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Critical Care Nurses' Perception of Alarm Fatigue and Related Issues for Effective Management

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Thesis Approval

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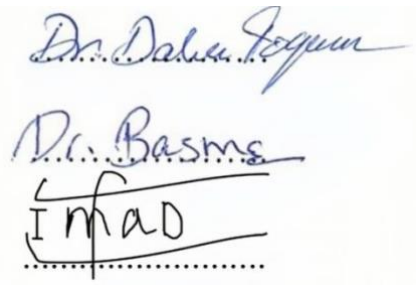
1. Dr. Dalia Toqan: Supervisor	
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Declaration

I declare that, except where explicit reference is made to the contribution of others, this thesis is substantially my own work and has not been submitted for any other degree at the Arab American University or any other institution.

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Dedication

This work is dedicated to my mother and father, whose steadfast prayers and unwavering support has been the cornerstone of my journey.

To my fiancée, to my cherished family, their unwavering support and faith in my potential has been my pillar of strength.

To my loyal friends, whose unwavering support and encouragement has been a beacon of light in moments of doubt.

To the brave martyrs and resilient people of Palestine, whose unwavering spirit and enduring struggle inspire me to strive for justice and peace.

To every individual who extended a helping hand and provided invaluable support along the way, I express my deepest gratitude.

May this work stand as a testament to the collective efforts and blessings that have guided me on this path.

Acknowledgment

Foremost, I express my profound thanks to my mom and dad for their steadfast love, guidance, and sacrifices have been the bedrock of my educational pursuits. Their enduring encouragement and understanding have been invaluable throughout this journey.

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Furthermore, I extend sincere gratitude to all who helped with their invaluable collaboration in data collection, which significantly enriched the Research.

While I have invested considerable effort into this endeavor, I am acutely aware that its realization would not have been feasible without the indispensable assistance of critical care nurses. Their dedicated participation and invaluable insights have profoundly contributed to the Research's success. Thus, I am very grateful to each and every one of them, may this work stand as a testament to the collective efforts and collaborations that have facilitated its fruition.

Abstract

Alarm fatigue resulting from frequent and often false alarms, poses significant risks to patient safety and nurse performance. The objective was to investigate critical care nurses' perceptions of alarm fatigue, identify contributing factors, and develop strategies for effective management to enhance patient safety and nurse performance in governmental hospitals in the West Bank. Cross-sectional research was achieved with 185 critical care nurses from six governmental hospitals using Convenience sampling to distribute and collect survey questionnaires—data analysis using SPSS 27, T-tests, ANOVA, and Chi-square tests. The study period is fromMay1, 2024, to May20, 2024.

The results found the mean alarm fatigue score was 30.64 ± 5.63indicating moderate to high alarm fatigue, with higher scores in Neonatal Intensive Care Units. Perpetual alarms interfere with patient care, according to 74.1% of nurses. The study highlighted a major issue: only 14.6% had received in-service alarm training. In conclusions there is a need for tailored, unit-specific training to address alarm management challenges. Despite a well-educated workforce, the low rate of in-service training underscores the urgency for comprehensive programs. Implementing smart alarms and ensuring adequate staffing is crucial to enhancing patient safety and minimizing alarm fatigue.

Recommendations found that Hospitals need continuous, specialized alarm management training, especially in Neonatal Intensive Care Units. Better nurse-topatient ratios and smart alarms that prioritize alarms can reduce workload and alarm fatigue. Clear policies for alarm management are crucial for consistent and effective practices.

Keywords**:** alarm fatigue, critical care nurses, patient safety, Intensive Care Unit

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List of Abbreviations

AF: Alarm Fatigue

AACN: American Association of Critical Care Nurses

AJC: The American Joint Commission

CCN: Critical care nurses

CCU: Critical care unit

ICU: Intensive Care Unit

NICU: Neonate Intensive Care Unit

PICU: Pediatric Intensive Care Unit

SPSS: Statistical Package for Social Sciences

WHO: World Health Organization

MOH: Palestine ministry of health

ECRI: Emergency Care Research Institute

JCAHO: Joint Commission on the Accreditation of Healthcare Organizations

HTF: Healthcare Technology Foundation

TJC: The Joint Commission

ACCE: American College of Clinical Engineering

FDA: Food and Drug Administration

Chapter 1

Introduction

1.1 Background

Alarm Fatigue encapsulates nurses' gradual desensitization and indifference toward alarms due to their sheer volume and lack of clinical relevance (Scott et al., 2019). This phenomenon is defined as a state where there is a reduced sensitivity or indifference towards alarms, often caused by an excessive number of false or non-urgent alarms or due to the frequent and persistent use of continuous monitoring systems (Turmell et al., 2017).

In the complex and demanding environment of the ICU, the reliance on sophisticated medical technology is paramount. Patients in these units are often critically ill and require continuous monitoring. The devices that facilitate this monitoring are equipped with various alarms to alarm caregivers to potential issues or changes in a patient's condition (Legere, 2018). The complexity of this challenge expands beyond bedside monitors and mechanical ventilators, which are fundamental in critical care. Both invasive and noninvasive forms of mechanical ventilation are equipped with both audible alarms and visual alarms. Their design aims to guarantee secure mechanical ventilator assistance by notifying the crew of any changes in the patient's condition, contributing significantly to AF (Scott et al., 2019). These devices, crucial for patient stability, add further alarms, often contributing to the cacophony of non-urgent signals (Alsuyayfi & Alanazi, 2022).

Concurrently, the noise level in ICUs remains notably high, averaging 71.9 decibels (dBA)—akin to the noise in a busy office space or that produced by a vacuum cleaner—and can reach peaks of 96 dBA, which is equivalent to the sound intensity of a propeller plane flying at 150 meters above. Studies have shown that much of this intense noise originates from medical equipment near patients (Koomen et al., 2021).

The repercussions of AF are profound and, at times, dire. Patient outcomes are imperiled as the inundation of non-urgent alarms leads to delayed responses or outright neglect of critical alarms, potentially resulting in adverse events, including patient deaths (Casey et al., 2018). The ramifications of AF extend far beyond the annoyance of persistent noise; it poses a significant threat to patient safety. In ICUs, where precision and timely intervention is critical, the high volume of false or clinically insignificant alarms can mask genuine alarms, leading to potential adverse events. Alarms, intended as beacons of critical information, have become ubiquitous—so much so that up to 85-99% of these signals are deemed false or non-urgent, inundating the clinical environment (Lewandowska et al., 2020).

Nurses, pivotal in identifying clinical deterioration, face cognitive overload and burnout due to the high sensitivity of monitor alarms, leading to delayed responses and endangering patient safety (Ergezen&Kol, 2020). Nurses are the frontline sentinels in patient responsibility and the backbone of patient care in critical care settings. They confront an avalanche of 150 to 400 alarms per patient during their shifts, consuming a staggering 35% of their work time. They face the daunting task of discerning critical alarms from hundreds of non-urgent ones, a challenge that can lead to alarm desensitization, and in some cases, the disabling of alarms to cope with the noise (Hravnak et al., 2018). This phenomenon not only disrupts patient care but also contributes significantly to the stress, fatigue, and burnout experienced by nurses, affecting their well-being and efficiency (Seifert et al., 2021).

The prevalence of AF is not confined to ICUs; it is widespread in various healthcare environments, including emergency departments, general wards, and pediatric care units (Jämsä et al., 2021). Moreover, this phenomenon affects the clinical domain and nurses' psychological well-being. "Compassion fatigue" describes a decline in empathy or desensitization towards patient care, often arising from prolonged exposure to high-stress conditions and extensive patient care. This issue is particularly acute in critical care units where the use of advanced healthcare technologies and clinical monitors with numerous alarm functions has significantly increased. AF and the demanding healthcare environment contribute to compassion fatigue and burnout among critical care nurses, impacting patient

care and staff welfare. This underscores the need for a comprehensive and universal approach to alarm management across different healthcare settings (Storm & Chen, 2021).

To effectively combat AF, a multi-pronged strategy is essential. This strategy includes technological innovations, such as sophisticated alarm algorithms to reduce false alarms and customization to meet the demands of specific patients. Additionally, understanding nurses' perceptions and practices towards these alarms is crucial. Many alarms are perceived as nuisances, especially when they are false or clinically irrelevant, affecting the response times and overall trust in the alarm systems. Increasing evidence suggests that nurses often view numerous clinical alarms as bothersome; particularly those that are found to be inaccurate or do not require any action (Simpson & Lyndon, 2019).

The issue has drawn significant attention from healthcare organizations and patient safety advocates. The ECRI Institute, a leader in patient safety research, has consistently ranked AF as a top health technology hazard. They identified alarm hazards as the foremost health technology risk for years 2012 through 2015, emphasizing the need for robust education and training in alarm management for nurses in critical care settings (Hoehne et al., 2018). The persistent noise from alarms in ICUs affects the healthcare staff's and patients' experiences and outcomes. Patients exposed to continuous alarm noise may experience increased stress and anxiety, which can hinder their recovery process (Cobus et al., 2018). Alarm management in ICUs also faces design and management challenges due to the growing number of monitoring devices. These challenges impact clinician workflow and patient comfort (Özcan et al., 2019). Effective alarm management, based on patient-customized approaches, is critical for maintaining patient safety without overwhelming healthcare providers (Lewis & Oster, 2019).

The urgent need to address this issue cannot be overstated. The proliferation of alarms, while well-intended, demands a comprehensive, systemic approach involving technological

advancements, revised protocols, and enhanced training initiatives (Ruppel et al., 2018). The shift toward mitigating AF necessitates a recalibration in designing, understanding, and managing clinical alarms in healthcare settings (Wilken et al., 2019). In essence, the narrative of AF transcends the mere annoyance of incessant beeping; it embodies a systemic challenge requiring a concerted effort to safeguard patient safety, alleviate nurse burden, and redefine the role of clinical alarms in modern healthcare (Zhao et al., 2021).

1.2 Problem Statement

In ICU environments, nurses face complex patient care tasks, often relying on monitoring systems like monitors, ventilators, and infusion pumps to assess patient health. While essential for safety, these systems emit frequent alarms—many non-critical—leading to overwhelming alarms. This constant exposure to alarms can result in alarm fatigue, increasing the risk of burnout among nurses and potentially compromising patient safety (Lewandowska et al., 2020). A notable concern is the high rate of false or unnecessary alarms, with studies indicating that 85% to 99% of these alarms do not require medical intervention, creating needless disruptions for medical staff (Lewandowska et al., 2020). The critical nature of AF is further highlighted by data linking it to serious safety incidents, including 216 deaths associated with unheeded physiological monitor alarms. Such statistics indicate an immediate need for alarm management and standardization improvements within healthcare systems (Casey et al., 2018).

The Joint Commission (TJC) documented 98 events related to alarms from January 2009 to June 2012, with 80 leading to death, 13 causing permanent loss of function, and 5 requiring additional care (Deb & Claudio, 2015). Since 2013, TJC has prioritized patient safety for alarm management, urging healthcare systems to implement policies to reduce the burden of superfluous alarms (Brief, 2016).Beyond patient safety, significantly impacts nurses, with the relentless flow of alarms leading to increased stress and burnout, adversely affecting job satisfaction (Storm & Chen, 2021). Organizations such as TJC are actively working to address these challenges and lessen alarm fatigue. This involves the application of standardized alarm handling policies and the promotion of professional alarm systems that

can sift through and give priority to critical alarms, thus easing the load of AF on healthcare personnel. These initiatives highlight the increasing acknowledgment of the necessity for enhanced technology, policy formulation, and staff training to address AF in the healthcare industry effectively (The Joint Commission, 2024).

1.3 Significance of Study

Still, the phenomenon of AF has only recently been explored by researchers; most of this Research emanates from North America, Australia, and Europe, but a few studies were found in the Middle East (Alsaad et al., 2017; Casey et al., 2018). Existing Research indicates a knowledge gap in alarm management and a pressing need for educational interventions to mitigate AF and enhance patient safety and nurse welfare (Hoehne et al., 2018). The study is significant as it aims to improve patient safety and enhance the working conditions of critical care nurses. The result of the study can inform policies and practices in critical care settings, reducing AF and improving the safety of patients. The study also contributes to understanding alarm management and patient safety in healthcare. It can decrease the risk of patient harm, improve critical care nurses' well-being and job satisfaction, and enhance the quality of care in critical care facilities. (Alsaad et al., 2017; Casey et al., 2018).

1.4 Research Aim

This research aims to investigate the perceptions of critical care nurses regarding alarm fatigue, to identify the contributing factors to alarm fatigue, and to provide insights into the extent of AF among critical care nurses to develop effective management strategies that enhance patient safety and nurse performance in governmental hospitals in the West Bank.

1.5 Objectives of the Study

1.5.1 Main Objective

This Research's main objective is to examine critical care nurses' perceptions of alarm fatigue, identify the key factors contributing to alarm fatigue, and develop effective management strategies to enhance patient safety and improve nurse performance in governmental hospitals in the West Bank.

1.5.2 Specific Objectives

1. Examine the prevalence and severity of alarm fatigue among Palestinian ICU nurses in governmental hospitals in the West Bank.

2. Investigate the association between sociodemographic characteristics (like as age, gender, social status, educational level, and unit) of Palestinian ICU nurses and their levels of alarm fatigue.

3. Examine the perspectives of Palestinian ICU nurses regarding clinical alarms, including their response behaviors and attitudes toward alarm management protocols.

4. Identify and analyze the key factors that hinder the effective management of clinical alarms in ICU settings within governmental hospitals in the West Bank.

5. Propose recommendations and strategies for mitigating alarm fatigue and improving alarm-management practices to enhance patient safety and nursing performance in Palestinian ICU environments.

1.6 Research Questions

In the study, four questions were examined:

1. What is the overall level of alarm fatigue among Palestinian ICU nurses?

2. Are there any significant differences in alarm fatigue levels among Palestinian ICU nurses based on their sociodemographic characteristics?

3. What are the perspectives of Palestinian ICU nurses toward clinical alarms?

4. What are important issues that could effective the management of clinical alarms?

1.7 Research Hypotheses

The null hypotheses are:

- There are no significant variations in alarm fatigue levels among Palestinian ICU nurses based on their demographic factors (age, gender, social status, educational level, unit …, etc.) at a 5% level of significance.

- No significant relationship between the perspectives of Palestinian ICU nurses regarding clinical alarms and their gender at a 5% level of significance.

1.8 Conceptual Framework

The researcher constructed his framework and offered a conceptual model (Fig. 1) illustrating how patient safety and performance are affected by alarm fatigue. The personality traits and the ICU working conditions, with the large number of ignored or not-ignored alarms ICU nurses are experiencing, will affect the sensation nurses feel toward alarm over time. Overwhelming sensations may lead to desensitization of the alarm. Given that personality has been connected to information processing and alarm weariness, the sense of alarm utility and the emotional reaction to alarms may be related to particular personality factors. Therefore, we hypothesize that personality traits and perceptions of clinical alarms are contributing factors that affect staff performance and may cause alarm adverse events that affect patient safety (Lewandowska et al., 2023). Moreover, nurses' well-being will be affected. Hospital managers and nursing leaders may be able to focus actions on anticipating and lowering AF in critical care by having a better understanding of the underlying variables.

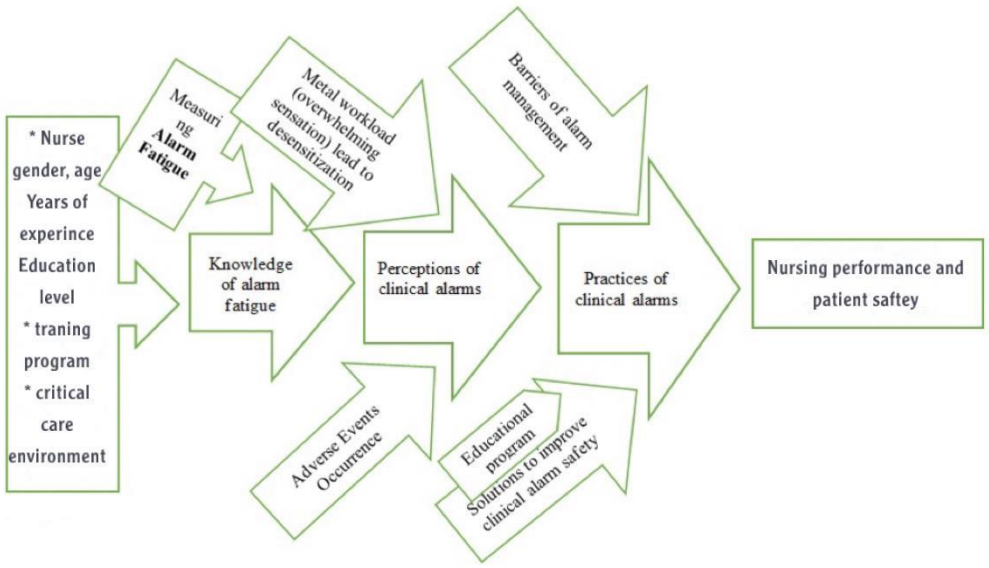

Figure 1.1: Conceptual Framework

1.9 Conceptual and Operational Definitions

1.9.1 Alarm Fatigue: a sense of overload while Nurses are exposed to an overabundant number of alarms, potentially leading to diminished sensitivity to alarms and missed alarms (Lewandowska et al., 2020).were Measured via a Questionnaire on a five-point Likert scale, there isn't a set threshold for alarm fatigue. Still, higher ratings suggest a more significant effect of alarm fatigue on the work of nurses.

1.9.2 Perceptions of clinical alarms: Nurses' perceptions of clinical alarms are the processes for arranging, recognizing, and making sense of sensory data to grasp and comprehend the information being of the environment. Perceptions of nurses regarding clinical alarms as are dependent variable were measured via a Questionnaire on a five-point Likert scale the higher the score, the more negative the alarm perception.

1.9.3 Gender: Individual physiological sex according to what he will describe himself as are Nominal and Independent variable were Measured via a Questionnaire on Male or Female.

1.9.4 Years of Experience: The number of working years in the ICU as is independent variable was measured via a Questionnaire on categorized numbers.

1.9.5 Education Level: The educational qualification of a nurse working in an ICU as an Ordinal and Independent variable was measured via a Questionnaire on Diploma, Bachelor, Master, or PhD.

1.9.6 Department: The clinical area the nurse works in according to the type of intensive care unit (ICU).According to the type of intensive care unit (ICU) Nominal and Independent variable was measured via a Questionnaire on General ICU, cardiac care unit, (CCU), neonate intensive care unit (NICU), and pediatric intensive care unit (NICU).

1.9.7 Educational Program: Availability of educational programs related to AF in the health institution. Nominal and Independent variable was Measured via a Questionnaire by Yes or No.

1.9.8 Barriers to Alarm Management: Issues that inhibit effective alarm management, such as difficulty setting alarms properly, difficulty hearing alarms…etc. Nominal and Independent variable was Measured via a Questionnaire by ranking the important issues.

Chapter Two

Literature Review

2.1 Introduction

This chapter gives a synthesis of recent studies on alarm fatigue. The collection of literature was conducted utilizing a computerized search of databases i.e., PubMed, ProQuest Nursing, MEDLINE, and Google Scholar. The studies reviewed were published from 2011 to 2024. Keywords used during the search included alarm fatigue, false alarms, clinical alarms, nurses' role and alarms, alarm fatigue influences, critical care nurses' performance, and patient safety.

2.2 Review of the Studies

Salameh et al. (2024) conducted a descriptive cross-sectional study in Palestine to investigate the impact of frequent warnings from monitors and other electro-medical gadgets on healthcare workers, specifically focusing on AF among intensive care unit (ICU) nurses. The study aimed to assess stress levels and AF among critical care nurses and to identify predictors of perceived stress and alarm fatigue. The study involved 187 ICU nurses from hospitals in the northern and central West Bank of Palestine. Due to logistical constraints, data were collected using the AF Scale and the Perceived Stress Scale via online surveys. The research was conducted from November 2023 to January 2024. The results showed that the average total AF score was 23.36 (SD = 5.57) out of 44.

According to the findings, 69.5% of the ICU nurses reported experiencing stress to an average or high degree, while 62.6% reported having alarm fatigue. The study found a strong positive Pearson correlation between stress and AF ($r = 0.40$, $p < 0.01$). Significant predictors of AF included the nurse-to-patient ratio, years of experience, gender, and reported stress. In contrast, the type of working shift and hospital unit were significant predictors of perceived stress.AF poses a risk to patient safety by potentially delaying necessary interventions and

leading to missed or ignored critical alarms. The study highlighted that the greatest score was associated with shifts in attention to alarms based on the working shift—a factor not examined in this research. Future studies should explore how different shifts impact patient outcomes and alarm fatigue. The study also emphasized that stress is a significant predictor of alarm fatigue. Therefore, managing stress is crucial for reducing AF and fostering a positive work environment conducive to optimal patient care.

Chromik et al. (2022) conducted a study in the United States focusing on the use of patient monitoring equipment in intensive care units (ICUs). For decades, such equipment has been instrumental in directing therapy and alerting staff when vital signs deviate from predefined ranges. However, the high volume of clinically irrelevant or technically false alarms has led to AF among workers, making them less responsive to urgent alarms.

In their systematic review, Chromik et al. (2022) summarized research efforts aimed at mitigating AF through IT solutions, adhering to the Preferred Reporting Items for Systematic Reviews (PRISMA) checklist. The review included 69 peer-reviewed papers. Most of the publications addressed strategies to prevent technically false alarms, while the remaining focused on predicting patient deterioration or optimizing alarm presentation. The review highlighted that the majority of analyzed alarms were related to arrhythmia or heart rate, followed by arterial blood pressure, oxygen saturation, and respiratory rate. Although some studies explored wearable technology, cell phones, or head-mounted displays for staff alarm delivery, most concentrated on developing software solutions. Among these, tree-based statistical models were the most commonly used.

The review concluded that IT-based solutions hold promise in reducing alarm fatigue. However, future efforts should focus more on preventing clinically actionable warnings, potentially by increasing data availability. The study found that current IT-based remedies align with the characteristics of alarm fatigue, addressing various aspects such as reducing

false alarms, prioritizing alarms, and presenting them effectively. Nonetheless, the review noted that current research heavily emphasizes available data rather than clinical needs. While there has been extensive study on preventing technically false alarms, research on preventing clinically inappropriate (i.e., non-actionable) alarms is limited, possibly due to a lack of verified datasets for this issue.

In a cross-sectional study conducted by Alan et al. (2021) in Turkey, the primary objective was to determine the validity and reliability of the Turkish translation of the AF Questionnaire. The study sample consisted of 140 nurses working in intensive care units across three hospitals in Istanbul, Turkey. Data were collected using the "Personal Information Form" and the "AF Scale."

The study involved two phases of data analysis: adaptation and confirmation. The adaptation process included translation, back-translation, expert opinion, and a pilot study. The confirmation phase involved several steps. Initial item analyses were conducted to evaluate individual items. Bartlett's sphericity test and the Kaiser-Meyer-Olkin (KMO) sample adequacy test were used to assess the factorability of the correlation matrix. Confirmatory factor analysis (CFA) was then applied to validate the initial construct. Finally, internal consistency was tested, and test-retest reliability was evaluated using the paired-samples t-test and Pearson's correlation test.

The scale consisted of two subscales and thirteen items. The content validity ratings for the scale items exceeded 0.35. The fit indices for the scale were $\chi^2/df = 1.453$, RMSEA = 0.059, and CFI = 0.91. The Cronbach's alpha coefficient for the scale was 0.71.The original 13-item construct of the AF Questionnaire was not confirmed by the goodness-of-fit indices in this study. Consequently, one item that showed a poor association across the scale was removed based on literature recommendations. After implementing certain modification suggestions, acceptable fit values were achieved in a subsequent CFA.

The study concluded that the final 12-item Turkish version of the scale met the required standards for validity and reliability. Given that this is a newly modified scale, it may be useful to evaluate its current construct further or retest it in different samples to verify its effectiveness.

Claudio et al (2021) conducted an observational study to explore personality and work-related factors that may contribute to AF among healthcare professionals. The primary aim of this research was to establish a foundation for identifying variables that could indicate the likelihood of AF in critical care personnel.

The study involved an observational component and a questionnaire-based survey to identify potential contributing factors to alarm fatigue. Key aspects considered included the staff-to-patient ratio, the criticality of alarms, the priority of various duties, and personality traits. The research took place at a mid-size hospital in Montana with eight ICU beds. Data were collected from 24 critical care workers, covering both day and night shifts. Over six days, work sampling produced six 15-minute intervals randomly selected within each 12-hour shift, resulting in a total of 1,080 observations. Validated questionnaires assessed the effects of boredom, apathy, and distrust, while a subjective workload assessment approach was used to gauge alarm fatigue. To evaluate personality traits, the Big Five Personality model was employed.

The study found that indicators of AF were related to work characteristics such as job priority, nurse-to-patient ratio, and shift duration. Additionally, personality traits such as openness, scrupulosity, and neuroticism were linked to AF indicators. This comprehensive examination highlights the influence of both personality and work-related factors on alarm fatigue. The researchers suggested that mitigating AF could extend beyond conventional methods of reducing nuisance alarms and tailoring alarms to individual patients. They proposed that personality traits and work-related pressures significantly contribute to AF and

recommended that nurse managers consider these factors when scheduling shifts and organizing care.

According to the Big Five personality trait definitions, an ideal candidate for critical care settings would have lower susceptibility to anxiety, higher levels of assertiveness, competitiveness, proactiveness, good impulse control, goal-directed behaviors, high intellectual curiosity, and independence of judgment. Attention to work shift duration, job prioritization, and nurse-to-patient ratios could potentially reduce AF among critical care nurses.

Seifert et al. (2021) conducted a quality improvement study in the United States to assess whether an evidence-based bundle designed to reduce the number of physiologic monitor alarms could also reduce AF among intensive care nurses. The study involved a retrospective review of alarm data rates, types, and frequencies to identify the top three physiologic alarms causing issues in an ICU. An alarm management package was implemented to reduce the number of alarms. AF among nurses was measured before and after the implementation of the bundle using the Nurses' AF Questionnaire. The study took place at an American hospital with accreditation that houses a mixed medical-surgical intensive care unit.

During the pre-implementation phase, the three most problematic alarms identified were for breathing, invasive blood pressure, and arrhythmia. Following the implementation of the alarm management package, the frequency of all three problematic physiological alarms decreased. Notably, arrhythmia alarms showed the most significant reduction in frequency, with a 46.82% drop.

Despite this decrease in alarm frequency, there was no significant difference in the overall total scores for AF between the two periods. AF scores increased from pre-implementation (M = 30.59, SD = 5.56) to post-implementation (M = 32.60, SD = 4.84). This finding suggests that while the quality improvement project successfully reduced the frequency of the three problematic physiological monitor alarms, it did not lead to a decrease in AF experienced by ICU nurses.

The study highlights that reducing alarm frequency alone may not be sufficient to mitigate alarm fatigue. To effectively address AF and improve patient safety, additional intervention areas should be prioritized and further research is needed.

Zhao et al. (2021) conducted a study in China focusing on AF among intensive care unit (ICU) nurses. The study examines the factors influencing AF in the context of advanced medical equipment and intelligent medicine. Following rapid development and reform in China, citizens now enjoy improved health and better access to medical resources, which has enhanced public health and safety. The ICU is the area in a hospital with the highest concentration of medical equipment, resulting in a high volume of alarms. Given the extensive responsibilities of ICU nurses, AF is a significant issue in this department compared to others. The study analyzes factors affecting AF among ICU nurses and investigates the current situation using intelligent medicine principles.

The research employs a variety of methods, including literature review and questionnaire surveys, to explore nurses' perceptions of clinical alarms and data from the Clinical AF Questionnaire. The study highlights that AF is a major problem among ICU nurses that needs addressing. To categorize the factors influencing medical equipment alarm fatigue, the study uses logistic regression analysis. The analysis reveals several significant findings. AF is negatively correlated with factors such as single status, high-level occupations, extended work years, elevated professional titles, and advanced education ($p < 0.05$). Conversely, the

number of night shifts performed each month is positively associated with AF among individuals without an alarm clock habit ($p < 0.05$). However, there is no significant correlation between AF and other factors ($p > 0.05$).

Bourji et al. (2020) conducted a cross-sectional study in Lebanon to assess AF (AF) among clinicians in critical care settings. The study aimed to evaluate clinician AF and related factors, recognizing that a high volume of false alarms may lead to AF and alarm desensitization, which are significant patient safety risks in intensive care units (ICUs). The study recruited 337 participants from critical care units in Lebanon using a self-administered Internet questionnaire. The questionnaire covered various aspects including health status, staff recognition and management of alarms, alarm fatigue, and sociodemographic characteristics. The AF Questionnaire was translated into Arabic using a standard technique and culturally adapted.

The mean age of participants was 30.79 years (SD = 7.26; median = 29), with 61.4% being female. Of the participants, 22.8% were doctors, and 77.2% were nurses. Additionally, 78.8% worked in private hospitals, and 41.3% were involved in intensive care units for neonates and children. The study found that 58.8% of doctors considered more than 50% of alarms to be irrelevant, and 69.4% reported disabling and silencing alarms when irritated. The validity and reliability of the AF Questionnaire were confirmed, with a Cronbach's alpha of 0.69, indicating acceptable reliability for group comparisons.AF was more prevalent in ICUs compared to other critical care units and was more common among physicians and registered nurses than among nurses and head nurses. Doctors who turned off and silenced alarms when irritated exhibited higher levels of alarm fatigue. For staff members reporting stress, AF was 3.14 times more frequent ($p < 0.001$). AF was linked to the frequency of non-actionable alarms, and doctors had slightly higher AF scores compared to nurses.

The study concluded that the Arabic version of the AF Questionnaire is a valuable tool for assessing AF in Lebanon, demonstrating high psychometric qualities. The findings suggest that multidisciplinary strategies to reduce AF can be developed using this valid and reliable tool.

Lewis & Oster (2019) conducted a quasi-experimental study in Ireland to explore the impact of AF on the implementation of CEASE, a nurse-driven, patient-centered, evidence-based monitoring bundle. AF is a known issue in clinical settings, potentially causing nursing staff to become desensitized to alarms. The CEASE Bundle stands for Communication, Electrodes (daily adjustments), Appropriateness (assessment), and Setup alarm parameters (customizing for each patient). This study aimed to address the following research questions: (1) Does using an evidence-based, patient-customized monitoring bundle result in fewer hemodynamic and respiratory monitoring alarms compared to current practices in a 36-bed intensive care unit/step-down unit (ICU/SDU) with continuous monitoring? (2) Does this bundle reduce the duration of alarms compared to current practices? (3) Does this bundle decrease AF as perceived by nurses compared to current practices?

This exploratory, nonrandomized, one-group quasi-experimental study was approved by the institutional review board and conducted over six months. It involved 74 registered nurses working in a 36-bed ICU/SDU. The researchers compared alarm data from the monitoring system's 30-day log before and after implementing the CEASE Bundle. Additionally, nurses completed a 36-item Clinical Alarms Survey, with 35 responses collected before and 18 after the implementation. The study found no significant change in the overall duration of alarms. However, the duration of high-priority Level 3 alarms increased significantly to 246 seconds ($t = 4.432$, $p < .0001$). Adherence to the CEASE Bundle improved significantly to 22.4% ($\chi^2 = 5.068$, $p = .0244$). After implementing the bundle, nurses reported a significant reduction in nuisance alarms, from 68% to 44% ($\chi^2 = 3.243$, $p = .0417$). No adverse patient events were reported. In conclusion, the implementation of the CEASE Bundle reduced the overall number of monitoring alarms, thereby improving the nurses' experience of alarm fatigue. The

study indicates that while adherence to the bundle was beneficial, the increased duration of high-priority Level 3 alarms suggests that further research is needed.

Johnson et al (2018) conducted a study in the USA to reduce nonactionable oximeter alarms by 80% without extending the duration that infants were either hypoxemic (SpO2 ~ 80%) or hyperoxic (SpO2 > 95% while receiving supplementary oxygen). This quality improvement (QI) effort, initiated in 2015, involved a multidisciplinary team at Connecticut Children's Medical Center and targeted two newborn intensive care units (NICUs).The study implemented several modifications to achieve this goal. These changes included lowering the oximeter alarm limit for specific groups, extending the delay for low alarms, creating postmenstrual age-based alarm profiles, and revising bedside visual reminders. Throughout the project, data were collected using electronic SpO2 recordings and manual alarm tallies. SpO2 data were available for 138 out of 158 patient care hours during which alarm tallies were recorded.

The results showed a significant reduction in nonactionable alarms. The average number of nonactionable alarms per patient per hour decreased from 9 to 2, representing a 78% reduction. For nonactionable low alarms, the decrease was from 5 to 1 per patient per hour, equating to an 80% reduction. Balancing measures, including the percentage of time with SpO2 ~ 80% (mean 4.3%) or SpO2 > 95% (mean 23.7%), remained unchanged, indicating no increase in hypoxemia or hyperoxia.AF is a critical safety concern in intensive care units. This QI initiative successfully reduced nonactionable oximeter alarms by 78% without increasing the incidence of hypoxemia, which helped to mitigate desensitization among NICU staff. The success of this project was attributed to the use of multisource local data to inform interventions. The findings suggest that extending similar techniques to other alarm devices in the NICU and addressing high saturation oximeter alarms could further reduce AF and improve patient safety.

Future efforts may include incorporating age-based alarm profiles into monitors, integrating alarm limits into electronic health record (EHR) orders, and updating policies to maintain these improvements.

Casey et al., (2018) conducted a cross-sectional study in Ireland to examine critical care nurses' practices related to alarms and their understanding of alarm fatigue (AF). The study utilized an adaptation of The Health Technology Foundation Clinical Alarms Survey. A total of 250 critical care nurses from six Irish hospitals, representing ten departments, participated in the survey, resulting in a 66% response rate (n = 166). The study recorded patient adverse events related to clinical alarms across all participating hospital sites.

Findings revealed that out of 86 nurses surveyed, 52% were either unaware of how to prevent AF or uncertain about it. A significant majority of nurses (90%, n = 148) agreed that non-actionable alarms were common and interfered with patient care (91%, n = 145). Additionally, 81% (n = 132) of nurses reported that they occasionally disabled alarms due to decreased confidence in their reliability. Among nurses who felt knowledgeable about preventing alarm fatigue, customizing patient alarm parameters was a common practice (p = 0.037). The study identified the primary barrier to effective alarm management as the prevalence of false alarms, which led to diminished attention and response to alarms. Staff shortages also contributed to difficulties in managing alarms. Only 31% of participants felt that alarm management procedures were used effectively.

The study highlights that, outside the US, the full scope of AF has not been thoroughly addressed. Nurses in the West of Ireland reported a high prevalence of AF precursors, despite recognizing the occurrence of adverse patient events.AF poses severe risks, including death or significant patient harm, and has substantial implications for patient safety. The study underscores how excessive alarms create an error-prone environment and deplete nursing resources due to the burden of managing multiple alarms.

In a cross-sectional study conducted by Torabizadeh et al. (2017) in Iran, AF was identified as a risk to patient safety due to its potential negative impact on nurses' productivity and focus. The primary aim of this study was to develop and evaluate an AF questionnaire specifically for nurses, focusing on psychometric accuracy. The research was conducted in two phases. Stage one involved a comprehensive literature review, including books and articles, to understand various facets of alarm fatigue. The researchers also held meetings with experts to define the concept and draft statements for the questionnaire.

In Stage two, the validity of the instrument was assessed using both face validity (quantitative and qualitative approaches) and content validity (qualitative and quantitative approaches). The researchers initially created a questionnaire with thirty statements using a 5-point Likert scale. Following the validation process, nineteen statements remained. During a second round of expert consultations, six items were removed based on "alpha if item deleted" and factor loadings.

The reliability of the nurses' AF questionnaire was tested through internal consistency and retest methods. The results indicated a test-retest correlation coefficient of 0.99, a Guttman split-half correlation coefficient of 0.79, and a Cronbach's alpha of 0.91.The study concluded that a reliable and valid technique for measuring AF in nurses is essential, given the significance of recognizing this condition. The developed questionnaire demonstrated adequate validity and reliability for assessing AF among nurses.

In a study conducted by Johnson et al (2017) in the USA, cardiorespiratory episodes with fluctuating vital signs, particularly in preterm newborns, contribute significantly to the alarm burden in neonatal intensive care units (NICUs). Frequent alarms for heart rate or oxygen saturation (SpO2) that resolve on their own before medical intervention is required can lead to AF or desensitization among NICU staff. A previous study from 2002 indicated that each monitor in NICUs alarmed 16.7 times per hour, with the majority being SpO2 alarms. At

Connecticut Children's NICUs, baseline measurements showed an average of 11.9 SpO2 alarms per hour for each very low birth weight (VLBW) baby (less than 1500g). Given the typical nurse assignments in open bay NICU rooms, this translates to nearly one SpO2 alarm per minute per nurse. This estimation does not include other cardiorespiratory alarms or alarms from additional devices, such as ventilators or pumps.

Modern NICUs are equipped with sophisticated alarm systems featuring numerous settings, prioritization for alarm signals, and algorithms for alarm escalation. NICU nurses, who are the primary users of these devices, need adequate training and ongoing support to configure and manage device alarms effectively. According to the study, 60% of ICU nurses reported needing additional training to handle alarms properly.

To address alarm fatigue, clinical engineering teams have collaborated to develop alarm in-service training and job aides for device alarm systems. These initiatives aim to improve alarm setting compliance and potentially reduce alarm load. AF is a significant risk to patient safety in NICUs due to the high alarm burden and the prevalence of nonactionable alarms, which can lead to missed alarms and patient injury. To mitigate this, evidence-based and data-driven alarm settings should be used to standardize responses, staff training should emphasize safe alarm practices, and device alarm capabilities should be utilized to decrease nuisance and false alarms.

In a study conducted by Winters et al. (2017) in the USA, AF is identified as a significant safety and quality issue in clinical settings. AF occurs when high frequencies of clinical alarm exposure lead to desensitization, causing healthcare professionals to slow down or stop responding to alarms. Nonactionable alarms are particularly problematic and exacerbate this issue. Despite these concerns, the quantity of clinical alarm signals has been rising with the increasing incorporation of medical technology into clinical care settings. The study utilized data sources including PubMed, SCOPUS, Embase, and CINAHL to conduct a thorough

literature review focused on clinical alarms. The primary research question was: "What interventions have been tried and have been successful in reducing alarm fatigue?" The study also addressed three secondary issues: "What are the unintended consequences of interventions; what are the balancing outcomes; and what human factor approaches apply to making an effective alarm?"

Data extraction involved an iterative review process where articles relevant to the key questions were selected, and pertinent data was extracted using a standardized technique. A total of 62 publications provided useful information on at least one significant question. However, it was discovered that no study explicitly defined or used the term "alarm fatigue. “The research relevant to the primary key question primarily focused on three areas: comparisons of interventions, studies on algorithm-based false and total alarm suppression, and quality improvement or bundled activities. Most of these studies aimed to reduce the total number of alarms and/or false alarms to improve the positive predictive value. While most studies showed varying degrees of success, none directly evaluated alarm fatigue.

The findings indicate that current methods for addressing AF are mostly indirect. There is no consensus on a reliable measure or metric for alarm fatigue. Although reducing the number of alarms and/or increasing the positive predictive value might address alarm fatigue, practical solutions to enhance patient safety and quality remain limited. Further research is necessary to develop effective ways to quantify AF and identify strategies that could potentially reduce it.

In a qualitative descriptive study conducted by Despins (2017) in the USA, the focus was on understanding the factors that influence ICU nurses' decisions regarding how soon they check an alarm and why they go to the patient's bedside. This study used a qualitative descriptive design, with data collected through semi-structured interviews.

The study employed the Patient Risk Detection Theoretical Framework for thematic analysis. The research was conducted at an academic medical center with four specialist ICUs. ICU nurses respond to alarms by going to the patient's bedside to prevent harm and detect patient deterioration. The immediacy with which nurses respond to alarms is influenced by their appraisal of the patient's risk and their determination to respond only to legitimate alarms. The study revealed that several factors influenced nurses' perceptions of how urgently they needed to check the patient in response to an alarm. These factors included the identification of patient deterioration, the urgency of the patient risk, and the prioritization of genuine alarms. Additionally, factors such as nurses' experience, teamwork, the frequency of false alarms, and the visibility of physiological data and waveform configurations affected their alarm response.

The study suggests that organizations should explore the feasibility of installing additional monitors, implementing nursing transition programs to educate staff on identifying clinically significant alarms assessing patient risks, and involving bedside nurses in developing and implementing alarm management protocols.

In a quality improvement project conducted by Sowan et al. (2016) in the United States, the focus was on the frequency of false alarms in intensive care units (ICUs), which are known to have higher rates of such alarms compared to non-critical care units. The study aimed to address the safety of clinical alarm systems, in line with the Joint Commission National Patient Safety Goal.06.01.01, which mandated that healthcare facilities prioritize alarm system safety by July 2014.

Understanding ICU nurses' perceptions of clinical alarms and standard operating procedures is a crucial first step towards meeting these safety criteria, particularly in situations where information is limited. The purpose of this study was to compare ICU nurses' views and management practices regarding clinical alarms to the 2011 Healthcare Technology

Foundation (HTF) Clinical Alarms Committee Survey data. The study was conducted in a transplant/cardiac ICU (TCICU) with 20 beds and 39 full- and part-time nurses. Nurses were surveyed using an adapted version of the HTF clinical alarms survey, and the results were compared to the 2011 HTF data. The relationships between various variables were analyzed, and all 39 TCICU nurses participated, providing comprehensive feedback (N = 100%).

The results revealed that a significant proportion of nurses (95–98%) reported that false alarms were common, disrupted patient care, and decreased confidence in alarm systems, leading to unnecessary disabling of alarms. Compared to the 2011 HTF survey results, a higher percentage of TCICU nurses perceived the current devices as complex and questioned the appropriateness of new monitoring systems for addressing alarm management issues. They also highlighted delays in responding to alarms and a lack of clinical policy regarding alarm management ($P<.01$).

The primary themes from the narrative data included nurses' frustrations with the poor usability and excessive number of alarms on cardiac monitors. Many nurses reported inadequate training on central and bedside cardiac monitors, with just over 60% indicating they received insufficient training. A correlation ($P=.01$) suggested that cardiac monitor training, particularly for senior nurses, was needed.

The study concluded that clinical alarm management is still developing in many institutions. The persistence of false and ineffective alarms contributes to alarm fatigue, which can lead to missed critical alarms. To reduce AF and enhance alarm system safety, a multi-method approach involving devices, doctors, unit layouts, training, and policies is required. Usability of monitoring equipment is a key factor in effective alarm management. Analyzing clinicians' attitudes and behaviors toward clinical alarms is essential for creating appropriate quality improvement efforts. Collaboration among clinicians, organizations, manufacturers,

researchers, safety, and regulatory bodies is necessary to improve alarm management. Future work should include comprehensive usability assessments and comparisons with other ICUs.

A quality improvement project conducted by Sowan et al. (2016) in the United States focused on the safety of clinical alarm systems, particularly in critical care units (ICUs) where the highest alarm rates are documented. Despite the national priority given to alarm safety, few interventional studies have examined how altering default alarm settings affect the overall alarm rate and the attitudes and behaviors of clinicians toward clinical alarms and alarm fatigue. The study aimed to determine whether changing the default alarm settings on cardiac monitors and providing in-service nursing education on using these monitors in an ICU would reduce the alarm rate and improve nurses' attitudes and behaviors toward clinical alarms. Before the intervention, there were 64,500 alarms at a rate of 87.86 alarms per patient day. After the intervention, the number of alarms decreased to 49,319, with a rate of 59.18 alarms per patient day ($P = .01$). The strongest alarms at baseline were for peripheral capillary oxygen saturation (SpO2), premature ventricular contractions (PVCs), and arterial blood pressure (ABP). Alarms for SpO2 and ABP remained among the top three in the post-project phase.

Out of 39 ICU nurses, 24 (62%) completed both the pre- and post-project survey forms. There were no significant changes in the nurses' attitudes towards alarms between the pre-and post-intervention surveys. The narrative data highlighted themes of frequent alarms and dissatisfaction with the usage of cardiac monitors.

The study concluded that standard in-service training and adjustments to default alarm settings alone are insufficient to enhance alarm system safety. Factors such as the level of training on system use, unit layout, availability of rules and procedures, complexity and usability of monitoring devices, and alarm management practices of doctors all contribute to the complexity of alarm management in ICUs. Given that modern monitoring systems are

increasingly complex, immediate usability testing is necessary. Multifaceted measures are required to improve alarm system safety and meet the Joint Commission National Patient Safety Goal on alarm systems safety in critical care units.

An observational study conducted by Deb & Claudio (2015) in the USA aimed to define, measure, and investigate the impact of AF on performance decline. An alarm is defined as a warning of an impending situation that necessitates a response. The Emergency Care Research Institute ranked alarm hazards as the top health technology hazard from 2012 to 2014. In response, the Joint Commission mandated that all hospitals in the US measure AF and adopt a systematic, coordinated approach to managing clinical alarm systems. To meet this requirement, a clear working definition of AF is essential.

The study developed a conceptual model to examine how the working environment and personnel individuality affect AF and its impact on staff performance. It found that alarm fatigue, working circumstances, and staff personality all contribute to deteriorating performance. Specifically, while AF itself did not affect nurses' reaction times, the working environment and individual staff characteristics were significant factors. The study revealed that AF is not the sole source of performance decline in healthcare settings, challenging the previous belief that it was the primary cause of poor performance, such as delayed response times. The hierarchical task analyses and literature review highlighted the importance of distinguishing between different roles, such as nurses and unit clerks, which other research had not adequately addressed.

Attempts to link AF directly to staff performance through regression analysis were unsuccessful, suggesting that the original model was flawed. This indicates that AF should be reevaluated as a health hazard. The study's findings suggest that alarm fatigue’s impact on staff performance may be more complex than previously thought. This research provides a foundation for future studies on defining and evaluating AF and its effects. It suggests that

physiological indicators, mental workload, and other effects should be considered for a more comprehensive understanding of alarm fatigue. Further research is needed to validate the proposed definitions and explore their applicability in acute care settings in the same and other hospitals.

A study conducted by Honan et al. (2015) in the USA focused on alarm dangers as a major concern for patient safety. Nurses, being the healthcare professionals most immediately impacted by numerous clinical alarms, were the primary subjects of this study. The goal was to investigate nurses' experiences with clinical alarms qualitatively. A national survey was conducted to gather opinions from 406 nurses regarding clinical alarms. The comments provided were analyzed using the Krippendorff method for content analysis. Six interconnected themes emerged from the analysis.

The first theme is dissonance and desensitization, highlighting how nurses experience conflict and become desensitized due to the overwhelming number of alarms. Another theme addresses pollution, panic, and pathology, noting that excessive alarms contribute to stress, panic, and a sense of being overwhelmed. The third theme revolves around demanding accountability, with nurses calling for greater responsibility in alarm management. The fourth theme concerns demanding the authority of nurses, as nurses feel they should have more authority in managing alarm settings. The fifth theme acknowledges that while clinical alarm management is important, it is not seen as a complete solution. Lastly, there is optimism for the future, with hope for improved alarm management practices.

A notable source of frustration was the setting of alarm parameters by doctors without nurses' input, which led to alarms that did not always require a response. Despite this, nurses agreed that while doctors should set realistic boundaries, the bedside nurse should play a role in customizing alarm settings for individual patients. The study supported the idea that nurses should be in charge of and accountable for customizing alarm settings, aligning with findings

from other studies. Suggestions for reducing annoyance from alarms included using larger screens to display high-priority alarms, involving nurses in the assessment and purchase of new alarm-equipped equipment, having doctors and nurses collaborate on setting alarm parameters, stopping monitoring when it was no longer needed, and adjusting alarm volumes.

The findings underscore the need for nurses to be actively involved in updating alarm regulations and reorganizing alarm systems to enhance patient safety. Nurses, who are most directly affected by the numerous alarms at the bedside, can offer innovative and practical solutions to address the evolving hazard posed by alarms.

A study conducted by Funk et al. (2014) highlights the issue of alarm fatigue, which has become a serious safety problem due to the increasing number of alarm-equipped devices. AF affects professionals at the bedside, leading to concerns about patient safety. The study aimed to evaluate whether practices and attitudes regarding clinical alarms have changed since 2005. To achieve this, the Clinical Alarms Committee of the Healthcare Technology Foundation developed an online poll to gather hospital staff views and practices related to clinical alarms. The study compared results from administrations conducted in 2005-2006 and 2011.Respondents were asked to rate their agreement with 19 alarm-related statements. Although there were noticeable shifts between the two survey years, many statements remained consistent. The 2011 study revealed that respondents were more likely to agree with statements about the necessity of central alarm management and the importance of specific alarm sounds indicating priority. Additionally, 2011 respondents reported less frequent disruption of patient care due to nuisance alarms.

Nine separate alarm issues were evaluated in order of importance by respondents. In both years, numerous false alarms were identified as the primary problem. In the 2011 poll, 18% of respondents reported that patients experienced adverse outcomes due to alarms at their institutions. Despite significant attention given to clinical alarm safety, the study found that

progress has been limited. Except for a few notable healthcare facilities, there has been little change since the initial survey in 2005-2006. The hospital environment remains noisy due to false and nonactionable alarms, and sentinel events resulting from AF are still a concern. With the Joint Commission's National Patient Safety Goal (NPSG) on alarm handling now in place, there is hope that hospitals will address this critical patient safety issue with greater urgency.

In a study conducted by Drew et al. (2014) in the United States, AF was identified as a significant issue affecting patient safety. This condition arises from the constant sound and visual alarms generated by physiological monitoring systems, which can lead to sensory overload and the potential overlooking of critical events. The study utilized a state-of-the-art technology acquisition infrastructure to collect data from 461 adults receiving intensive care unit (ICU) treatment. This data included seven ECG leads, pressure waveforms, SpO2, respiration waveforms, user settings, and alarms. The study gathered information from all available physiological waveforms, vital sign measurements, and clinician alarm settings across five adult ICUs at a large tertiary-quaternary medical center. The patient populations in these units represented a wide range of clinical issues, including medical, surgical, cardiac, and neurologic conditions.

Nurse scientists, with 95% inter-rater reliability, annotated a total of 12,671 arrhythmia alarms using a clear alarm annotation technique. Over the 31-day study period, the ICUs generated 2,558,760 distinct alarms: 1,154,201 from arrhythmia, 612,927 from parameter issues, and 791,632 from technical problems. Of these, 381,560 were audible alarms, resulting in an average of 187 audible alarms per bed each day. False positives comprised 88.8% of the 12,671 annotated arrhythmia alarms. The study identified several factors contributing to excessive alarms, including unsuitable alarm settings, chronic atrial fibrillation, and non-actionable events such as PVCs and brief spikes in ST segments. Additionally, some ECG leads showed low amplitude QRS complexes, leading to undercounting and misleading arrhythmia alarms. Wide QRS complexes from cardiac

pacemakers or bundle branch blocks also caused false alarms. Out of 168 genuine ventricular tachycardia alarms, 93% did not last long enough to necessitate medical intervention.

The study concluded that a complex interaction between patient conditions, improper user settings, and algorithm flaws contributed to the excessive number of physiologic monitor alarms. To improve the situation, it is recommended to use all available ECG leads to identify non-artifact leads and those with sufficient QRS amplitude. Devices should offer reminders for better customization of alarm settings to individual patients and allow modifications to delays for ST-segment and other parameter warnings. The study suggests that advancements in computer reliability could enhance physiological monitoring and help reduce alarm fatigue.

In a study conducted by Cvach (2012) in the USA, AF was identified as the top technological risk associated with medical devices in 2012 and was recognized as a nationwide issue. This condition is exacerbated by several factors, including a high false alarm rate, low positive predictive value, lack of alarm standardization, and the use of problematic medical instruments in hospitals. The study utilized the Johns Hopkins Nursing Evidence-Based Practice approach to conduct an integrative review of research and non-research data published between January 1, 2000, and October 1, 2011. A total of seventy-two articles were reviewed. The research data was categorized into several primary themes. One theme focused on technology to lessen false alarms, addressing advancements and solutions aimed at reducing the frequency of false alarms. Another theme examined excessive alarms and their consequences on staff, discussing the impact of these alarms on healthcare professionals and their responses. Additionally, the study explored nurses' responses to alarms, investigating how nurses react to and manage clinical alarms. The effectiveness of alarm sounds and their audibility in clinical settings was also reviewed, alongside different alarm notification systems and their effectiveness in alerting staff.

Non-research evidence was categorized into themes that addressed alarm priority and notification systems, focusing on how alarms are prioritized and the effectiveness of notification systems. Another theme covered methods to lessen alarm desensitization, reviewing strategies to reduce the impact of alarm fatigue. The review highlighted that missed alarm occurrences have led to fatalities and serious injuries. It presented the findings from both research and non-research data on monitoring AF over the past ten years. The study emphasized knowledge gaps and the need for further research. It underscored the importance of focusing on patient outcomes rather than merely reducing the number of alarms, advocating for outcomes research to provide the highest level of evidence.

In a study conducted by Solet & Barach (2012) in the United States, alarm safety was identified as one of the most prominent and challenging issues in healthcare. A phenomenon known as "alarm fatigue" contributes to this issue, characterized by deliberate deactivations of alarms and delayed or unsuccessful alarm responses. AF also includes a reduced ability to recognize and prioritize warning signals. Federal agency investigations and public articles have linked AF to patient deaths, some of which have garnered significant media attention. Between 2005 and 2008, there were reportedly 200 to 566 patient deaths related to alarm fatigue; however, these figures are likely underestimates.

AF can be caused by various factors, with the false alarm rate being a major contributor. Reports indicate that false alarms can constitute as much as 83–85% of all alarms. The large number of clinically irrelevant signals leads to staff desensitization. Additionally, high background noise levels in operating rooms, critical care units, and variable acuity units contribute to alarm response failures. These high noise levels make it more difficult for staff to make decisions, assign blame, and communicate effectively. They also add to the cognitive load of healthcare workers, making them more easily distracted and agitated.

Over the past few decades, hospital noise levels have increased and now exceed World Health Organization guideline values. To facilitate prompt warning reactions, the study outlines several potential impacts and interventions. These include expanding the auditory environment, increasing clinician accountability, providing training in collaboration and deployment, setting guidelines for threshold-setting, improving user interfaces, and developing algorithms that balance alarm specificity and sensitivity.

The study suggests that monitoring systems should handle complex data streams effectively, generate clinically relevant alarm signals; operate in environments optimized for perception and attribution, and feature user interfaces that enable quick interpretation, prioritization, and action. Addressing AF requires that regulators, manufacturers, and clinical leaders recognize the importance of staff behavior and human factors. Rigorous usability testing and clinical simulations are essential for device design and evaluation to effectively manage alarm fatigue.

In a study conducted by Welch (2011), Masimo Corp., based in Irvine, CA, analyzed 32 million pulse oximetry (SpO2) data points from 10 general post-surgical care areas in hospitals. This analysis aimed to assist physicians in making evidence-based decisions about programming alarm settings. A Masimo Patient Safety Net™ remote monitoring and clinician alerting system was installed in each hospital. This system continuously records and maintains time-stamped SpO2 data with a one-second resolution. The company performed a retrospective analysis to determine the frequency of alarms at different alarm thresholds and delay settings.

The study highlights a recent high-profile instance from a major tertiary care hospital in Boston, where clinicians responded to the high prevalence of false and nuisance alarms by either disregarding or disabling the alarms. Research from the emergency department (ED) found that less than 1% of alarms were clinically actionable, meaning they required bedside

intervention. Addressing AF is a joint responsibility of the industry, biomedical engineers, and clinicians. Strategies to mitigate this risk include optimizing technology and signal channels. The study demonstrates how Masimo's continuous pulse oximetry technology can reduce nuisance alarms, though similar methodologies may apply to other continuous monitoring devices. Based on the data, clinicians can make evidence-based decisions on where to set SpO2 alarm thresholds. For post-surgical general care wards, achieving optimal alarm frequency and actionable alarm notifications can be done by using sensors designed for single-patient use, ensuring cables and connectors are in good condition, reducing alarm limits to 88%, and delaying alarms by 15 seconds. This approach can result in an 85% reduction in alarms while maintaining 8-second average. Healthcare professionals should ensure proper application of the SpO2 sensor and establish alarm levels based on the specific patient and care environment.

Chapter 3

Methodology

This chapter outlines the approach used to conduct the research, encompassing the chosen study design, location and context, target population, determination of sample size and sampling technique, criteria for participant inclusion, the process of data collection, utilized instruments, considerations of validity and reliability, ethical concerns, and methods for data analysis.

3.1 Study Design

The study employs a cross-sectional design to investigate the phenomenon of AF in governmental hospitals in the West Bank. The study period was fromMay1, 2024, to May20; 2024.This design choice was motivated by its capacity to capture a momentary snapshot of the variables under study, thereby offering a comprehensive understanding of the present condition of AF among critical care nurses. By collecting data from a single group of participants at a specific time point, the cross-sectional design facilitates efficient data gathering. It allows for the investigation of relationships between variables. This approach aligns seamlessly with the research inquiries and goals, enabling a thorough examination of AF prevalence among critical care nurses. Ultimately, the design's capability to provide useful perspectives on the contemporary state of AF in the critical care environment renders it well-suited for achieving the research objectives of this study.

3.2 Study Setting

The study is conducted in governmental hospitals located in the West Bank. The research selected six governmental hospitals from the eighteen available and was sure the six hospitals included critical care units, aiming to ensure geographical distribution across all areas. This selection was made to achieve a balanced representation of the diverse geographical and

demographic conditions in the region. It is crucial as it allows for a comprehensive and balanced depiction of healthcare reality in the West Bank. The chosen hospitals reflect the diversity of healthcare services provided and the challenges faced by healthcare workers. Thus, they provide a suitable environment for understanding the Critical Care Nurses' Perception of AF and Related Issues for Effective Management.

The geographical distribution of study encompasses northern, middle, and southern regions of the West Bank, offering a well-rounded perspective of the experiences of critical care nurses across different locales. In the North Region (Jenin, Nablus, Tulkarm, Tubas, and Qalqilya) The research selected Rafidia Hospital (Nablus) and Jenin Hospital (Jenin), from the Middle Region (Ramallah, Jericho, Jerusalem, Salfeet) research selected PMC Hospital (Ramallah) and Jericho Hospital (Jericho), from South Region (Hebron and Bethlehem) research selected Hebron Hospital (Hebron) and King Hussein Hospital (Bethlehem).

These hospitals provide critical care services to patients with severe medical conditions, requiring specialized nursing care and constant monitoring. The choice of governmental hospitals in the West Bank as the study setting was deliberate, given their significance as primary healthcare providers in the region. These hospitals typically serve diverse patient populations and face various challenges related to resource availability, staffing, and patient load. By conducting the study in this setting, we aim to capture a comprehensive understanding of Critical Care Nurses' Perceptions of AF and Related Issues for Effective Management within the context of real-world healthcare delivery in the West Bank. This setting offers valuable insights into the challenges faced by critical care nurses and the potential implications of AF on patient care outcomes in a resource-constrained healthcare environment.

3.3 Target Population

The target population for this study comprises critical care nurses working in governmental hospitals located in the West Bank. The number of critical care nurses who work in different types of critical care units in governmental hospitals in West Bank is389 nurses. The study focuses on critical care nurses who are directly involved in providing care to patients in critical care units within these hospitals. This includes practical nurses and registered nurses responsible for delivering specialized care to critically ill patients.

3.4 Study Sample

The study sample consists of critical care nurses employed in selected governmental hospitals in the West Bank. A convenience sampling technique was employed to select participants who met the inclusion criteria and could provide valuable insights into the phenomenon under investigation. A total of 286 critical care nurses were invited to participate in the study.

3.5 Eligibility Criteria

The eligibility criteria for participation in the study entail being a registered nurse or practical nurse actively working in a critical care unit within the selected governmental hospitals situated in the West Bank. They should possess the ability to comprehend and respond to the questionnaire questions. These criteria were established to ensure that participants have the necessary qualifications, willingness, and language proficiency to contribute valuable insights into the phenomenon of interest.

3.5.1 Inclusion Criteria: encompass current employment as a registered nurse or practical nurse in a critical care unit within the selected governmental hospitals in the West Bank, willingness to participate in the study, and proficiency in understanding and responding to the questionnaire.

3.5.2 Exclusion Criteria: involve individuals not meeting the qualifications, including Nursing students, who work part-time, who refuse to participate or provide informed consent, or who experience difficulties in understanding or responding to the study questionnaire.

3.6 Sample Size Determination

In this study, we distributed 289 survey questionnaires to the respondents at the 6 selected governmental hospitals and received only 185 usable responses (i.e., the overall response rate was 64.0%). Table 3.1 summarizes nurses' response rate by hospital. Noting that the minimum required sample size was 166 on the basis of ± 5% margin of error and with a 95% confidence interval using the single population proportion formula implemented in Stat disk software. In addition, increasing the margin of error to ± 6% will reduce the required sample size to 159.

Table 3.1: Nurses' response rate by hospital (N = 185).

Hospital	ICU Team	Response n (%)
Beit Jala – Bethlehem	25	12 (48.0)
Jericho – Jericho	11	10 (90.9)
Martyr Khalil – Jenin	52	28 (53.8%)
Palestine Medical Complex (PMC) - Ramallah	121	81 (66.9)
Queen Alia - Hebron	48	23 (47.9)
Rafidia – Nablus	32	31 (96.9)
Total cohort	**289**	**185 (64.0)**

3.7 Sampling Techniques

The study employed convenience sampling as the primary technique to recruit participants from the target population of critical care nurses in governmental hospitals located in the West Bank. Convenience sampling allowed for the selection of participants based on their availability and willingness to participate. This method ensured that participants had the necessary experience and knowledge to provide valuable insights, facilitating the timely completion of data collection. While convenience sampling does not guarantee a representative sample, the study aimed to include critical care nurses from different geographical areas and healthcare environments within the West Bank to capture a diverse range of perspectives. This diversity was intended to enhance the relevance and applicability of the study findings to the target population.

3.8 Data Collection Instrument and Technique

The study's instrument for gathering data was a combination of two questionnaires that have been extensively used in the literature (e.g., Ruppel et. al., 2018; Torabizadeh et. al, 2017). The permission to use both questionnaires was obtained via E-mail, it includes four sections:

Section 1: the work-related sociodemographic information, which included age, gender, hospital, unit, social status, level of education, ICU experience, nurse/patient ratio during day and night, ICU no. of beds, percent of ventilated patients, and in-service alarm training.

Section 2: the perception was measured through the 2016 Health Care Technology Foundation Clinical Alarms Survey (Ruppel et. al., 2018). This section included 19 general statements about clinical alarms. The nurses had to give their opinion using a 5-point Likert scale ranging from strongly disagree (Score 1) to strongly agree (Score 5), the higher the score, the more negative the alarm perception. In this study, Cronbach's α value was 0.76.

Section 3: This section included 9 issues that interfere with the management of clinical alarms that were used in previous studies (Sowan et. al. 2015; Funk et. al., 2014). The nurses were asked to rank the issues on a scale from 1 (most important) to 9 (least important). The average ranking was measured by summing up the rankings assigned to each of the nine questions then measuring the average value, and then assigning them from first to ninth in the order of lowest average.

Section 4: the nurses' AF scale consists of 13 questions (Torabizadeh et al., 2017) on the 5-point Likert scale (never, rarely, occasionally, usually, and always). Each item on the questionnaire is scored from 0 (never) to 4 (always). The score range of the questionnaire is between 0 (minimum) and 52 (maximum). There isn't a set threshold for alarm fatigue. Still, higher ratings suggest a more significant effect of AF on the work of nurses. From 0-7 indicating no alarm fatigue, 8-20 reflecting low alarm fatigue, 21-32 indicating moderate alarm fatigue, and 33-52 reflecting severe alarm fatigue. This questionnaire is valid and reliable with Cronbach's alpha of 0.91 (Torabizadeh et al., 2017).

3.9 Data Quality Control

In this study, the internal consistency of the AF scale was tested using Cronbach's Alpha. The Cronbach's Alpha coefficient of internal consistency reliability was 0.73 presenting acceptable reliability. The perception of the AF scale was tested using Cronbach's Alpha also, Cronbach's Alpha coefficient of internal consistency reliability was 0.71 presenting acceptable reliability

3.10 Data Analysis

The 27th edition of the Statistical Package for Social Sciences (SPSS) program was used to conduct the analyses. Categorical variables in sociodemographic and clinical data were

expressed as frequencies and percentages. Continuous variables were described as mean and standard deviation.

Internal consistency was assessed by measuring Cronbach's Alpha coefficient. The minimum criterion for acceptable reliability is an α of at least 0.7 (Tavakol&Dennick, 2011). The significance level was set at 5% for all calculations. Analysis of variance (ANOVA) with the Scheffé post-hoc test and an independent T-test were used to examine alarm tiredness scores by general characteristics of nurses. Nurses' perceptions and practices regarding clinical alarms by gender were analyzed using the Chi-square test. P-value < 0.05 was considered statistically significant.

3.11 Ethical Considerations

Ethical reviewing and approval for this study was taken by the Health Research Ethics Committee of the AAUP with code number **"R-2024/A/54/N".** Ethical reviewing and approval were also gained from the Palestinian Ministry of Health, and the director of target hospitals. From these hospitals, Participants were informed about the voluntary nature of the study and rapport built before conducting the data collection. The privacy of participants during the data collection is assured by conducting in a comfortable private place. Participants also are assured that all their personal information is protected from the public and secured by the researcher. The main findings, conclusion, and recommendations of the study will be presented and reported to responsible bodies. It will be disseminated to the critical care department and hospital administrations.

Chapter 4

Result

4.1 General Characteristics of the Respondents

The general characteristics of the respondents are presented in Table 4.1. Nearly half (47.0 %) of participants worked in ICUs. The majority of them were men (63.2 %) and with a bachelor degree (85.9 %). About two-thirds (67.0 %) of them are less than 35 years old. Nearly half of them (46.5 %) had 5 to 10 years of ICU experience. Only 11.4 % of units had 70 % or more mechanically ventilated patients and only (11.9 %) of them had more than 20 ICU beds. Most units' use 1:3 nurse/patient ratio during the day (44.3 %) and at night (49.2 %). Only 14.6 % of the respondents had in-service alarm training.

Table 4.1: General characteristics of the respondents (N = 185).

Characteristic	Categories	n (%)
Unit/Department	ICU	87 (47.0)
	CCU	38 (20.5)
	NICU	46 (24.9)
	PICU	14 (7.6)
Gender	Male	117 (63.2)
	Female	68 (36.8)
Age	< 35	124 (67.0)
	≥ 35	61 (33.0)
Education	Diploma	2 (1.1)
	Bachelor	159 (85.9)
	Postgraduate	24 (13.0)

Social status	Single	72 (38.9)
	Married	112 (60.5)
	Widowed/Divorced	1 (0.5)
ICU experience (y)	< 5	43 (23.2)
	5 - 10	86 (46.5)
	> 10	56 (30.3)
ICU no. of beds	< 10	82 (44.3)
	10 - 20	81 (43.8)
	> 20	22 (11.9)
Ventilated patients (%)	< 50	82 (44.3)
	50 - 70	81 (43.8)
	> 70	21 (11.4)
	Not available	1 (0.5)
Nurse/patient ratio (day)	1:2	62 (33.5)
	1:3	82 (44.3)
	1:4	41 (22.2)
Nurse/patient ratio (night)	1:1	1 (0.5)
	1:2	20 (10.8)
	1:3	91 (49.2)
	1:4	73 (39.5)
In-service alarm training	Yes	27 (14.6)
	No	158 (85.4)

4.2 Nurses' Perceptions Regarding Clinical Alarms

Respondents were asked about their level of agreement with 19 statements about alarms (Figure 4.1). More than 90 % of participants believed that alarm sounds should differentiate the priority of the alarm (item 3), smart alarms would be effective for improving clinical response to important patient alarms and for reducing false alarms (items 16 and 17). Furthermore, less than half of them agreed or strongly agreed that clinical policies were lacking regarding alarm management (item 18), properly setting alarm parameters and alarms

is overly complex in existing devices (item 6), there is a requirement in my institution to document that the alarms are set and are appropriate for each patient (item 19), and central alarm management staff responsible for receiving alarm messages and alerting appropriate nurses is helpful (item 14).

A comparison of nurses who agreed or strongly agreed on clinical alarm survey statements based on their gender is displayed in Table 4.2. Results demonstrated that male nurses who believed in items 7 and 12 were more than female counterparts (i.e., p-values < 0.05). However, female nurses who believed in items 6 and 18 were more than their male counterparts (i.e., p-values < 0.05).

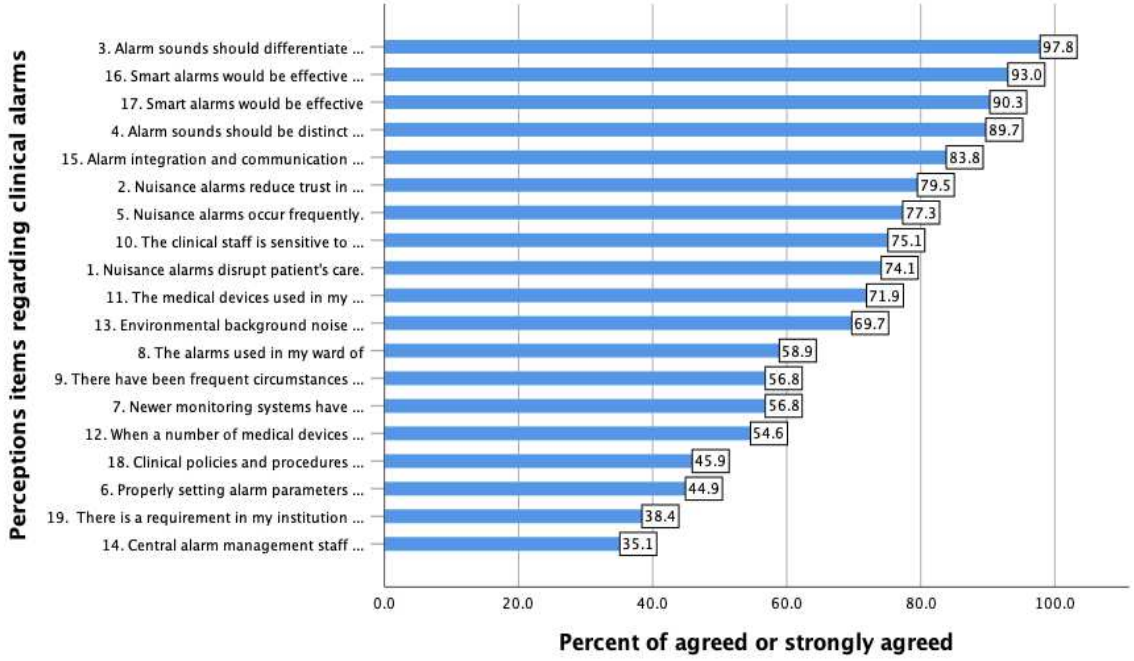

Figure 4.1 Nurses' perceptions regarding clinical alarms (N= 185).

Table 4.2: Nurses' perceptions regarding clinical alarms according to gender (N= 185).

	Item	Males n (%)[a]	Females n (%)[b]	p-value (Chi-square)
1	"Nuisance alarms disrupt patient's care"	86 (73.5)	51 (75.0)	0.823
2	"Nuisance alarms reduce trust in alarms and cause caregivers to inappropriately turn alarms off at times other than setup or procedural events"	91 (77.8)	56 (82.4)	0.458
3	"Alarm sounds should differentiate the priority of the alarm"	113 (96.6)	68 (100.0)	0.123
4	"Alarm sounds should be distinct based on the parameter (e.g. heart rate) or source (device type)"	106 (90.6)	60 (88.2)	0.610
5	"Nuisance alarms occur frequently"	86 (73.5)	57 (83.8)	0.106
6	"Properly setting alarm parameters and alerts is overly complex in existing devices"	39 (33.3)	44 (64.7)	< 0.001*
7	"Newer monitoring systems (e.g.< 3 years old) have solved most of the previous problems we experienced with clinical alarms"	76 (65.0)	29 (42.6)	0.003*
8	"The alarms used in my ward of the hospital are adequate to alert nurses of potential or actual changes in a patient's condition"	68 (58.1)	41 (60.3)	0.772
9	"There have been frequent circumstances in which alarms could not be heard and were missed"	69 (59.0)	36 (52.9)	0.425
10	"The clinical staff is sensitive to alarms and responds quickly"	92 (78.6)	47 (69.1)	0.149
11	"The medical devices used in my unit of the hospital have distinct outputs (i.e. sounds, repetition rates, or visual displays) that allow staff to identify the source of the alarm"	89 (76.1)	44 (64.7)	0.097
12	"When a number of medical devices are used with a patient, it can be confusing to understand which device is in an alarm condition"	78 (66.7)	23 (33.8)	< 0.001*
13	"Environmental background noise has interfered with	85 (72.6)	44 (64.7)	0.257

	alarm recognition"			
14	"Central alarm management staff responsible for receiving alarm messages and alerting appropriate nurses is helpful"	41 (35.0)	24 (35.3)	0.972
15	"Alarm integration and communication systems via cell phones, pagers, and other wireless devices can be useful for improving alarm management and response"	97 (82.9)	58 (85.3)	0.671
16	"Smart alarms would be effective to use for improving clinical response to important patient alarms"	112 (95.7)	60 (88.2)	0.055
17	"Smart alarms would be effective to use for reducing false alarms"	109 (93.2)	58 (85.3)	0.082
18	"Clinical policies and procedures regarding alarm management are effectively used in my ward of the hospital"	44 (37.6)	41 (60.3)	0.003*
19	"There is a requirement in my institution to document that the alarms are set and are appropriate for each patient"	41 (35.0)	30 (44.1)	0.221

[a] Frequencies and percentages are based on the total number of 117 male nurses who agreed or strongly agreed on clinical alarm survey statements.

[b] Frequencies and percentages are based on the total number of 68 female nurses who agreed or strongly agreed on clinical alarm survey statements.

* The relationship was significant (p-value < 0.05).

4.3 Clinical Alarm-Related Important Issues

This section provided insights into how the participants rated the relative influences of the various challenges they faced with clinical alarm management. Participants ranked the importance of the nine alarm issues that may affect alarm recognition and response (Table 4.3). The most important issue that nurses recognized as difficult in alarm management was the "Lack of training on alarm systems" (item 9), followed by "Inadequate staff to respond to

alarms as they occur" (item 6). Conversely, the least important issue was "Difficulty in setting alarms properly" (item 1). Furthermore, these ratings were categorized according to their importance as "High" (for ratings 1, 2, and 3), "Medium" (for ratings 4, 5, and 6), and 'Low' (for ratings 7, 8, and 9). Responses are summarized in Figure 4.2. Similarly, items 9 and 6 appeared to be the most important (i.e., the percentage of high ranking was 67.0 % and 53.0 % respectively).

Table 4.3: Clinical alarm-related important issues (N = 185).

Issue		**Mean** [a]	**Ranking** [b]
1	"Difficulty in setting alarms properly"	5.71	9
2	"Difficulty in hearing alarms when they occur"	5.22	6
3	"Difficulty in identifying the source of an alarm"	5.39	8
4	"Difficulty in understanding the priority of an alarm"	5.33	7
5	"Frequent false alarms, which lead to reduced attention or response to alarms when they occur"	4.02	3
6	"Inadequate staff to respond to alarms as they occur"	3.96	2
7	"Over-reliance on alarms to call attention to patient problems"	4.89	4
8	"Noise competition from non-clinical alarms and pages"	5.11	5
9	"Lack of training on alarm systems"	3.09	1

[a]Mean rank of the items on the basis of the total number of 185 nurses.

[b]Ranking of the means from 1 (most important) to 9 (least important).

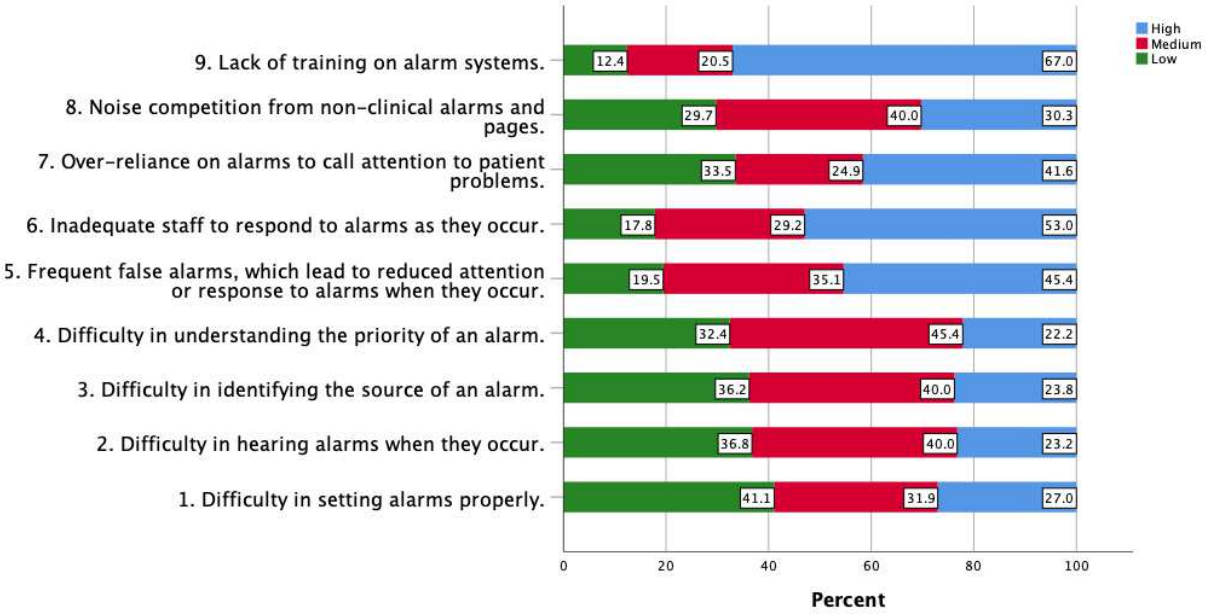

Figure 4.2: Clinical alarm-related important issues (N= 185).

4.4 Alarm Fatigue Evaluation

In this section, the participants are asked to quantify the frequency of any of the behaviors regarding alarm management described in each item. The total score of the tool ranges from 0 (lowest impact of fatigue) to 52 (highest impact of fatigue). There isn't a set threshold for alarm fatigue. Nonetheless, elevated readings are linked to increased degrees of exhaustion. An evaluation of the AF survey is summarized in Table 4.4 and Figure 4.3.

The highest mean score of AF was for the question “I pay more attention to the alarms on certain shifts” (item 5), where the majority of participants (81.1%) answered this question as “usually to always”, followed by “Generally, I hear a certain amount of noise in the ward” (item 3) where most of the participants (75.1%) answered this question as “usually to always”. Conversely, the lowest mean score was for the question “I turn off the alarms at the beginning of every shift” (item 2) where about half (49.7%) of the participants answered this question as “never”. The average AF score across the board was 30.64 ± 5.63, ranging from 16 to 43.

Table 4.4: behaviors assumed and experiences of alarm fatigue incidents

Item		Mean ± SD[a]	Ranking [b]
1	"I regularly readjust the limits of alarms based on the clinical symptoms of patients"	2.57 ± 1.01	6
2	"I turn off the alarms at the beginning of every shift"	1.01 ± 1.23	13
3	"Generally, I hear a certain amount of noise in the ward"	3.05 ± 0.91	2
4	"I believe much of the noise in the ward is from the alarms of the monitoring equipment"	2.83 ± 0.88	4
5	"I pay more attention to the alarms on certain shifts"	3.08 ± 0.91	1
6	"In some shifts, the heavy workload in the ward prevents my quick response to alarms"	2.15 ± 1.08	9
7	"When alarms go off repeatedly, I become indifferent to them"	1.77 ± 1.09	11
8	"Alarm sounds make me nervous"	2.77 ± 0.98	5
9	"I react differently to the low-volume (yellow) and high-volume (red) alarms of the ventilator"	2.93 ± 0.77	3
10	"When I am angry and nervous, I am more bothered by alarm sounds"	2.45 ± 1.02	7
11	"When alarms go off repeatedly and continuously, I lose my patience"	2.35 ± 1.29	8
12	"Alarm sounds prevent me from focusing on my professional duties"	2.09 ± 1.13	10
13	"At visiting hours, I pay less attention to the alarms on the equipment"	1.61 ± 1.02	12
The overall mean of alarm fatigue		**2.36 ± 0.62**	

[a]Mean score of alarm fatigue for each item on the basis of the total number of 185 nurses.

[b]Ranking of the means from 1 (most fatigue) to 13 (lowest fatigue).

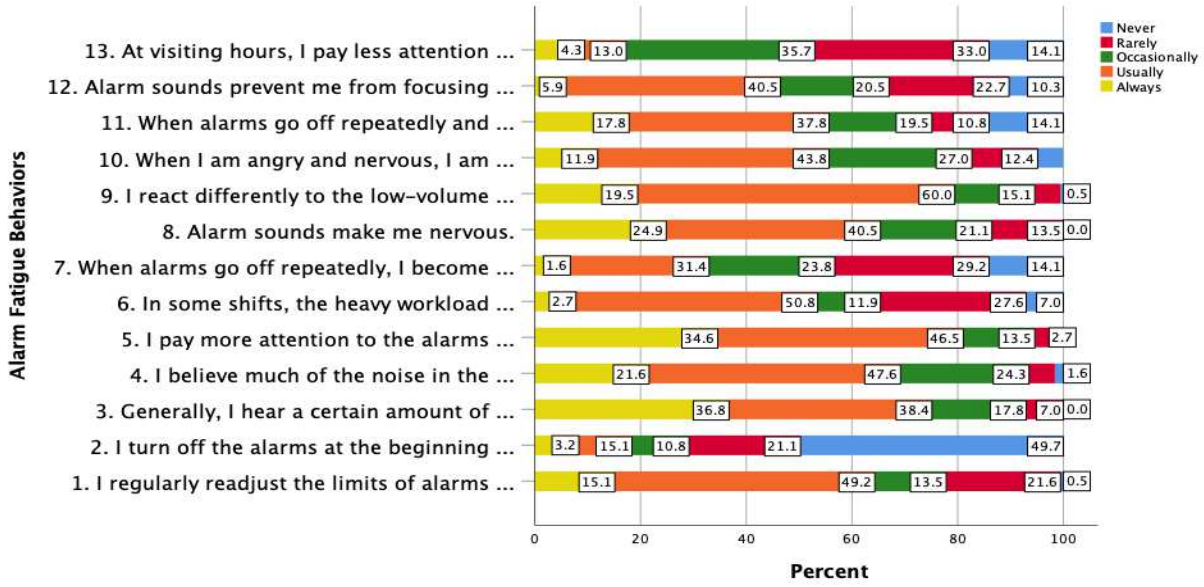

Figure 4.3: Alarm fatigue evaluation (N = 185).

4.5 Alarm Fatigue and Sociodemographic Characteristics

The differences in the mean AF scores according to socio-demographic variables are shown in Table 4.5. Significant differences in AF scores were found according to the unit. It was observed that AF scores in NICUs are greater than in CCUs and PICUs. Furthermore, female (respectively, married) nurses had higher scores of AF than male (respectively, single) nurses.

In addition, nurses with one to five years of ICU experience had lower scores of AF than those with experience of 5 – 10 years. Moreover, nurses in ICUs using a 1:2 or 1:3 nurse/patient ratio during the day had lower AF scores than those using a 1:4 nurse/patient ratio.

Table 4.5: Differences between alarm fatigue and socio-demographic variables (N = 185).

Characteristic		Mean ± SD	P-value (t or F)	Scheffé Test
Hospital	Beit Jala	30.42 ± 6.98	0.151	
	Jericho	33.10 ± 6.59		
	Jenin	32.75 ± 5.33		
	PMC	30.34 ± 5.39		
	Queen Alia	29.91 ± 5.45		
	Rafidia	29.35 ± 5.49		
Unit	ICU[a]	30.83 ± 5.66	0.013*	c > b
	CCU[b]	29.29 ± 6.34		c > d
	NICU[c]	32.35 ± 4.96		
	PICU[d]	30.64 ± 5.63		
Gender	Male	30.00 ± 5.84	0.041*	
	Female	31.75 ± 5.09		
Age	< 35	30.79 ± 5.10	0.626	
	≥ 35	30.33 ± 6.61		
Education	Bachelor	30.44 ± 5.71	0.373	
	Postgraduate	31.54 ± 4.96		
Social status	Single	29.49 ± 5.24	0.027*	
	Married	31.37 ± 5.79		
ICU experience (y)	< 5[a]	28.60 ± 5.73	0.010*	a < b
	5 – 10[b]	31.77 ± 4.73		
	> 10[c]	30.48 ± 6.42		

ICU no. of beds	< 10 10 - 20 > 20	30.23 ± 6.75 30.44 ± 4.41 32.91 ± 4.66	0.129	
Ventilated patients (%)	< 50 50 - 70 > 70	30.69 ± 5.83 30.32 ± 5.76 31.52 ± 4.39	0.679	
Nurse/patient ratio (day)	1:2[a] 1:3[b] 1:4[c]	29.84 ± 5.79 30.26 ± 5.96 32.63 ± 4.17	0.033*	a < c b < c
Nurse/patient ratio (night)	1:2 1:3 1:4	31.60 ± 6.16 30.23 ± 5.58 31.04 ± 5.47	0.419	
In-service alarm training	Yes No	30. 59 ± 6.77 30. 65 ± 5.44	0.960	
The overall mean score of alarm fatigue		**30.64 ± 5.63**		
***The difference is significant (p-value < 0.05).**				

Lastly, the differences in AF mean scores were not significant based on the groups of other sociodemographic characteristics (i.e., hospital, age, education, ICU number of beds, percent of ventilated patients, nurse/patient ratio during the night, and in-service alarm training).

4.6 Summary

To sum up, the analysis in this chapter revealed that the overall mean score of AF was 30.64 ± 5.63, ranging from 16 to 43 compared to the theoretical range from 0 to 52. It was observed that AF scores in NICUs are greater than in CCUs and PICUs. Women nurses had higher scores of AF than men. Married nurses also had higher scores of AF than singles. In addition, nurses with one to five years of ICU experience had lower scores of AF than those with experience of 5 – 10 years. Moreover, nurses in ICUs using a 1:2 or 1:3 nurse/patient ratio during the day had lower AF scores than those using a 1:4 nurse/patient ratio.

The study also suggested that "lack of training on alarm systems" as the most important issue related to alarms. This was consistent with our findings in the sociodemographic part, where only 14.6% of the respondents had in-service alarm training. It should be taken into account by hospital administrators and researchers to decrease AF and improve alarm system services.

Finally, more than 90% of participants in this study believed that alarm sounds should differentiate the priority of the alarm and that smart alarms would be effective to use for improving clinical response to important patient alarms and for reducing false alarms.

Chapter Five

Discussion

5.1 Introduction

The study aim, objectives, and variables are examined in relation to the study findings in this chapter. To the best of our knowledge, this study examines the extent and consequences of AF on critical care nurses in governmental hospitals in the West Bank. It is being conducted among ICU nurses in these hospitals using a tool that the researcher established. In all clinical settings where a lot of equipment and electromedical devices with acoustic alarm systems are used, AF is becoming a problem. Increasing awareness of the phenomenon and creating preventive measures can help to ensure patient safety.

5.2 General Characteristics of Respondents

The demographic characteristics of the participants in terms of gender, the proportion of males (63.2%) is higher than females (63.8%), this result is similar to Salameh et al., 2024 that the mean male participants are (63.6), and not similar to Bourji et al., 2020 which found the female (61.4%) participant greater than male. The predominance of male respondents could influence perspectives and responses related to clinical alarms, as gender-based differences might affect stress and multitasking abilities.

In terms of age, most of those < 35 years (67%), do not agree with a study by Bourji et al., 2020 that show most age between 20-30 years (52.2%), and disagree with Salameh et al., 2024 that show (15.5%) of the participant < 35 years. A younger workforce might be more adaptable to technology but lack extensive experience managing complex clinical situations.

Almost half of the participants worked in ICUs (47%), consistent with Salameh et al., 2024 where most of the participants in her study are working in ICUs (44.4%). That emphasizes the importance of alarm management in an intensive care setting.

Regarding the educational level, the bachelor's degree proportion (85.9%) is higher than other degrees, it is not consistent with ALAN et al., 2021 that 55.7% of the participants are undergraduate degrees, and consistent with Bourji et al., 2020 (58.2%) and Salameh et al., 2024 (72.2%). The high educational level suggests that respondents are well-qualified to handle sophisticated alarm systems.

On the other hand, married status (60.5%) is higher than single status (38.9%), not agreeing with Bourji et al., 2020 (43.9%) married participants, but it is equal according to Salameh et al., 2024 who have (50.3%) married. The marital status of respondents might reflect differing levels of work-life balance, which could impact alarm fatigue. Unmarried, high-level positions, long working years, high professional titles, and high education are negatively correlated with alarm fatigue.

Regarding ICU experience the result indicates most of the participants have 5-10 years of experience (46.5%), which agrees with Sowan et al., 2016 (46%) 5-10 years but does not agree with Torabizadeh et al., 2017 (47.1%) 1-5 years and Salameh et al., 2024 (40.6%) <5 years. This significant proportion of mid-level experience indicates a balance between experience and openness to new training methods.

When we assess In-Service Alarm Training, the results show only 14.6% had received in-service alarm training, which is not consistent with DEB&CLAUDIO, 2015 (36.36%),

Johnson et al., 2017 (60%), Casey et al., 2018 (52%) that received In-Service Alarm Training. It highlights a critical area for improvement given its impact on effective alarm management.

5.3 Nurses' Perceptions Regarding Clinical Alarms

Over 90% of respondents believe that alarm sounds should differentiate priority and that smart alarms could improve responses and reduce false alarms. This result is similar to Claudio et al., 2021 (84.6%) but not similar to Ruppel et al., 2018 (47.78%). This consensus suggests a clear need for advanced alarm technology.

More females believe that setting alarm parameters is complex and that clinical policies regarding alarm management are lacking ($p < 0.001$ and $p = 0.003$, respectively), this belief agrees with Ruppel et al., 2018 (39.38%), Claudio et al., 2021 (46.2%), and Bourji et al., 2020 (50.1%).

More males believe newer systems have resolved previous issues and that it can be confusing to identify which device is alarming ($p = 0.003$ and $p < 0.001$, respectively), consistent with Ruppel et al., 2018 (62.4%), but not consistent with Claudio et al., 2021 (23.1%).These differences reflect varied experiences and stress responses between genders, influencing their views on alarm systems.

5.4 Clinical Alarm-Related Important Issues

This section provided insights into how the participants rated the relative influences of the various challenges they faced with clinical alarm management. Participants ranked the importance of the nine alarm issues that may affect alarm recognition and response. The staff's replies explain the purpose of the alarms during the work shift to them. When an alarm

is regarded as a bother, it is likely to be disabled, making it ineffective as a warning system for medical emergencies.

Lack of Training on Alarm Systems ranked as the most important issue (67.0% high ranking), this rank agrees with Sowan et al., 2015 that shows the rank of lack training is (Rank 9) on the other hand Ferrara et al., 2022 report that about 11.54% have received training about the alarm system.

Regarding inadequate staff to respond to alarms, the study result shows a high ranking of 53%, which agrees with Zhao et al., 2021 (57.7%) and Claudio et al., 2021(30.8%) and rank 5 according to Sowan et al., 2015.These issues underscore the necessity of improved instruction and staffing to manage alarms effectively.

5.5 Alarm Fatigue Evaluation

Paying more attention to alarms on certain shifts and hearing a certain amount of noise in the ward, were identified as the most frequent behaviors linked to alarm fatigue, this result is consistent with Claudio et al., 2021 (92.3%) and Casey et al., 2018 (81%). Alarm fatigue's total mean score was 30.64 ± 5.63, indicating a moderate to high level of fatigue among nurses, the other hand, it shows in Salameh et al., 2024 23.36 (SD=5.57) out of 44 conducted in Palestine.

5.6 Sociodemographic Influences on Alarm Fatigue

NICU nurses reported higher AF scores compared to CCU and PICU nurses. The high-stakes nature of neonatal care could explain the increased fatigue, this result disagrees with Salameh

et al., 2024 (62.6%) of the participating ICU nurses experienced an average to a high degree of alarm fatigue.

Female and married nurses had higher fatigue scores, suggesting that these demographics might face more cumulative stress from balancing professional and personal responsibilities. Nurses with 1-5 years of experience had lower fatigue scores compared to those with 5-10 years. Higher nurse/patient ratios (1:4) during the day were associated with increased fatigue, highlighting the strain of managing more patients per nurse.

5.7 Influences on Patient Safety

This study indicates that false alarms negatively impact patient care, corroborating findings from previous research (Oliveira et al., 2018; Casey et al., 2018). AF endangers patient safety by causing delays in nurses' responses to alarms (Srinivasa et al., 2017), a sentiment echoed by the majority of our survey respondents. A notable discovery from this research is that 74.1% of critical care nurses believe that nuisance alarms interfere with patient care, and the percentage higher than found by Alsuyayfi&Alanazi 2022which found 65 %. This significant percentage highlights the adverse effects of AF on the quality of care in intensive care units (ICUs).

Frequent and often false nuisance alarms can lead to desensitization among nurses, resulting in delayed or missed responses to actual emergencies. In addition to endangering patients, this also makes nurses' workloads and stress levels higher. Previous studies have demonstrated that AF reduces the sense of urgency and heightens the risk of errors (Sendelbach& Funk, 2013). The widespread perception that nuisance alarms disrupt patient care supports these findings, suggesting that the high occurrence of false alarms compromises patient safety by distracting nurses from real alarms and necessary interventions.

5.8 Summary

Finally, the subjects who had completed at least one clinical experience in the critical area had higher AF scores (though they did not reach statistical significance). Since these subjects had more prolonged exposure to alarms than those who were conducting their experience in the critical area for the first time, it is plausible that these subjects had higher levels of alarm fatigue; however, the literature provides inconsistent results regarding the impact of exposure duration on nurses.

Chapter Six

Conclusion & Recommendation

6.1 Conclusion

- ✓ Given that 47% of respondents work in intensive care units and others in PICUs, CCUs, and NICUs, it is evident that each unit has different demands. To properly handle these disparities, customized technologies and training are required.

- ✓ Gender-specific training and assistance may be advantageous, as evidenced by the considerable disparities in alarm perceptions between the sexes and the 63.2% male response rate. Planning an intervention should consider the differences between how men and women experience and handle alarm concerns.

- ✓ The majority of workers (67.0% are under 35 years old), which may make them more nimble with emerging technology but may also mean they lack deep experience with intricate alarm systems. Peer training programs can benefit greatly from the experience and adaptability that nurses with 5–10 years of experience (46.5%) bring to the table.

- ✓ With 85.9% of workers holding a bachelor's degree, the workforce is well-educated and capable of managing sophisticated alarm systems. But just 14.6% of employees have undergone in-service alarm training, underscoring the urgent need for more training initiatives. To effectively manage alarms and lessen alarm fatigue, proper training is necessary.

- ✓ Nurses strongly agree (over 90%) that priority levels should be indicated by alarm sounds, and that smart alarms could enhance responses and decrease false alarms. This agreement demonstrates the strong need for sophisticated alarm systems that facilitate improved clinical judgment and lighten the cognitive burden of nurses.

- ✓ The primary concerns that have been discovered are inadequate staffing levels to respond to alarms (53.0%) and a lack of training on alarm systems (67.0%). These results highlight how important it is for hospitals to fund extensive training initiatives and make sure they have enough employees to handle alarms in an efficient manner, which can greatly lower AF and enhance patient safety.

- ✓ Several variables, including the particular unit, the nurses' marital status, gender, and experience level, can affect alarm fatigue. Because neonatal care involves high stakes, NICU nurses reported more alarm fatigue. Higher levels of exhaustion were reported by married and female nurses, which may indicate that they are under more stress from juggling their personal and professional obligations.

- ✓ Notably, 74.1% of nurses reported that nuisance alarms disrupt patient care. This finding underscores the urgent need to address AF to enhance the quality of care in ICUs. By mitigating the frequency of nuisance alarms, healthcare facilities can reduce the risk of missed critical alarms, thereby improving patient safety and outcomes.

6.2 Recommendations

1. More in-service training for alarm management is desperately needed. To improve nurse readiness and lessen alarm fatigue, training should be continuous and customized to the unique requirements of various units and populations.

2. In high-stress environments like NICUs, increasing nurse-to-patient ratios is crucial to lowering workload and alarm fatigue. A sufficient workforce guarantees prompt and efficient handling of alarms.

3. It’s critical to deploy smart alarms that distinguish between priorities and lower false alarm rates. These tools can help nurses respond more clinically and with less cognitive strain.

4. It's essential to create precise, comprehensive clinical policies for alarm management and to streamline the alarm-setting process. Uncomplicated and unambiguous policies guarantee uniform procedures throughout departments and lessen the complexity of handling alarms.

6.3 Limitation

1. The study was planned to collect data through observational and questionnaire as part of a cross-sectional study, but approval was not obtained from the Ministry of Health for the observational component. Therefore, data was collected only via a questionnaire that was permitted.

2. The cross-sectional design of the study provides a moment-in-time view of alarm management and weariness, but it does not take changes over time into consideration.

3. Longitudinal studies are required to monitor the evolution of these problems and the effects of interventions.

4. Difficulty in moving between cities in the West Bank due to restrictions on movement by the Israeli occupation.

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Appendices

Appendices 1: Data Collection Sheet

الجامعة العربية الأمريكية
ARAB AMERICAN UNIVERSITY

Alarm Fatigue and Its Influences on Critical Care Nurse's Performance and Patient Safety in Governmental Hospitals in West Bank

Dear Nurse,

I humbly request your assistance. My name is Osama Nassar. I am currently conducting research for my master's thesis on the topic "Alarm Fatigue and Its Influences on Critical Care Nurse's Performance and Patient Safety in Governmental Hospitals in West Bank". I am asking if you would consider participating in a survey. Participation is voluntary but enthusiastically appreciated. The survey contains four parts, the first Demographics, and the last 41-point questionnaire which will take less than 15 minutes of your time.

Your participation is essential, and all information provided will be treated with utmost confidentiality, and used solely for research purposes. Feel free to answer the questionnaire objectively, as your input significantly contributes to accurate results. The research team is ready to share study results upon request. Thank you for your cooperation.

Researcher: Osama Nassar **Supervisor: Dr Dalia Touqan**

Email:osama.nassar93@hotmail.com

Phone N.: 0566229833

1. Socio-demographic Information		
1.	Hospital	○ Queen Alia ○ Beit Jala ○ PMC ○ Jericho ○ Rafidia ○ Jenin
2.	Unit	○ ICU ○ CCU ○ NICU ○ PICU
3.	Gender	○ Male ○ Female
4.	Age (years)	○ < 35 ○ 35 – 50 ○ > 50
5.	Educational Level	○ Diploma ○ Bachelor ○ Master/PhD
6.	Marital status	○ Single ○ Married ○ Widowed/ Divorced
7.	Years of ICU experience	○ <5 ○ 5-10 ○ >10
8.	No. of ICU beds	○ <10 ○ 10 - 20 ○ > 20
9.	Nurse: patient ratio on the day shift	○ 1:1 ○ 1:2 ○ 1:3 ○ 1:4
10.	Nurse: patient ratio during night shift	○ 1:1 ○ 1:2 ○ 1:3 ○ 1:4
11.	In-service alarm training	○ Yes ○ No
12.	Proportion of mechanically ventilated patients?	○ < 50% ○ 50 - 70% ○ > 70% ○ Not available

2. Perceptions Section						
	Statement/ Item	**Strongly Agree**	**Agree**	**Neutral**	**disagree**	**Strongly disagree**
1	Nuisance alarms disrupt patient's care.					
2	Nuisance alarms reduce trust in alarms and cause caregivers to inappropriately turn alarms off at times other than setup or procedural events.					
3	Alarm sounds should differentiate the priority of the alarm.					
4	Alarm sounds should be distinct based on the parameter (e.g. heart rate) or source (device type).					
5	Nuisance alarms occur frequently.					
6	Properly setting alarm parameters and alerts is overly complex in existing devices.					
7	Newer monitoring systems (e.g.< 3 years old) have solved most of the previous problems we experienced with clinical alarms.					
8	The alarms used in my ward of the hospital are adequate to alert nurses of potential or actual changes in a patient's condition.					

Statement/ Item		Strongly Agree	Agree	Neutral	disagree	Strongly disagree
9	There have been frequent circumstances in which alarms could not be heard and were missed.					
10	The clinical staff is sensitive to alarms and responds quickly.					
11	The medical devices used in my unit of the hospital have distinct outputs (i.e. sounds, repetition rates, or visual displays) that allow staff to identify the source of the alarm.					
12	When a number of medical devices are used with a patient, it can be confusing to understand which device is in an alarm condition.					
13	Environmental background noise has interfered with alarm recognition.					
14	Central alarm management staff responsible for receiving alarm messages and alerting appropriate nurses is helpful.					
15	Alarm integration and communication systems via cell phones, pagers, and other wireless devices can be useful for improving alarm management and response.					

Statement/ Item		Strongly Agree	Agree	Neutral	disagree	Strongly disagree
16	Smart alarms would be effective to use for improving clinical response to important patient alarms.					
17	Smart alarms would be effective to use for reducing false alarms.					
18	Clinical policies and procedures regarding alarm management are effectively used in my ward of the hospital.					
19	There is a requirement in my institution to document that the alarms are set and are appropriate for each patient.					

3. Effective Management Section:

Please rank the following issues below concerning alarms; *Read all issues first, then rank each issue with only one ranking* ****** 1 = most important** **9 = least important**

3. Effective Management Section		
	Statement/ Item	**Rank 1-9**
1	**Difficulty in setting alarms properly.**	
2	**Difficulty in hearing alarms when they occur.**	
3	**Difficulty in identifying the source of an alarm.**	
4	**Difficulty in understanding the priority of an alarm.**	
5	**Frequent false alarms, which lead to reduced attention or response to alarms when they occur.**	
6	**Inadequate staff to respond to alarms as they occur.**	
7	**Over-reliance on alarms to call attention to patient problems.**	
8	**Noise competition from non-clinical alarms and pages.**	
9	**Lack of training on alarm systems.**	

4. Nurses' Alarm fatigue section						
	Statement/item	Always	Usually	Occasionally	Rarely	Never
1	I regularly readjust the limits of alarms based on the clinical symptoms of patients.					
2	I turn off the alarms at the beginning of every shift.					
3	Generally, I hear a certain amount of noise in the ward.					
4	I believe much of the noise in the ward is from the alarms of the monitoring equipment.					
5	I pay more attention to the alarms on certain shifts.					
6	In some shifts, the heavy workload in the ward prevents my quick response to alarms.					
7	When alarms go off repeatedly, I become indifferent to them.					
8	Alarm sounds make me nervous.					
9	I react differently to the low-volume (yellow) and high-volume (red) alarms of the ventilator.					
10	When I'm upset and nervous, I'm more responsive to alarm sounds.					
11	When alarms go off repeatedly and continuously, I lose my patience.					
12	Alarm sounds prevent me from focusing on my professional duties.					
13	At visiting hours, I pay less attention to the alarms on the equipment.					

Thank you ☺

Appendices 2: MOH Approval

State of Palestine
Ministry of Health
Education in Health and Scientific
Research Unit

دولة فلسطين
وزارة الصحة
وحدة التعليم الصحي
والبحث العلمي

Ref.: .....
Date:.....

الرقم: ١٦٤/٨٠٥/٢٠٢١
التاريخ: ٢٠٢١/٤/١٧

عطوفة الوكيل المساعد لشؤون المستشفيات المحترم،،،

عطوفة الوكيل المساعد لمجمع فلسطين الطبي المحترم،،،

تحية واحترام،،

الموضـــوع: تسهيل مهمة بحث

يرجى تسهيل مهمة الطالب: – **اسامة عاطف كامل نصار** برنامج دراسات عليا تخصص تمريض العناية المكثفة الجامعة العربية الامريكية ، في عمل بحث بعنوان:

"ارهاق الانذار وتأثيره على اداء ممرضي العناية المكثفة وسلامة المرضى في المستشفيات الحكومية في الضفة الغربية "

تحت اشراف **د. داليا طوقان** حيث سيتم جمع معلومات من خلال توزيع استبانة وذلك في :

. – مستشفى الخليل – مستشفى بيت جالا – مستشفى اريحا

– مستشفى رفيديا – مستشفى جنين

مجمع فلسطين الطبي

*على ان يتم الالتزام باساليب واخلاقيات البحث العلمي، **وعدم التعرض للمعلومات التعريفية للمشاركين.***
على ان يتم تزويد الوزارة بنسخة PDF من نتائج البحث. والتعهد بعدم النشر لحين الحصول على موافقة الوزارة على نتائج البحث.

مع الاحترام،،

د. عبد الله القواسمي
رئيس وحدة التعليم الصحي والبحث العلمي

نسخة: عميد كلية الدراسات العليا المحترم/ الجامعة العربية الامريكية

Appendices 3: IRB Approval

Arab American University
Institutional Review Board - Ramallah

الجامعة العربية الأمريكية
مجلس اخلاقيات البحث العلمي – رام الله

IRB Approval Letter

Study Title: "Alarm Fatigue and Its Influences on Critical Care Nurse's Performance and Patient Safety in Governmental Hospital in West Bank".

Submitted by: Osama Atif Kamel Nassar

Date received: 30th March 2024

Date reviewed: 6th May 2024

Date approved: 6th May 2024

Your Study titled **"Alarm Fatigue and Its Influences on Critical Care Nurse's Performance and Patient Safety in Governmental Hospital in West Bank"** with the code number **"R-2024/A/54/N"** was reviewed by the Arab American University Institutional Review Board - Ramallah and it was approved on the 6th of May 2024.

Sajed Ghawadra, PhD
IRB-R Chairman
Arab American University of Palestine

الجامعة العربية الأمريكية - فلسطين
مجلس اخلاقيات البحث العلمي - رام الله
IRB-R
ARAB AMERICAN UNIVERSITY-PALESTINE
INSTITUTIONAL REVIEW BOARD - RAMALLAH

General Conditions:

1. Valid for 6 months from the date of approval.
2. It is important to inform the IRB-R with any modification of the approved study protocol.
3. The Bord appreciates a copy of the research when accomplished.

رام الله – فلسطين

Tel: 02-294-1999 **E-Email:** IRB-R@aaup.edu **Website:** www.aaup.edu

Appendices 4: Consent Form

Arab American University
Institutional Review Board - Ramallah

الجامعـــة العربيـــة الأمريكيـــة
مجلس اخلاقيات البحث العلمي – رام الله

نموذج الموافقة

AAUP-IRB-R Code No.: .....
AAUP-IRB-R Date: .....

أنا ..... (اسم المشارك / اختياري)

أوافق بموجبه على المشاركة في البحث السريري (الاستبيان) المحددة أدناه:

ارهاق الإنذار وتأثيره على أداء ممرضي العناية المكثفة وسلامة المرضى في المستشفيات الحكومية في الضفة الغربية /فلسطين

لتحقيق درجة: الماجستير، في برنامج تمريض العناية المكثفة في الجامعة العربية الامريكية.

تم شرح وتفسير طبيعة الدراسة وهدفها عن طريق الباحث: اسامة نصار

لقد تم إخباري عن طبيعة البحث من حيث المنهجية والآثار السلبية المحتملة والمضاعفات (حسب ورقة معلومات المشارك).

بعد معرفة وفهم جميع المزايا والعيوب المحتملة لهذا البحث، أوافق طواعية بمحض إرادتي على المشاركة في البحث السريري المحدد أعلاه.

أفهم أنه يمكنني الانسحاب من هذا البحث في أي وقت دون إبداء أي سبب على الإطلاق.

التاريخ: ..... إمضاء المشارك: .....

في حضور:-

اسم: .....

التسمية / اللقب: ..... إمضاء: .....

(شاهد على توقيع المشارك)

أؤكد أنني أوضحت للمشارك طبيعة وهدف البحث المذكور أعلاه.

تاريخ: ..... إمضاء: .....

(الباحث)

رام الله – فلسطين
Tel: 02-294-1999 **E-Email:** IRB-R@aaup.edu **Website:** www.aaup.edu

Appendices 5: Permission to use HTF Clinical Alarm Survey 2016

Kallirroi Stavrianou

KS

jennifer.ott2@mercy.net إلى أنت و

Dear Osama,

Thank you for submitting your proposal. Please find here the questions in Word format for the 2016 HTF Clinical Alarm Survey. Let me know if you have any further questions. We would love to hear more about your results. We are always looking for ways to improve education on alarms globally!

Best wishes,
Kallirroi

Kallirroi Stavrianou
GCEA Manager

secretariat@globalcea.org
www.globalcea.org

GLOBAL CLINICAL ENGINEERING ALLIANCE

Appendices 6: Permission to use Alarm Fatigue Questionnaire

من: Torabik <torabik@sums.ac.ir>
تاريخ الإرسال: الاثنين, نيسان 15, 2024 4:40 م
إلى: Osama Nassar <osama.nassar93@hotmail.com>
الموضوع: Re: permission request

Dear Colleague,

It is an honor for me that you are interested in my questionnaire. The questionnaire and its scoring is attached. I hope it will be useful. You have my permission to use the Alarm Fatigue Questionnaire.

Best regards,

Camellia Torabizadeh

ملخص الدراسة

يحدث اجهاد الأنذار نتيجة للإنذارات المتكررة وغير الدقيقة مما يشكل خطرا كبيرا على سلامة المرضى وأداء التمريض. الهدف من الدراسة هو استقصاء تصور ومفهوم التمريض في وحدات العناية المركزة حول ارهاق الإنذار، وتحديد العوامل المساهمة فيها، ووضع استراتيجيات لإدارتها بشكل فعال لتعزيز سلامة المرضى وتحسين أداء التمريض في المستشفيات الحكومية في الضفة الغربية.

تمت الدراسة بشكل عرضي مع 185 ممرض وممرضة من أقسام العناية المكثفة في ستة مستشفيات حكومية باستخدام أسلوب العينة المناسبة لتوزيع وجمع استبيانات الدراسة. تم تحليل البيانات باستخدام برنامج SPSS 27 واستخدام اختبارات T و ANOVA واختبارات .Chi-square كانت فترة الدراسة من 1 مايو 2024 إلى 20 مايو 2024. أظهرت النتائج أن متوسط ارهاق الأنذار كان 30.64 ± 5.63 مما يشير إلى وجود إرهاق من نسبة متوسطة إلى شديدة، مع درجات أعلى في وحدات العناية المكثفة لحديثي الولادة. وأفاد 74.1% من التمريض أن الإنذارات المتواصلة تتداخل مع رعاية المرضى. كما أبرزت الدراسة مشكلة رئيسية هي أن 14.6% فقط من التمريض تلقى التدريب الداخلي على الإنذارات.

في الاستنتاجات، هناك حاجة إلى تدريب مخصص ومحدد لوحدة للتعامل مع تحديات إدارة الإنذارات. على الرغم من أن هناك قوى عاملة متعلمة بشكل جيد، إلا أن معدل التدريب الداخلي المنخفض يؤكد على ضرورة الحاجة الى برامج شاملة بشكل عاجل. تطبيق الإنذارات الذكية وضمان الكفاءة في

التشغيل هو أمر حيوي لتعزيز سلامة المرضى وتقليل إجهاد الأنذار. وتوصي الدراسة بأن المستشفيات بحاجة إلى تدريب مستمر ومتخصص في إدارة الإنذارات، خاصة في وحدات الرعاية المركزة لحديثي الولادة. كما أن نسبة التمريض لعدد المرضى والإنذارات الذكية التي تعطي الأولوية للإنذارات يمكن أن تقلل من العبء العملي واجهاد الأنذار. تعتبر السياسات الواضحة لإدارة الإنذارات أمراً ملحا ومتطلب للممارسات الفعالة والمتسقة.