ADDIS ABABA UNIVERSITY COLLEGE OF MEDICINE AND HEALTH SCIENCES

DEPARTMENT OF ANESTHESIOLOGY CRITICAL CARE AND PAIN MEDICINE

Assessment of alarm response time and alarm fatigue among nurses working in Intensive Care Units of Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia

The thesis report to be summited to Addis Ababa University, School of Medicine, Department of Anesthesiology, Critical Care, and Pain Medicine, in partial fulfillment of the requirement for speciality of Anesthesiology, Critical Care, and Pain Medicine

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April, 2025
Addis Ababa, Ethiopia

Acknowledgment

First and foremost, I give all praise and glory to Almighty God, whose grace, wisdom, and strength have guided me throughout this journey.

I would like to express my sincere gratitude to Addis Ababa University, School of Medicine, Department of Anesthesiology, Critical Care, and Pain Medicine for providing me the opportunity to pursue my postgraduate studies. The resources and facilities provided by the university were indispensable in carrying out my research project. My sincere appreciation also goes to the nursing staff and administration of Tikur Anbesa Specialized Hospital. I am especially grateful to the ICU nurses who willingly participated in this study. Your time and perspectives are at the core of this research, and I am truly thankful for your contribution.

I would like to extend my deepest gratitude to my advisors, Dr. Nura Kedir and Dr. Getachew Jiregna for their unwavering support and thoughtful guidance throughout the development of this thesis.

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ABBREVIATIONS AND ACRONYMS

ACCPM -- Anesthesiology, Critical Care, and Pain Medicine
AFS – Alarm Fatigue Scale
ANOVA – Analysis of variance
ASA – American Society of Anesthesiologists
CICU – Cardiac intensive care unit
ECRI – Emergency Care Research Institute
FDA – Food and Drug Administration
HCPs – Healthcare professionals
MD – Medical Doctor
NICU – Neonatal intensive care unit
PICU – Pediatric intensive care unit
SPSS – Statistical Package for Social Sciences
SICU – Surgical intensive care unit
TASH – Tikur Anbesa Specialized Hospital
TJC – The Joint Commission

ABSTRACT

Background: Alarm systems are essential for monitoring critically ill patients in ICUs, but a high proportion of false or non-actionable alarms—reported to range from 80% to 99%—has led to widespread alarm fatigue among healthcare workers. This desensitization can result in delayed or missed responses to critical alarms, thereby posing serious risks to patient safety. Understanding alarm fatigue is vital for improving patient safety and care quality in ICUs, and this study aims to identify strategies for better alarm management.

Objectives: This study aimed to assess alarm response time and the prevalence of alarm fatigue among ICU nurses at Tikur Anbessa Specialized Hospital (TASH), and to identify associated factors.

Methods and materials: A prospective institutional-based observational study was conducted from October 2024 to March 2025 to assess the alarm response time of nurses and the prevalence of alarm fatigue in intensive care units (ICUs) of Tikur Anbesa Specialized Hospital (TASH). Data were collected through a structured observation checklist and a semi-structured, self-administered questionnaire. The questionnaire included a 9-item, 5-point Likert scale adopted from Charité Alarm Fatigue Questionnaire; CAFQa and Torabizadeh, C., et al. assessing alarm fatigue, with a Cronbach's alpha across factors of 0.84, indicating good internal consistency.

The sample size was determined using the single population proportion formula, considering a 95% confidence level, a 5% margin of error, and an estimated proportion (p) of 0.5 because there were no similar studies. Data were entered and analyzed using SPSS version 25. Descriptive statistics such as frequencies, percentages, means, and standard deviations were calculated to summarize the data. Analytical methods included chi-square tests and binary logistic regression to identify factors associated with the outcome variables. A p-value <0.05 was considered statistically significant, with $p < 0.001$ interpreted as highly significant.

Results: A total of 76 ICU nurses participated in the study. The mean age of participants was 33.3 years and median age was 35.5, with a male-to-female ratio of 1:1.5. The majority i.e. 52.5% were aged 31–40 years. Forty one point four had 5–8 years of general nursing experience. Nearly half i.e. 49.5% had 2–4 years of ICU experience.

Of 86 alarms went off ECG alarms were the most frequently observed type i.e. 42%. Of all alarms 39.5% were high-priority alarms. In terms of response, 43% of nurses reached patients within 31–60 seconds, and 38.9% resolved the alarms in the same timeframe. Immediate responses most commonly included equipment adjustment (39%) and checking vital signs (21%).

Alarm fatigue was reported by 88% of nurses. Among them, 63.2% felt overwhelmed by the frequency of alarms, and 53.9% believed alarm fatigue negatively impacted patient care. Additionally, 52.6% reported a moderate effect on their job performance, and only 38.2% had received any form of training on alarm management.

Alarm fatigue showed significant correlations with nurses' age ($r = 0.388$, $p < 0.001$), years of general nursing experience ($r = 0.226$, $p = 0.025$), and ICU experience ($r = 0.333$, $p = 0.001$). No significant associations were found with gender, alarm type, patient age, or response time.

Conclusion: Alarm fatigue is highly prevalent among ICU nurses at TASH and is influenced by demographic and work-related factors. Although most alarms are addressed within one minute, the psychological burden and performance implications of alarm fatigue are considerable.

Recommendation: Regular training on alarm management, improved alarm system design, and strategies such as alarm customization and reduction of non-actionable alarms are recommended to mitigate alarm fatigue and enhance patient safety in ICUs.

1. Introduction

1.1 Background

In the intensive care unit (ICU), where patients are in critical condition, alarms are a common occurrence [1]. These alarms are designed to alert medical staff to changes in vital signs or to signal equipment malfunctions. Devices such as monitors, ventilators, and infusion pumps frequently generate these sound signals. However, the vast majority of these alarms—between 85% and 99%—are either false or not clinically relevant [2].

Alarm fatigue in medical settings describes a condition in which healthcare professionals, after prolonged exposure to frequent alarms from various medical devices, become less responsive to these signals. This reduced sensitivity can lead to the neglect of important alarms. The term "alarm fatigue" specifically highlights the burden that excessive, repetitive, or concurrent alarm sounds place on nursing staff [25]. This desensitization is a significant factor in adverse alarm-related incidents, potentially jeopardizing patient safety and leading to serious outcomes [26].Nursing staff, who spend most of their time with patients, monitoring their condition 24 h, are particularly exposed to so-called alarm fatigue.

ICU nurses typically respond to between 150 and 400 alarms per patient during a shift [4], with alarm response activities consuming approximately 35% of their total working time [5]. This overwhelming volume of alarms can result in sensory overload, potentially causing delayed responses or even complete disregard of alarms [6]. Although alarm fatigue among ICU staff has been acknowledged as a significant issue for over two decades, there is still no universally accepted standard for measuring it. Notably, Torabizadeh et al. conducted the first and only systematic effort to develop a reliable tool for evaluating alarm fatigue in nurses.

1.2 Statement of the Problem

Alarm systems in Intensive Care Units (ICUs) play a critical role in tracking patients' vital signs and identifying potential health complications. However, their frequent activation often contributes to alarm fatigue among nurses. ICU nurses regularly experience frustration due to the overwhelming number of alarms—many of which are false or non-actionable. This can lead to critical alerts being overlooked, jeopardizing patient safety and potentially resulting in serious outcomes such as missed clinical changes, delayed medical responses, and increased rates of illness and mortality [21].

A study conducted at Inha University in Incheon, Korea, revealed that four types of medical devices—patient monitors, mechanical ventilators, continuous renal replacement therapy machines, and infusion pumps—were responsible for generating alarms. Over a 48-hour period, 2,184 alarms were recorded across 48 patients, averaging 45.5 alarms per patient per hour. Of these, 37.3 alarms per hour came from patient monitors. Only 790 of the alarms (36.2%) were valid, while the remaining 1,394 (63.8%) were false, consisting of 369 non-technical and 1,025 technical alarms. Alarm settings on patient monitors were seldom customized; only 18.8% of cases had alarm parameters adjusted by nurses based on individual patient needs. In 35.4% of cases, default system settings were used, and in 45.8%, settings from previous shifts were retained [26].

In the ICUs of Tikur Anbessa Specialized Hospital (TASH), nurses face alarm exposure from multiple devices, including cardiac monitors, ventilators, and infusion pumps. The excessive number of alarms contributes to alarm fatigue and can significantly delay responses to critical alerts. Such delays may lead to severe consequences, such as failure to recognize patient deterioration in time, incorrect handling of emergencies, and extended ICU stays.

The persistent noise and stress from constant alarms also create a high-pressure work environment, which can hinder nurses' ability to deliver high-quality care and negatively affect their mental and physical well-being. Alarm fatigue, therefore, not only compromises patient safety but also contributes to increased stress, burnout, and job dissatisfaction among nursing staff.

Despite the evident significance of effective alarm management, there is a noticeable lack of in-depth research on alarm fatigue and response times among nurses at TASH. Gaining a clearer understanding of how prevalent alarm fatigue is, its contributing factors and the most effective strategies to reduce it is crucial for improving patient outcomes and fostering a healthier work environment for nurses.

1.3 Significance of the study

The central importance of this study lies in its potential to improve patient safety within the Intensive Care Units (ICUs) of Tikur Anbessa Specialized Hospital (TASH). By examining alarm response times and alarm fatigue among nursing staff, the study seeks to uncover the factors responsible for delayed or missed responses to alarms—delays that can have serious, even life-threatening, consequences for critically ill patients. Enhancing alarm management practices can promote more timely clinical interventions, improve health outcomes, and reduce the risks of complications and mortality.

Alarm fatigue is also closely linked to increased stress, burnout, and dissatisfaction among nurses. By tackling this issue, the study aims to foster a more supportive and less stressful work environment, ultimately benefiting nurses' mental and physical health. Improved staff well-being is likely to boost job satisfaction, reduce turnover, and contribute to higher standards of patient care.

The research will generate evidence-based insights into how prevalent alarm fatigue is and what factors contribute to slow or missed alarm responses. This information is essential for developing targeted strategies—such as optimizing alarm settings, introducing intelligent alarm systems, and offering comprehensive training in alarm management. These interventions can help reduce alarm fatigue, enhance nurses' responsiveness, and improve both patient safety and staff well-being.

Moreover, this study will add to the limited body of research on alarm fatigue and response times in ICUs, particularly within the Ethiopian healthcare context. As one of the few investigations focused on a major referral hospital like TASH, its findings will be valuable not only locally but also to healthcare systems facing similar challenges worldwide. Disseminating the results

through academic publications, conferences, and professional workshops will contribute to a broader understanding of how alarm management affects both patients and healthcare providers.

The study's outcomes can also inform decision-making and policy development at TASH and other institutions. By highlighting the specific issues contributing to alarm fatigue in TASH ICUs, the research can support the creation of effective protocols, guide resource allocation, and recommend organizational changes to improve alarm management.

Although the significance of effective alarm management is well acknowledged, there remains a gap in detailed research addressing alarm fatigue and response times among ICU nurses at TASH. This study aims to close that gap by thoroughly examining current practices, determining the extent and impact of alarm fatigue, and identifying its root causes. In doing so, it will provide a strong foundation for implementing tailored, evidence-based interventions.

Finally, by supplying essential baseline data, this study will support ongoing quality improvement efforts aimed at safeguarding patients and supporting healthcare workers. The findings will enable tracking of progress over time and evaluation of the effectiveness of alarm management strategies, contributing to continuous improvement in ICU care delivery.

2. Literature Review

2.1. Introduction

Alarm fatigue describes the progressive desensitization of healthcare workers to frequent alarm signals, which can lead to delayed or missed responses, ultimately putting patient safety at risk. In 2002, the Joint Commission released a Sentinel Event Alert reporting 23 serious incidents related to long-term ventilation; alarm-related issues—such as disabled alarms, inaudible signals, or incorrect settings—were responsible for 65% of these cases. Between 2005 and 2008, the FDA received over 500 reports of patient deaths linked to alarms, and the ECRI Institute identified that alarms were involved in 12% of all device-related safety incidents [7].

Similarly, research from KwaZulu-Natal, South Africa, found that although ICU nurses acknowledged the importance of alarms, the frequent occurrence of false alarms led to behavioral desensitization and delays in responding to critical alerts [48].

A 2020 study assessing alarm fatigue awareness, practices, and associated factors among nurses in adult ICUs of federal hospitals in Addis Ababa, Ethiopia, revealed that 63% of the 162 participants were unfamiliar with the term "alarm fatigue." However, many recognized that nuisance alarms reduce trust in the system and can disrupt patient care.

Most participants reported a lack of understanding about the causes and prevention of alarm fatigue, with over 65% indicating they did not know how to prevent it. Despite this, 154 nurses (95.1%) correctly stated that alarms should indicate their priority, and 149 (92%) correctly noted that alarms should be distinguishable based on their parameter (e.g., heart rate) or source (device type). Furthermore, 140 nurses (86.4%) agreed that nonactionable or false alarms interfere with patient care, and 145 (89.5%) acknowledged that these alarms could reduce trust in alarm systems, potentially leading caregivers to disable them inappropriately outside of necessary situations, such as during setup or procedures [16].

2.2 Impact of Alarm Overload

Studies have shown that between 72% and 99% of clinical alarms are false. This overwhelming volume of false alerts contributes to alarm fatigue—a state of sensory overload experienced by healthcare providers exposed to constant alarms. As a result, clinicians may become desensitized, increasing the risk of missed alarms. Alarm fatigue has been linked to incidents of patient deaths[7].

Becoming desensitized to alarms due to improper settings is a significant concern, especially considering the critical role of alarm monitoring. While many support implementing more structured strategies—such as buddy systems or oversight through clinical rounds by the nurse in charge—the primary responsibility for patient care and continuous monitoring ultimately lies with the assigned nurse [8].

The World Health Organization (WHO) recommends that noise levels remain below 35 decibels during the day to support optimal health. However, most hospitals exceed this guideline, with daytime noise levels recorded between 72 and 100 decibels, and nighttime levels ranging from 42 to 60 decibels [23].

Elevated alarm fatigue significantly impairs ICU nurses' ability to remain attentive and respond effectively to alarms, posing a risk to patient safety. In a study conducted in China, nearly half of the ICU nurses reported that nuisance alarms were common (41.23%), disrupted patient care (62.47%), and diminished their trust in alarm systems. As a result, 49.03% admitted to turning off alarms instead of properly adjusting the settings as needed [39].

2.3 Response Times and Patient Safety

Research highlights a clear link between how quickly alarms are addressed and patient safety. A qualitative study by Snyder et al. (2020) found that delays in responding to critical alarms can result in serious consequences, including unexpected patient deaths. Supporting this, Schein et al. (2021) demonstrated that the likelihood of sentinel events increases with each minute of delay in alarm response by healthcare staff.

In an observational study carried out in an adult ICU at a university hospital in the Mediterranean region of Turkey from August 2016 to January 2017, 13 registered nurses were monitored for a total of 328 hours. During this period, 1,781 alarms were recorded, with blood pressure alarms accounting for 37.6%, respiration and oxygen saturation alarms 35.3%, and heart rate and arrhythmia alarms 27.1%. Nurses responded to just under half (46.9%) of the alarms that necessitated action. Their responses included muting the alarms, attending to the patient's clinical needs, and resolving issues related to contact or signal transmission [19].

A study done in Australia showed 93% of nurses agreed that alarm fatigue can result in alarm desensitisation and the disabling of alarms, whilst 81% suggested the key factors are those associated with false-positive alarms and inappropriately set alarms [8].
A descriptive cross-sectional quantitative study done in adult ICUs of federal government hospitals in Addis Ababa city, Ethiopia, majority of the participants 145 (89.5%) said Non-actionable/Nuisance alarms reduce trust in alarms and cause caregivers to turn the alarms off at times other than setup or procedural events paraphrase (16).

2.4 Factors Contributing to Alarm Fatigue

Medical equipment alarm fatigue is a condition in which healthcare professionals become desensitized to the constant sound of alarms from various medical devices due to prolonged exposure. This reduced sensitivity can lead to critical alarms being overlooked. Alarm fatigue is often used to describe the impact of numerous alarms on nursing staff [20].
The study revealed an average of nurses' alarm fatigue in critical care settings in public hospitals of Hail city Saudi Arabia, where alarm fatigue has increasingly become a phenomenon in which HCPs become desensitized to the constant barrage of alarms, leading to delayed responsiveness and potentially dangerous situations [9].
A descriptive cross-sectional study involving 187 ICU nurses from hospitals in the northern and central regions of the West Bank, Palestine, found that the average Alarm Fatigue Scale (AFS) score was 23.36 (SD ± 5.57) out of a possible 44. Among the participants, 70 nurses (37.4%) reported low levels of alarm fatigue, 62 nurses (33.2%) reported moderate levels, and 55 nurses (29.4%) reported high levels of alarm fatigue. The mean score on the Perceived Stress Scale (PSS) was 16.99 out of 40. In terms of perceived stress, 57 nurses (30.5%) fell into the low-stress

category, 73 nurses (39.0%) reported moderate stress levels, and 57 nurses (30.5%) were identified as experiencing high stress. [10].

Research conducted in hospitals across the United States found a link between nurses' alarm burden and their perceptions of care quality and safety. The study also identified a relationship between alarm burden and modifiable organizational factors, such as the work environment and staffing levels[14]. Alarm fatigue, stemming from desensitization to frequent alarms, can lead to delayed responses from nurses and may prompt them to ignore, disable, or override alarms. According to the ECRI Institute (2007), human error was linked to half of the reported deaths related to clinical alarms between 2002 and 2004 [24].

The cross-sectional study was conducted in critical care units of five hospitals in Ghana from November 2021 to January 2022. The overall alarm fatigue score was 76.43 ± 27.80 out of 124. Longer years working at the critical care unit and having policies related to alarm management were associated with a decreased risk of alarm fatigue, while working in neonatal intensive care unit and having anxiety and stress were associated with an increased risk of alarm fatigue. In addition, alarm fatigue was positively associated with emotional exhaustion and depersonalisation but not personal accomplishment.

2.5 Conceptual framework

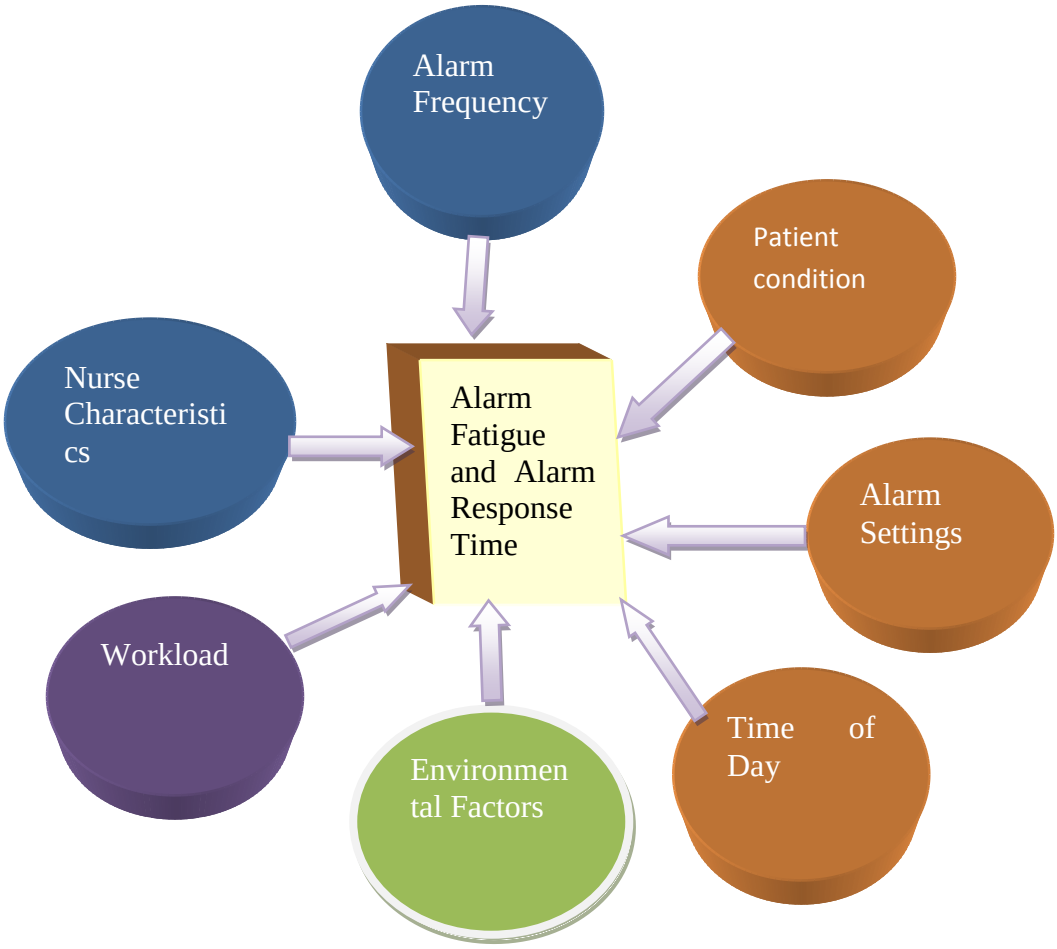

Figure 1: Conceptual frame work of alarm response time and alarm fatigue

Alarm Frequency: A high frequency of alarms can lead to alarm fatigue, which in turn can increase response times.
Nurse Characteristics: Factors such as age, gender, experience, and shift type can influence how nurses perceive and respond to alarms.
Workload: Higher workload can increase cognitive load and stress, contributing to alarm fatigue and longer response times.
Environmental Factors: Noise levels, lighting, and distractions can affect nurses' ability to respond to alarms promptly.
Alarm Settings: Sensitive alarm settings can result in more frequent alarms, leading to alarm fatigue and delayed responses.
Patient Acuity: The severity of the patient's condition can influence the urgency and complexity of the response required.
Time of Day: The time when the alarm occurs can affect nurses' alertness and response times.

3. Objectives

3.1 General Objective

To assess alarm response time, prevalence of alarm fatigue, factors contributing to delayed alarm response time and alarm fatigue and its impact on patient care and nurses' wellbeing among nurses working in intensive care units (ICUs) of Tikur Anbesa Specialized Hospital (TASH) October 2024 to March 2025.

3.2 Specific Objectives

1) To assess alarm response time of nurses in the ICUs of Tikur Anbesa Specialized Hospital October 2024 to March 2025
2) To assess the prevalence of alarm fatigue among nurses working in ICUs of Tikur Anbesa Specialized Hospital October 2024 to March 2025
3) To identify factors contributing to delayed alarm response times and alarm fatigue among nurses working in ICUs of Tikur Anbesa Specialized Hospital October 2024 to March 2025
4) To assess the effects of alarm fatigue on patient outcomes and nurse well being among nurses working in ICUs of Tikur Anbesa Specialized Hospital October 2024 to March 2025

4. Materials and Methods

4.1. Study Design

An institutional based prospective observational study was conducted

4.2. Study Setting and period

The study was conducted at TASH ICUs. Tikur Anbesa specialized hospital(TASH) is the largest teaching and referral hospital in Addis Ababa, Ethiopia. It provides ICU services which include medical intensive care unit (MICU), surgical intensive care unit (SICU), pediatric intensive care unit (PICU), cardiac intensive care unit (CICU) and neonatal intensive care unit (NICU). The study period was from October 2024 to March 2025.

4.3. Source Population

All nurses working in the Tikur Anbesa Specialized hospital (TASH) ICUs

4.4. Study Population

The study population was all nurses working in Tikur Anbesa Specialized hospital (TASH) ICUs who were willing to participate in the study

4.5. Inclusion and Exclusion Criteria

4.5.1. Inclusion Criteria

- Registered nurses currently working in ICU units at TASH with minimum of 6 months ICU experience, to ensure participants are familiar with ICU alarm systems and routines
- Nurses who are involved in direct patient care and available during the data collection period
- Those who were willing to participate and provided informed consent

4.5.2. Exclusion Criteria

- Nurses with less than 6 months of ICU experience
- Student nurses and nurses on leave such as maternity leave was excluded from the study
- Those nurses who did not give consent for the study
- Nurses in administrative or non-clinical roles (ICU nurse managers or educators)
- Those alarms responded to by residents and interns
- Alarms from already malfunctioned monitors
- Nurses working at neonatal intensive care unit

4.6. Sample Size Determination and Method

4.6.1. Sample Size Determination

The sample size will be determined by assuming the following since there is no previous study in the area. So I assumed the p-value as 0.5, confidence interval of 95% and margin of error to be 0.05. The sample size for the study was determined using a single population formula;

$$n = \frac{z^2 \times p(1-p)}{d^2}$$

Where, n= sample size

z= standard normal variant at 5% type I error which is 1.96,

p= expected proportion in population (taken to be 50% since no previous study) and
d= absolute error in precision which is taken to be 5%.

- $n = \frac{1.96^2 \times 0.5(1-0.5)}{0.05^2}$=384

- Since population size is below 10,000 it was adjusted by finite population correction formula

$$nf = \frac{ni}{1 + ni/N}$$

,

Where nf= final sample size, ni= initial sample size and N= the number of nurses working in TASH ICUs which is 88. So using the above formula it will be 72.
Adding 20% non-respondent the final sample size will be 90. Since the numbers of nurses are less than 90, all nurses were targeted for the study.
Sample size for alarm response time was determined comparing between two means (equal sample size) formula.

$$n = \frac{(Z_{\alpha/2} + Z_{\beta})^2 \text{x } 2\ (\sigma)^2}{(\mu_1 - \mu_2)^2}$$

- n= sample size per group
- $Z_{\alpha/2}$ = Z-score for significance level
  = 1.96 for 95% confidence level
- Z_{β} = Z-score for power
  = 0.84 for 80% power
- σ = pooled standard deviation
- μ_1, μ_2 = the expected mean of the outcome in group 1 and group 2, respectively

From previous study done in Saudi Arabia

- σ=8.3
- μ1−μ2=5
  $Z_{\alpha/2}$ = 1.96 for 95% confidence level

- Z_β= 0.84 for 80% power

$\frac{(1.96+0.84)^2 \text{x } 2 \text{ x } 8.3^2}{5^2}$ = 43 participants per group and total of 86 participants

4.6.2. Sampling Method

Convenience sampling technique was used where nurses who are currently working in the ICU of Tikur Anbesa specialized hospital (TASH) and willing to participate in the study was selected.

4.7. Variables

4.7.1. Dependent Variables

Alarm Response Time
Alarm Fatigue

4.7.2. Independent Variables

Heart rate
Blood pressure
Oxygen saturation
Age
Gender
Night
Morning

4.8. Operational definition

Alarm fatigue - Participants who scored more than 50% (22.5) of alarm fatigue assessment questions out of total score of 45
Alarm response time - Time taken by nurses to respond to a clinical alarm, measured in seconds
Delayed alarm response- A nurse's failure to acknowledge or respond to a clinical alarm within acceptable time of its activation
Frequency of alarms - The total number of alarms that occur within a specified time period per hour or per shift.
Alarm settings - Sensitivity and threshold settings of the alarm systems, as configured on the monitoring equipment.
False/Nuisance alarms - A non-actionable alarm due to an artifact resulted in false data which are transmitted and displayed on the patient monitoring devices
Critical care nurses - Nurses who are currently working in ICU.
Impact – The statistically significant variation in the mean alarm fatigue scores among ICU nurses based on demographic and work-related characteristics, such as age, years of nursing/ICU experience, and shift schedule.

4.9. Data Collection

4.9.1. Data collection procedure

A prospective institution-based observational study was conducted from October 1 2024 to March 30 2025 to assess the alarm response time of nurses and the prevalence of alarm fatigue among nurses working at Intensive Care Units (ICUs) of Tikur Anbesa Specialized Hospital (TASH). Data were collected through a structured observation checklist and a semi-structured, a self-administered questionnaire. Trained observers (interns and residents) directly observed nurses during their shifts, noting the time of each alarm and the nurse's response time. A stopwatch was used to measure response times from alarm activation to nurse intervention and self-administered questionnaire was filled by nurses for alarm fatigue assessment. The observation checklist and questionnaire were formulated in the English language. The observation checklist had four sections. The first section was the general information. The second section was alarm information. The third section was about alarm response time. The fourth section focused on nurses' actions or responses to those alarms that went off. The alarm fatigue questionnaire also had four parts. The first part was demographic information of the nurses. The second part was alarm fatigue assessment questions of a 9-item, 5-point Likert scale. The third part included the impact of alarm fatigue on performance and the fourth were suggestions for improvement. The questionnaire was adopted from Charité Alarm Fatigue Questionnaire; CAFQa and Torabizadeh, C., et al. assessing alarm fatigue, with a Cronbach's alpha across factors of 0.84, indicating good internal consistency. Data was collected using Google Forms, an online electronic method by trained data collectors and supervised by the principal investigator.

4.10. Data analysis

The collected data was exported to Microsoft Excel and incomplete data was cleaned. Descriptive statistics such as frequencies, percentages, means, and standard deviations were calculated to summarize the data. Analytical methods included chi-square tests and binary logistic regression to identify factors associated with the outcome variables.

4.11. Data quality assurance

Data collectors (interns and residents) were trained, the questionnaires was pre-tested before the actual data collection days on 10% of nurses who were not selected for the study. The activity was also closely supervised by principal investigator on a daily basis. At the end of each data collection day the principal investigator checked for completeness of filled questionnaires and appropriateness of informations recorded.

4.12. Ethical Considerations

Ethical clearance was obtained from the Department of ACCPM, Addis Ababa University. Informed consent was taken from each nurse before observation, following the hospital's written consent procedures. The study ensured that no personal identifiers were recorded, and the confidentiality of participants strictly maintained. Participants were informed that they have the right to withdraw from the study at any point without facing any consequences.

4.13. Dissemination of Results

The result of the study will be disseminated to relevant departments within AAU, including Department of Anesthesiology and Critical Care, Department of nursing, AAU School of Medicine. Additionally, it will be presented at professional meetings and conferences at the local, national and international levels. The study results will also be submitted for publication in peer-reviewed national and international journals.

5. Result

5.1. Alarm response related characteristics of the study participants

In the study, out of 86 triggered alarms, 42% were related to ECG readings, and 39.5% of the total alarms were classified as high priority. Response times varied, with 43% of participants reacting within 31-60 seconds, although 5.8% of the alarms were ignored altogether. Resolution times showed that 38.9% of the participants addressed the alarms within the same 31-60 second window. The majority of alarms, 39%, were resolved by adjusting equipment, while 21% involved checking the patient's vital signs before any intervention. Additionally, 31% of the nurses sought extra assistance in responding to the alarms, and effective communication was observed among 34.9% of them during their responses. Notably, nearly 8% of the alarms were resolved without the need for further intervention.

The study involved 76 nurses, out of which 49% were aged between 31 and 40 years, with a mean age of 33.4 years. Among the participants, 61% were female. In terms of experience, 35.5% had 5-8 years of clinical nursing experience, and 52.6% had 2-4 years of experience specifically in the ICU. The study was conducted during the day shift for 45% of the time, and 81.6% of the nurses reported working 3-4 days per week.

Alarm fatigue was assessed using a five-point Likert scale across nine questions, totaling a maximum score of 45 points. Nurses scoring above 50% (22.5 points) were considered to have alarm fatigue, which affected 88% of the participants.

Regarding the specifics of alarm fatigue, 63.2% of the nurses felt overwhelmed by the number of alarms during their shifts. Additionally, 43.4% reported becoming desensitized to the alarms, and 53.9% believed that the frequency of alarms negatively impacted patient care. Furthermore, 15% of the nurses expressed strong frustration or irritability due to the alarms.

Table 1: Alarm response related characteristics of the study participants

Variable	frequency	Percent
Types of Alarm		
Blood pressure	18	20.9
ECG	36	42
oxygen saturation	15	17.4
Ventilator	13	15
Infusion Pump	4	4.7
Alarm priority level		
Low	22	25.6
Medium	30	34.9
High	34	39.5
Total time from alarm to reaching to patient in second		
Ignored	5	5.8
≤15	15	17.5
16-30	16	18.6
31-60	37	43
>60	13	15.1
Time taken to resolve alarm in second(n=72)		
<30	32	37.2
31-60	34	39.8
>60	20	23
Immediate action taken by nurses		
Adjusted equipment	34	39.5
Administered medication	14	16.3
Called for additional help	13	15.1
Checked patients' vital signs	18	21
Other	7	8.1
Additional staff involved		
Yes	27	31.4
No	59	68.6
Communication during response		
Clear and effective	30	34.9
Needs improvement	17	19.8
Others	39	45.3
Outcome of alarm response		
Patient stabilized	6	7
Required additional intervention	30	34.9
Resolved without further intervention	7	8.1
Others	43	50

5.2. Factors associated with alarm response time

A multiple logistic regression analysis was conducted to examine the impact of various factors on nurses' alarm response times. While none of the variables reached statistical significance at the $p < 0.05$ threshold, age ($\beta = 0.407$, $p = 0.052$) demonstrated a marginal effect, hinting at a potential trend of slower response times with increasing age. Similarly, ICU experience ($\beta = -0.499$, $p = 0.089$) showed a near-significant association, suggesting that nurses with more ICU experience might respond faster to alarms. Other variables, such as gender, shift type, total nursing experience, and training, did not show significant predictive value ($p > 0.05$).

Table 2: Logistic Regression for alarm response time

Variable	Coefficient β	Std. Error	z-value	p-value	95% CI Lower	95% CI Upper
Gender	0.326	0.694	0.47	0.638	-1.034	1.687
Night shift	-0.085	0.733	-0.116	0.907	-1.521	1.351
Rotating shifts	-0.414	0.905	-0.457	0.648	-2.188	1.361
Age	0.407	0.21	1.942	0.052	-0.004	0.818
Nursing Experience	0.039	0.252	0.155	0.877	-0.455	0.534
ICU Experience	-0.499	0.294	-1.698	0.089	-1.075	0.077
Training	-0.135	0.779	-0.173	0.863	-1.662	1.393

5.3. Chi-Square Analysis.

There was no significant relationship between gender and alarm response time ($\chi^2 = 2.309$, $p = 0.315$). Similarly, no significant association was observed for the type of ICU unit ($\chi^2 = 4.446$, $p = 0.487$). However, alarm priority level showed a borderline association with response time ($\chi^2 = 5.859$, $p = 0.053$), indicating that the urgency of alarms might have an effect on how quickly nurses respond. No relationship was found between experience group and response time ($\chi^2 = 0.000$, $p = 1.000$).

Table 3: Chi-Square Test Results

Variable	Chi-Square(χ^2)	p-Value	Degrees of Freedom
Gender	2.309	0.3152	2
ICU Unit:	4.446	0.4872	5
Alarm Priority Level	5.859	0.0534	2
Experience	0.0	1.0	1

Table 4: Alarm fatigue related characteristics of the study participants

Variable	frequency	Percent
Age of nurses in years		
≤30	36	47.4
31-40	37	48.7
41-50	3	3.9
Gender		
Male	30	60.5
Female	46	39.5
Year of experience in nursing		
≤4	31	40.8
5-8	27	35.5
>8	18	23.7
Year of experience in ICU		
≤2	9	11.8
2-4	40	52.6
4-6	10	13.2
>6	17	22.4
Shift schedule		
Days	34	44.7
Night	24	31.6
Rotating shift	18	23.7
Number of days working in ICU per week		
1-2	7	9.2
3-4	62	81.6
>4	7	9.2
Position in the ICU		
Senior	29	38.2
Staff	47	61.8

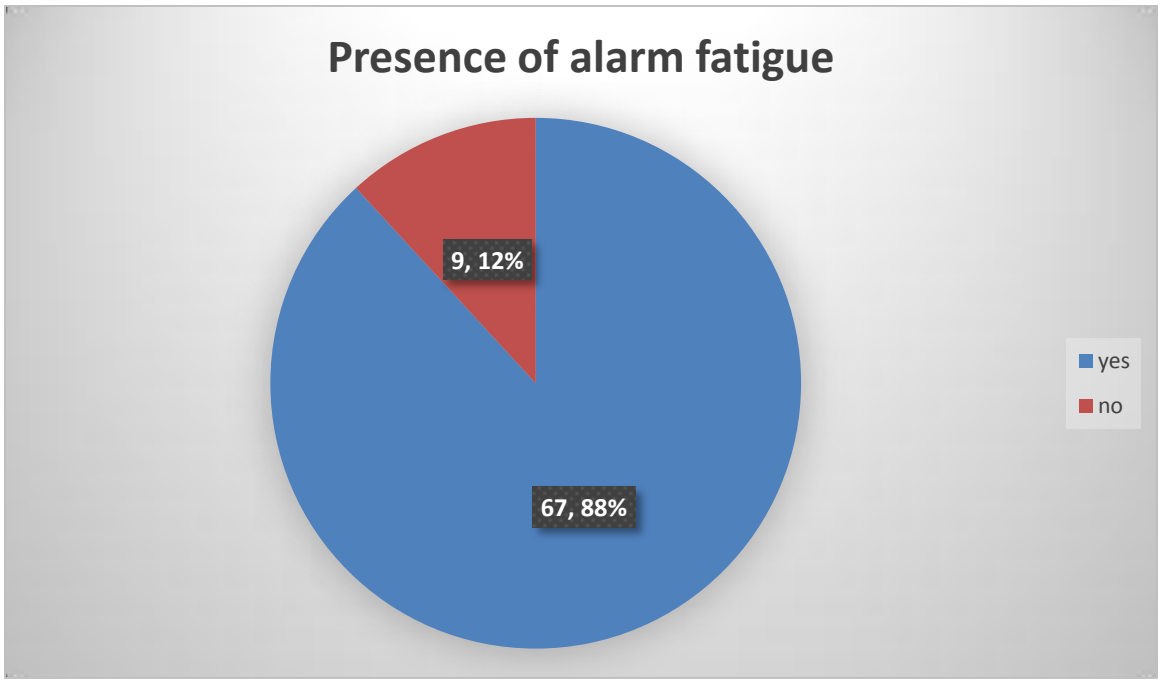

Figure 2: The level of alarm fatigue among nurses working in the ICU, TASH.

Table 5: Alarm fatigue related characteristics of the study participants

Variable	Response				
	SD	D	N	A	SA
I feel overwhelmed by the number of alarms during my shift.	3(3.9%)	3(3.9%)	13(17.1%)	49(64.5%)	8(10.5%)
I often feel desensitized to alarms because of how frequent they are.	3(3.9%)	4(5.3%)	26(34.2%)	33(43.4%)	10(13.2%)
The frequency of alarms negatively impacts my ability to focus on patient care.	1(1.3%)	8(10.5%)	15(19.7%)	41(53.9%)	11(14.5%)
I sometimes ignore alarms because I assume they are false or unimportant.	2(2.6%)	10(13.2%)	9(11.8%)	28(36.8%)	27(35.5%)
I feel stressed or anxious due to the constant sound of alarms.		6(7.9%)	14(18.4%)	43(56.6%)	13(17.1%)
The alarms cause me to feel frustrated or irritable.		7(9.2%)	15(19.7%)	43(56.6%)	11(14.5%)
I believe alarm fatigue reduces the quality of care I provide to patients.	6(7.9%)	8(10.5%)	22(28.9%)	24(31.6%)	16(21.1%)
I am able to differentiate between critical and non-critical alarms.	2(2.6%)		14(18.4%)	30(39.5%)	30(39.5%)
I feel that the hospital administration should take steps to reduce alarm fatigue.			16(21.1%)	17(22.4%)	43(56.6%)

5.4. Impact of Alarm Fatigue on Performance or activity

Over half of the nurses indicated that alarm fatigue moderately affects their job performance, while 34.2% reported occasionally feeling fatigued or burned out due to frequent alarms. Additionally, 60% of respondents recognized the impact of alarm fatigue on their ability to respond promptly in emergency or critical situations. However, only 38.2% stated that they had received training on managing or reducing alarm fatigue.

Table 6: Impact of Alarm Fatigue on Performance or activity

Variable	Response	frequency	Percent
Alarm fatigue impact on work performance	Minor impact	29	38.2
	Moderate impact	40	52.6
	Severe impact	7	9.2
Time to feel fatigued or burnout due to frequent	Rarely	4	5.3
	Occasionally	14	18.4
	Sometimes	26	34.2
	Often	22	28.9
	Always	10	13.2
alarm fatigue affects the ability to respond quickly to emergencies or critical situations	Yes	46	60.5
	No	30	39.5
received any training on how to manage or reduce alarm fatigue	Yes	29	38.2
	No	47	61.8
Important of the training(n=29)	Alarm setting	2	6.9
	check alarm limits and patient condition	8	27.6
	Check alarms severity	5	17.2
	Early response to alarm	1	3.4
	helps me adjust alarms, assess patients	4	13.8
	identify critical alarm	6	20.7
	Identify types of alarms	2	6.9
	Manage alarm settings and patient	1	3.4
What changes would you suggest to improve alarm management in the ICU	Implement quiet hours or reduce alarm volume	11	14.5
	Implement smarter alarm systems	4	5.3
	Increase staffing to manage alarm load	15	19.7
	Reduce the number of unnecessary alarms	25	32.9
	Regular training on alarm management	21	27.6
alarm fatigue could be reduced by changing how alarms are handled or by implementing new technology	Yes	68	89.5
	No	8	10.5

5.5. Strategies of nurse to manage alarm fatigue or reduce its impact work place

Variable	Frequency	Percent
Adjust alarm according to patient condition	5	6.6
Adjust alarm sound volume	2	2.6
Adjust equipment and alarms	5	6.6
Assess patient and set alarms	7	9.2
Check alarm limit based on patient condition	2	2.6
Check alarm limits and volume	4	5.3
Check equipment frequently	6	7.9
Check monitor functionality	2	2.6
Check patient condition	6	7.9
Equipment placement	1	1.3
Identify case of alarm	2	2.6
Ignore unnecessary alarms	3	3.9
Monitor patient condition regularly and check alarm settings	6	7.9
Proper placement equipment	5	6.6
Put monitors properly	1	1.3
Reduce alarm volume	5	6.6
Reduce unnecessary alarms	6	7.9
Set alarm according to patient condition	2	2.6
Silent alarm	6	7.9

5.6. Pearson correlation between alarm fatigue level and independent variables

The results of the Pearson correlation analysis revealed a statistically significant positive relationship between nurses' age and their level of alarm fatigue, indicating that alarm fatigue tends to increase with age ($p < 0.001$). Similarly, years of nursing experience were positively and significantly associated with alarm fatigue ($p < 0.025$). ICU experience also showed a significant positive correlation with alarm fatigue, with a p-value less than 0.001.

Table 7: Pearson correlation between alarm fatigue level and independent variables

Correlations		
		Alarm fatigue
Age of the patient	Pearson Correlation	.077
	Sig. (2-tailed)	.448
	N	99
Total response time from alarm to reaching patient in sec	Pearson Correlation	-.014
	Sig. (2-tailed)	.896
	N	94
Time taken to resolve alarm in sec	Pearson Correlation	.049
	Sig. (2-tailed)	.636
	N	94
Age of nurse	Pearson Correlation	.388**
	Sig. (2-tailed)	.000
	N	99
Years of experience in nursing years	Pearson Correlation	.226*
	Sig. (2-tailed)	.025
	N	99
Years of experience in ICU	Pearson Correlation	.333**
	Sig. (2-tailed)	.001
	N	99
**. Correlation is significant at the 0.01 level (2-tailed).		
*. Correlation is significant at the 0.05 level (2-tailed).		

5.7. The relation between alarm fatigue and independent variables

The study's findings indicated that alarm fatigue among nurses was significantly linked to certain demographic and professional characteristics. Significant differences in alarm fatigue levels were found based on nurses' age ($p = 0.000$), total years of nursing experience ($p = 0.042$), ICU experience ($p = 0.002$), and work shift ($p = 0.000$). Higher levels of alarm fatigue were reported by nurses aged 41–50 and those with more than eight years of experience in nursing or ICU settings. Nurses working night shifts also reported notably greater alarm fatigue compared to those on day or rotating shifts. In contrast, no significant associations were found between alarm fatigue and other factors such as ICU unit type, patient age, nurse gender, types of alarms, or alarm priority level ($p > 0.05$). These findings highlight that individual and professional factors—particularly age, experience, and shift schedule—significantly influence the extent of alarm fatigue among nurses.

Table 8: The relation between alarm fatigue and independent variables

Variable	Alarm fatigue		P-value
	mean	SD	
ICU unit			0.705
CICU	33.5	6.4	
MICU	35.24	5.3	
SICU	33.53	6.1	
PICU	33.43	5.8	
Age of the patient			0.340
<5	34.8	6.0	
6-17	32.6	5.7	
18-40	32.8	6.2	
>40	34.9	5.7	
Gender			0.965
Female	33.88	6.1	
Male	33.83	5.6	
Types of Alarm			0.873
blood pressure	34.1	4.9	
ECG	33.2	6.0	
oxygen saturation	33.9	7.0	
Ventilator	34.6	6.3	
Infusion Pump	35.8	1.9	
Alarm priority level			0.745
Low	33.4	6.2	
Medium	33.6	5.6	
High	34.5	6.1	
Total time from alarm to reaching to patient in second			0.882
Ignored	31.4	6.2	
≤15	33.6	6.2	
16-30	34.5	5.8	
31-60	34.0	6.0	
>60	33.5	5.9	
Time taken to resolve alarm in second(n=94)			0.180
<30	34.1	5.9	
31-60	32.8	6.4	
>60	35.7	4.8	
Age of nurses in years			0.000
≤30	30.9	6.0	
31-40	36.1	4.9	
41-50	37.3	0.57	
Sex of nurse			0.921
Male	33.8	5.9	
Female	33.9	6.1	

Year of experience in nursing			0.042
≤4	33.05	5.5	
5-8	33.2	6.4	
>8	36.6	5.2	
Year of experience in ICU			0.002
≤2	28.9	6.5	
2-4	34.2	5.7	
4-6	32.9	4.8	
>6	36.8	5.3	
Shift schedule			0.000
Days	35.1	5.4	
Night	35.2	5.2	
Rotating shift	29.6	6.0	

6. Discussion

6.1. Alarm Response Behavior Among ICU Nurses

This study revealed that nearly half of the nurses responded to alarms within 31–60 seconds, which is comparable to findings in studies conducted in the United States, where the average alarm response time was found to range from 30 to 60 seconds in high-acuity units (29). However, the 5.8% of alarms that were completely ignored aligns with international findings showing that 5–10% of critical alarms may be missed due to staff being overwhelmed or desensitized (9).

The high frequency of ECG alarms in this study (42%) is also consistent with other research, which found that ECG and oxygen saturation monitors contribute to the majority of false or non-actionable alarms, increasing the burden on nurses (35). This suggests a universal problem across ICUs: the overabundance of non-urgent alarms reduces the effectiveness of alarm systems.

6.2. Prevalence and Characteristics of Alarm Fatigue

The finding that 88% of ICU nurses at TASH experienced alarm fatigue is higher than reported in some Western studies which documented alarm fatigue prevalence ranging from 60–80% (12). This finding closely aligns with findings from similar resource-limited contexts, which is a Nigerian study which reported 85% of ICU nurses experience moderate to severe alarm fatigue (40).

Feeling overwhelmed by frequent alarms (reported as 63.2% in this study) is a recurring theme in alarm fatigue literature. A 2014 survey by the ECRI Institute revealed that 74% of nurses across multiple hospitals felt overwhelmed by alarms during their shifts. Similarly, desensitization to alarms—reported here by 43.4%—has been identified in studies as a major safety concern, as it may result in slow or no responses to critical events (42).

6.3. Alarm Fatigue and Its Impact on Nurse Performance

In this study, more than half of the nurses indicated that alarm fatigue had a moderate effect on their job performance, and 32.3% reported occasionally feeling fatigued or burned out. These results align with previous research showing that alarm fatigue can lead to cognitive overload, reduced attention, and symptoms of burnout among ICU personnel (43).

Additionally, the study's findings regarding delayed or absent alarm responses—often due to the assumption that alarms are false—are consistent with existing literature. Research has shown that over 85% of ICU alarms are non-actionable, contributing to a “cry wolf” effect. This behavior compromises patient safety and emphasizes the need for more accurate alarm systems and effective filtering mechanisms (35).

6.4. Correlates of Alarm Fatigue

The study found significant correlations between alarm fatigue and age, nursing experience, ICU experience, and shift type. These results echo a study done among ICU nurses in Iran which found that years of experience and working conditions (especially fixed night shifts) were significantly associated with higher levels of alarm fatigue (44).

The lack of correlation between gender and alarm fatigue in the current study is consistent with the findings of Korniewicz et al. (2008), who found no significant gender differences in alarm response or fatigue levels (45). This suggests that alarm fatigue is more closely tied to professional factors than to demographic ones.

6.5. Strategies to Manage Alarm Fatigue

In this study, only 39% of nurses reported having received training on alarm management—an number significantly below international benchmarks. For example, the American Association of Critical-Care Nurses (AACN) strongly advocates for regular training and simulation-based programs to enhance alarm response. Supporting this, a study by Winters et al. (2015) demonstrated that such training significantly improved both the accuracy and speed of alarm responses. Additionally, literature widely endorses strategies like adjusting alarm thresholds and implementing advanced alarm systems as effective interventions. Sendelbach and Funk (2013) observed that hospitals adopting alarm customization protocols experienced a 40% decrease in non-actionable alarms (7).

7. Conclusion and Recommendation

7.1. Conclusion

The results of this study highlight that alarm fatigue is a common and critical concern among ICU nurses at TASH, carrying serious consequences for patient safety, nurse health, and the overall quality of care. Although many alarms received timely responses, the occurrence of ignored alarms and poor communication within teams points to underlying deficiencies in alarm management systems.

Alarm fatigue showed significant correlations with work-related and professional factors, such as years of experience and shift schedules. The absence of standardized training programs and alarm management protocols exacerbates the problem. While nurses have developed personal strategies to cope, these individual efforts fall short in addressing the broader organizational shortcomings.

The findings make it clear that, without focused technical and educational interventions, alarm fatigue will continue to prevent effective care delivery in ICU environments.

7.2. Recommendations

Based on the findings of the study, the following recommendations are proposed for clinical practice, training, administration, and further research.

7.2.1. For Clinical Practice

Implement alarm customization protocols based on patient-specific conditions to reduce false and non-actionable alarms.
Encourage team-based alarm responses with clear communication strategies to ensure coordinated and effective interventions.
Develop and enforce alarm hygiene guidelines to ensure appropriate alarm settings and timely responses.

7.2.2. For Training and Capacity Building

Regular training programs on alarm management should be provided to all ICU nurses.
Training should focus on:

- Identifying critical vs. non-critical alarms
- Adjusting alarm thresholds
- Efficient use of monitoring equipment
- Techniques to minimize alarm fatigue

7.2.3. For Hospital Administration and Policy Makers

Invest in smart monitoring systems that filter and prioritize alarms based on urgency and relevance.

Increase ICU staffing to distribute alarm burden and reduce response fatigue.

Conduct routine audits on alarm frequency, response time, and outcomes to continuously improve safety practices.

Develop institutional policies that mandate alarm management protocols and regular refresher training.

7.2.4. For Future Research

Conduct longitudinal studies to examine the long-term effects of alarm fatigue on nurse health and patient outcomes.

Investigate the effectiveness of specific interventions (e.g., alarm delays, bundling alerts, wearable alarms) in reducing alarm fatigue.

Explore qualitative aspects of alarm fatigue to gain deeper insights into nurses' experiences and perceptions.

8. Limitation of the study

The study was conducted in a single hospital (TASH), limiting the ability to generalize findings to other healthcare settings in Ethiopia or abroad.

Despite efforts to minimize observer bias through structured protocols, the presence of an observer during alarm events may influence nurse behavior, potentially leading to Hawthorne effects.

The use of self-administered questionnaires to assess alarm fatigue may lead to response bias, as nurses may underreport or overreport their fatigue levels due to personal perceptions, social desirability, or fear of judgment.

The exclusion of NICU nurses, while necessary for maintaining homogeneity within the study sample, means that the findings will not reflect alarm fatigue or response times in neonatal care.

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Annex

Annex 1: Subject information sheet

Addis Ababa University
School of medicine

Subject information sheet

Hello, my name is_____, I am here on behalf of Dr.Kasaye Bedada, a student in Addis Ababa University School of medicine. He is conducting a research on **"Assessment of alarm response time and alarm fatigue among nurses working in Intensive Care Units of Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia."** He has received permission from Addis Ababa University School of medicine and Tikur Anbessa Specialized Hospital officials to conduct the study.

Your participation in this study will only be based on your willingness to participate. You have the right to choose not to take part in this study. If you are willing, you have the right to stop at any time or withdraw without giving any reason. There will be no direct benefit by participating in this study but in future information gathered by this study will help policy makers, programmers and researchers to give appropriate attention on issues of interest and designspecific treatment options.

The information that you provide will be kept confidential by using only code numbers and locking the data. Only the members of the study team will have the access to the non-coded data and the data will not be used for purposes other than the study. Your willingness and active participation is very important for the success of this study.

If you need any further information or explanation regarding to the study, you can have this address to contact.

Name: .Kasaye Bedada Tel- +251-985093912 Email- Kassayebedada@gmail.com

Annex 2: questionnaire

Dear Participant, Thank you for agreeing to participate in this important research. The purpose of this questionnaire is to assess alarm response time and alarm fatigue in the ICU. Your responses will help improve patient safety and care within the ICU environment.
Please answer the questions honestly. Your responses are confidential and anonymous. There is no right or wrong answer. It should take approximately 10-15 minutes to complete the questionnaire.

Section1: Alarm Response Time Observation

I. General Information

1. Observer's Name:
2. Date of Observation:
3. Time of Observation:
4. ICU Unit:
5. Nurse's Name/ID (if applicable):
6. Patient Information (if applicable):
    a. Patient ID: _____
    b. Age: _____
    c. Gender: _____
    d. Primary Diagnosis: _____

II. Alarm Information

10. Type of Alarm:
A. Cardiac Monitor
B. Ventilator
C. Infusion Pump
D. Blood Pressure Monitor
E. Oxygen Saturation Monitor
F. Other (specify) _____

11. Time Alarm Sounded: _____

12. Location of Alarm:
A. Patient Room Number: _____
B. Bed Number: _____

13. Alarm Priority Level:
a. High
b. Medium
c. Low

III. Response Time

14. Time Nurse Acknowledged Alarm: _____

15. Time Nurse Reached Patient: _____

16. Total Response Time (from alarm to reaching patient): _____
17. Time Taken to Resolve Alarm: _____

IV. Nurse Actions

18. Immediate Actions Taken by Nurse:
a. Checked patient vitals
b. Adjusted equipment
c. Called for additional help
d. Administered medication
e. Other (specify) _____

19. Additional Staff Involved:
a. Yes (specify roles) _____
b. No

20. Communication During Response:
a. Clear and effective
b. Needs improvement
c. Other (specify) _____

21. Outcome of Alarm Response:
a. Resolved without further intervention
b. Required additional intervention
c. Patient stabilized
d. Patient condition worsened
e. Other (specify) _____

Section2: alarm fatigue assessment questionnaire

I. Demographic Information

(Please tick the appropriate box or provide a response where required.)

1. Age: _____ years
2. Gender:
   ☐ Male
   ☐ Female
   ☐ Other (please specify): _____
3. Years of experience in nursing: _____ years
4. Years of experience in ICU: _____ years
5. Shift schedule:
   ☐ Day shift
   ☐ Night shift
   ☐ Rotating shifts
6. How many days per week do you work in the ICU?
   ☐ 1-2 days

☐ 3-4 days
☐ 5 or more days

7. Position in the ICU:
   ☐ Staff nurse
   ☐ Senior nurse
   ☐ Nurse manager
   ☐ Other (please specify): _____

II. Alarm Fatigue Assessment

(Please rate the following statements based on your experiences in the ICU. Circle the number that best reflects your view

1. I feel overwhelmed by the number of alarms during my shift.
   1. Strongly Disagree 2. Disagree
   3. Neutral 4. Agree 5. Strongly Agree
2. I often feel desensitized to alarms because of how frequent they are.
   1. Strongly Disagree 2. Disagree 3. Neutral 4. Agree 5. Strongly Agree
3. The frequency of alarms negatively impacts my ability to focus on patient care.
   1. Strongly Disagree 2. Disagree
   3. Neutral 4. Agree 5. Strongly Agree
4. I sometimes ignore alarms because I assume they are false or unimportant.
   1. Strongly Disagree 2. Disagree
   3. Neutral 4. Agree 5. Strongly Agree
5. I feel stressed or anxious due to the constant sound of alarms.
   1. Strongly Disagree 2. Disagree
   3. Neutral 4. Agree 5. Strongly Agree
6. The alarms cause me to feel frustrated or irritable.
   1. Strongly Disagree 2. Disagree
   3. Neutral 4. Agree 5. Strongly Agree
7. I believe alarm fatigue reduces the quality of care I provide to patients.
   1. Strongly Disagree 2. Disagree
   3. Neutral 4. Agree 5. Strongly Agree
8. I am able to differentiate between critical and non-critical alarms.
   1. Strongly Disagree 2. Disagree
   3. Neutral 4. Agree 5. Strongly Agree
9. I feel that the hospital administration should take steps to reduce alarm fatigue.
   1. Strongly Disagree 2. Disagree
   3. Neutral 4. Agree 5. Strongly Agree

III. Impact of Alarm Fatigue on Performance

1. In your opinion, how does alarm fatigue impact your work performance?

☐ No impact
☐Minor impact
☐Moderate impact
☐Severe impact

2. How often do you feel fatigued or burnt out due to frequent alarms?
   ☐Never
   ☐Occasionally
   ☐Often
   ☐Always
3. Do you think alarm fatigue affects your ability to respond quickly to emergencies or critical situations?
   ☐Yes
   ☐No
   ☐Sometimes
4. Have you received any training on how to manage or reduce alarm fatigue?
   ☐Yes
   ☐No
5. If yes, was the training helpful? (Please explain):

   _____

6. What strategies do you use to manage alarm fatigue or reduce its impact on your work? (Please specify): _____

IV. **Suggestions for Improvement**

1. What changes would you suggest to improve alarm management in the ICU? (Check all that apply)
   ☐Reduce the number of unnecessary alarms
   ☐Implement smarter alarm systems (e.g., only sound alarms for critical situations)
   ☐Regular training on alarm management
   ☐Implement quiet hours or reduce alarm volume
   ☐Increase staffing to manage alarm load
   ☐Other suggestions (please specify): _____
2. Do you think alarm fatigue could be reduced by changing how alarms are handled or by implementing new technology?
   ☐Yes
   ☐No

Declaration

The undersigned agrees to accept responsibility for the scientific ethical and technical conduct of the research project and for provision of required progress reports as per terms and conditions of the Department and College, in effect at the time of grant is forwarded as the result of this application.

Name of the Student: _____

Date: _____ Signature: _____

Approval of the First Advisor

Name of the First Advisor: _____

Date: _____ Signature: _____

Approval of the Second Advisor

Name of the Second Advisor: _____

Date: _____ Signature: _____