alarms, and responding to critical alarms. Clear guidelines can help ensure consistency in alarm management practices and reduce the risk of alarm fatigue.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

The author(s) hereby declare that NO generative AI technologies such as Large Language Models or text-to-image generators have been used during the writing or editing of this manuscript.

CONSENT

The respondents were asked if they agree to take part in the study, and those who agreed, they electronically signed the consent form using Microsoft forms and the questionnaire was given to them to complete at their convenience, and the researcher then received it immediately.

ETHICAL APPROVAL

Ethical clearance was obtained from the IERC at Mount Kenya University, and the Thika level 5 Research and Ethics committee.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. The joint commission, sound the alarm: Managing physiologic monitoring systems. Jt Comm Perspect Patient Saf. 2018; 11(12):6-11.
2. Cheung WK, Chau LS, Mak ILL. Prevalence of alarms in intensive care units, and its relationship with nursing. Journal of Perioperative and Critical Intensive Care Nursing; 2016.
3. Luna AA, Silva RCLD, Barbosa MTS. The influence of nursing activities score on clinical alarms service. Scelo; 2020. Available:https://doi.org/10.1590/0034-7167-2018-0963
4. Lewandowska K, Weisbrot M, Cieloszyk A, Mędrzycka-Dąbrowska W, Krupa S, Ozga D. International Journal of Public Health; 2020. Available:https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7697990/
5. Yue L, Plummer V, Cross W. The effectiveness of nurse education and training for clinical alarm response and management: A systematic review. Journal of Clinical Nursing. 2018;17-18:2511-2526. DOI: 10.1111/jocn.13605
6. West, Abbott and Probst. Alarm fatigue: A concept analysis. 2019;18(2):1-1.
7. Walsh-Irwin C, Jurgens C. Proper skin preparation and electrode placement decreases alarms on a telemetry unit, Dimensions Critical Care Nursing. 2015;34 (3):134-139.
8. Sue Sendelbach RP, CCNS Marjorie Funk RP. Alarm fatigue; A patient safety concern. AACN Advanced Critical Care. 2013;24 (4):378-386.
9. Storm J, Chen HC. The relationships among alarm fatigue, compassion fatigue, burnout and compassion satisfaction in critical care and step-down nurses; 2020. Available:https://onlinelibrary.wiley.com/doi/full/10.1111/jocn.15555
10. Sowan AK, Gomez, Michelle T, Tarriela AF, Reed C. Calhoun and Michael B. JMIR Publications; Advancing Digital Health and Open Science; 2016. Available:https://humanfactors.jmir.org/2016/1/e1/
11. WSAASP, Sendelbach S. Stop the noise: A quality improvement project to decrease electrocardiographic nuisance alarms. Critical Care Nurse. 2015;35(4):15-22.
12. Cvach M, Biggs M, Rothwell K, CHC. Daily electrode change and effect on cardiac monitor alarms: An evidence-based practice approach. J Nurs Care Qual. 2013;28(3):265–271.
13. Sendelbach S, Funk M. Alarm fatigue: A patient safety concern. Lippincot Nursing Center. 2015;378 - 386.
14. Seiferta M, Tola DH, Thompson J, McGugan L, Smallheer B. Effect of bundle set interventions on physiologic alarms and alarm fatigue in an intensive care unit: A quality improvement project. Intensive and Critical Care Nursing. 2021; 67:103098. Available:https://www.sciencedirect.com/science/article/pii/S0964339721000872?casa_token=2WzSsyZ3wtoAAAAA:o4dyxqVBBP1ySjXYhSNfOjD9wavCkUu5cyPsKk7zUcwbWHuZ0aWh3vo8bwLVC_zY-PgnAeUw-mE

15. Schmid F, Goepfert M, Reuter D. Patient monitoring alarms in the ICU and in the operating room. Journal of critical Care. 2018;216.
16. Rossum MCV, Vlaskamp LB, Posthuma LM, Visscher MJ, Breteler MJM, Hermens HJ, Kalkman CJ, Preckel B. Journal of Clinical Monitoring and Computing; 2021. Available:https://link.springer.com/article/10.1007/s10877-021-00666-4
17. Ramlaul A, Chironda G. Alarms in the ICU: A study investigating how ICU nurses respond to clinical alarms for patient safety in a selected hospital in KwaZulu-Natal Province, South Africa. South African Journal Of Critical Care Nursing. 2021;57-53.
18. Poole S, Shah N. Addressing vital sign alarm fatigue using personalized alarm thresholds. Bio Computing. 2018;472-483.
19. Pelter MM, Drew BJ. Patient Safety Network; 2015. Available:https://psnet.ahrq.gov/web-mm/harm-alarm-fatigue
20. Zhao Y, Wan M, Liu H, Ma M. The current situation and influencing factors of the alarm fatigue of nurses' medical equipment in the intensive care unit based on intelligent medical care. Journal of Healthcare Engineering, p. Article ID 9994303 Available:https://doi.org/10.1155/2021/9994303, 2021
21. Pelter MM, Mortara D, Badilini F. Computer assisted patient monitoring: Associated patient, clinical and ECG characteristics and strategy to minimize false alarms. The Application of Computer Techniques to ECG Interpretation). 2021;2(4):459-471. Available:https://doi.org/10.3390/hearts2040036
22. Mahmoud HWS. Assessment Knowledge of Nurses about clinical alarms in critical setting in ELRebat University Hospital; 2017. Available:http://repository.ush.sd:8080/xmlui/handle/123456789/791
23. Luo B, Mc Loone M, Rasooly IR, Craig S, Muthu N, Won J, Ruppel H, Bonafide CP. Protocol for a New Method to Measure Physiologic Monitor Alarm Responsiveness. Biomedical Instrumentation and Technologies. 2020;54(6):389–396. Available:https://doi.org/10.2345/0899-8205-54.6.389
24. Lukasewicz C, Andersson Mattox E. Patient safety. Understanding clinical alarm safety. American Journal of critical Care Nursing. 2015;35(4):45-57.
25. Lukasewicz C, Mattox E. Understanding clinical alarm safety. Critical Care Nurses. 2015;35(4):45-57.
26. Lee SJ, Yun Mi L, Seo EJ, Son YJ. Impact of hospital nurses' perception on clinical alarms and patient safety culture on alarm management practice. International Journal of public health and environmental Research. 2021;18(8):4018. Available:https://doi.org/10.3390/ijerph18084018
27. Cvach M, Doyle P, Wong SY, Letnaunchyn K, Dell D, Mamaril M. Decreasing Pediatric PACU noise level and alarm fatigue: a quality improvement initiative to improve safety and satisfaction. Journal of Peri Anesthesia Nursing. 2020;357-364.
28. Casey S, Avalos G, Dowling M. Critical care nurses' knowledge of alarm fatigue and practices towards alarms: A multicentre study. Intensive Crit. Care Nurs. Intensive Care Nursing. 2018;48:36–41.
29. Busch-Vishniac I. Death by alarm: An error model of hospital alarms. The Journal of the Acoustical Society of America. 2016;139:2201.
30. Bourgi H, Sabbah H, Al'Jamil A, Sabbah I. Evaluating the alarm fatigue and its associated factors among clinicians in critical care units. Indian Journal of Clinical Medicine. 2020;1(1):9.
31. Walsh BK, Waugh JB. Alarm strategies and surveillance for mechanical ventilation. Journal of Respiratory Care. 2020;65(6): 820-831. Available:https://doi.org/10.4187/respcare.07546
32. Keller J. Clinical alarm hazards: A top ten health technology safety concern. Journal of Electrocardiology. 2012;45:588–591. DOI: 10.1016/j.jelectrocard.2012.08.050
33. I. Joint Commision. Hospital Inter National Patient Safety Goals; Goal 6 - Reduce the harm associated with clinical alarm systems. The Joint Commision, Pennsylvania; Washington DC; 2020.
34. Jamsa JO, HUutela K, Tapper AM, Lehtonen L. Clinical alarms and alarm fatigue in a University Hospital Emergency Department; A retrospective Analysis.

Journal of Emergency Anaesthsiology; 2021.
35. Horkan MA. Alarm fatigue and patient safety. Nephrol Nurs J. 2014;41 (1):83-85.
36. Schmidt B. Alarm Fatigue Hazards: The Sirens Are Calling; 2020. Available:https://www.psqh.com/analysis/alarm-fatigue-hazards-the-sirens-are-calling/
37. Graham K, Cvach M. Monitor alarm fatigue: Standardizing use of physiological monitors and decreasing nuisance alarms. Am J Crit Care. 2010;28–34.
38. Gorisek R, Mayer C, Hicks B, Barnes J. An evidence-based initiative to reduce alarm fatigue in a burn intensive care unit. Journal of Critical Care Nursing. 2021;29-37.
39. Funk M, Clark JT, Bauld TJOJC, CP. Attitudes and practices related to clinical alarms. American Journal of critical care Nursing. 2014;23(3):9-e18.
40. Foley L, Anderson CJ, Schutz M. Re-Sounding Alarms: Designing Ergonomic Auditory Interfaces by Embracing Musical Insights; 2020. Available:https://doi.org/10.3390/healthcare8040389
41. Despins LA. Factors influencing when intensive care unit nurses go to the bedside to investigate patient related alarms; A descriptive qualitative study. Intensive and critical care Nursing 2017; 2017.
42. Christensen M, Dodds A, Sauer J, Watts N. Alarm setting for the critically ill patient: A descriptive pilot survey of nurses' perceptions of current practice in an Australian Regional Critical Care Unit. Intensive Critical Care Nursing. 2014;30: 204–210.
43. Cho OM, Kim H, Young Whee Lee. Clinical Alarms in Intensive Care Units: Perceived Obstacles of Alarm Management and Alarm Fatigue in Nurses; 2016. Available:https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4756058/#:~:text=Four%20of%20the%209%20types,rang%20per%20patient%20per%20hour
44. Welch J. Alarm fatigue hazards: The sirens are calling. Journal of Anaesthesia. 2021;307:1591.
45. Rodger J, Baker K. Data for: Assessing Causes of Alarm Fatigue in Long-Term Acute Care and Its Impact on Identifying Clinical Changes in Patient Conditions; 2020. Available:https://data.mendeley.com/datasets/dr5hvdydbv/1
46. Goepfert MS, Reuter DA. Patient monitoring alarms in the ICU and in the operating room. Biomed central (BMC) article. 2018;216:17.
47. Bliss JP, Gilson RD, Deaton JE. Human probability matching behaviour in response to alarms of varying reliability. Journal of Clinical Ergonomics. 2017;38 (11):1995.
48. Bi J, Yin X, Li H, Gao R, Zhang Q, Zhong T, Zan T, Guan B, Li Z. Effects of monitor alarm management training on nurses' alarm fatigue: A randomised controlled trial. Journal of Clinical Nursing. 2020;29 (21-22):4203-4216.
49. Baker' K, Rodger J. Assessing causes of alarm fatigue in long-term acute care and its impact on identifying clinical changes in patient conditions. Informatics in Medicine Unlocked. 2020; (18).
50. Asadi N, Salmani F, Asgari N, Salmani M. Alarm fatigue and moral distress in ICU nurses in COVID-19 pandemic. British Medical Journal. 2022;125.
51. ACCE Foundation TH. Journal of Clinical Engineering: Clinical Alarms Task Force Impact of Clinical Alarms on Patient Safety. 2017;32(1):22-33.
52. Etikan I, Musa SA, Alkassim RS. Comparison convinience sampling and purposive sampling; census. American Journal of Theoritical and Applied Statistics. 2016;1-4.
53. T. The Joint Commission. Medical Device Alarm Safety in Hospitals. The Joint Commission; 2013.
54. Meng'anyi LW, Omondi LA, Muiva MN. Assessment of nurses interventions in the Management of Clinical Alarms in the critical care unit, Kenyatta National Hospital, a cross sectional study. Biomed Central Nursing. 2017;16:41.
55. Lewandowska K, Weisbrot M, Cieloszyk A, Krupa S, Ozga D. Impact of alarm fatigue on the work of nurses in an intensive care environment—a systematic review. International Journal of Environmetal Research and Public Health. 2020;22-34.
56. Sowan AK, Vera AG, Fonseca EI, Reed CC, Tarriela AF, Berndt AE.

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