Balancing the Beeps: Navigating Stress, Teamwork, and Patient Safety in ICU Alarm Management

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ABSTRACT

Background: Critical care nurses are frequently exposed to alarm fatigue and moral distress due to the high demands of intensive care settings. Alarm fatigue arises from desensitization to repetitive alarms, while moral distress stems from ethical dilemmas when fulfilling patient care responsibilities. This study explores the interplay between these phenomena among Malaysian critical care nurses. **Methods:** An exploratory qualitative approach using a hermeneutic phenomenological method was employed. Data were collected through in-depth interviews with 11 registered critical care nurses from a government intensive care unit in Klang Valley, Malaysia, conducted from June to August 2023. Colaizzi's method was used for data analysis, revealing emergent themes. **Results:** Five themes emerged: alarm management, patient care, stress, teamwork and support, and training. Participants reported that alarm fatigue disrupted patient care, caused emotional strain, and led to ethical dilemmas. Effective teamwork, including colleague support and guidance from senior staff, mitigated these challenges. Training on alarm systems, emergency protocols, and ethical decision-making was highlighted as crucial for improving resilience and reducing stress. **Conclusion:** Alarm fatigue and moral distress significantly impact critical care nurses' well-being and patient care quality. Addressing these challenges requires a multifaceted approach, integrating technical interventions, systemic support, and personal coping strategies. Enhanced training and supportive workplace environments are essential for mitigating these issues and ensuring optimal care outcomes.

Keywords: Alarm fatigue; alarm management; Colaizzi's method; critical care nursing; patient safety; qualitative study

INTRODUCTION

Critical care nurses play a pivotal role in managing critically ill patients, a demanding task that requires substantial physical and emotional resilience (Nikbakht Nasrabadi *et al.*, 2021; Liu *et al.*, 2023; Ni *et al.*, 2023; Turunç *et al.*, 2024). These professionals face numerous challenges, including moral distress, which occurs when external barriers prevent them from acting in alignment with their ethical principles (Saeedi *et al.*, 2019; Turunç *et al.*, 2024). Additionally, nurses in intensive care units (ICUs) frequently contend with alarm fatigue—a phenomenon caused by constant exposure to alarms from medical devices. This desensitization diminishes their responsiveness, posing risks to patient safety, especially given the variability in alarm systems across ICUs (Asadi *et al.*, 2022; Oliveira *et al.*, 2018).

Globally, while ICU practices are standardized, limited research has explored how Malaysian critical care nurses experience and manage alarm fatigue and moral distress. These interconnected challenges remain underexamined within this regional context. Moral distress, recognized as a pressing ethical dilemma, is linked to emotional strain from end-of-life care and patient deaths, particularly in paediatric ICUs, often leading to burnout and turnover intentions (Donkers *et al.*, 2021; Sannino *et al.*, 2019; Silverman *et al.*, 2022). Research

underscores that targeted strategies, such as theoretical models and training, can mitigate its impact (Riedel *et al.,* 2022; Donkers *et al.,* 2021). Similarly, alarm fatigue, exacerbated by clinically irrelevant alarms, significantly increases stress and decreases caregiving efficacy (Au-Yeung *et al.,* 2021; Claudio *et al.,* 2021; Dos Santos et al., 2018). Addressing these issues holistically is crucial to enhancing nurses' well-being and patient care outcomes.

To address these issues, annual training in alarm management and enhanced education on moral competence are recommended (Asadi *et al.,* 2022; Martins *et al.,* 2020). By understanding how Malaysian nurses experience these challenges, this study seeks to provide insights into managing alarm fatigue and moral distress in ICUs.

RESEARCH METHODOLOGY

Design

An explorative qualitative approach has been deemed most appropriate to describe the aspects of in-depth insight into the phenomenon under study (Creswell & Poth, 2017). In this case, alarm fatigue and moral distress among Critical Care nurses when dealing with daily demanding patient care. As aforementioned, the Hermeneutic phenomenological approach was chosen in this study. In this qualitative inquiry, both data and analysis are generated based on shared experiences of the Critical Care nurses when dealing with alarm fatigue and moral distress in patient care. This was enabling the researchers to be open minded and work with the clues that would be found in the data (Creswell & Poth, 2017).

Study Population and Location

This study was conducted in identified government intensive care units in Klang Valley. Thus, in this phenomenological inquiry, it is to gain more insight into how Critical Care nurses experience when dealing with alarm fatigue and moral distress in patient care under different circumstances; we included participants with as broad variation in individual experiences as possible. Our inclusive criteria: both female and male, Critical Care registered nurses with more than 6 months in Critical Care setting. The exclusive criteria: Critical Care registered nurses who do not volunteer for this study. In this study, the selection of the participants was conducted with the purposive sampling approach in accordance with the recommendations in qualitative design (Creswell & Poth, 2017).

11 Critical Care registered nurses from different years of critical care working experiences was considered because novice Critical Care nurses coped differently from intermediate or senior Critical Care nurses. The reason of this recruitment is to get a mixture of Critical Care nurses from different gender, ages, organisation, working scheduling, married status and highest education. This study used phenomenological approach with in-dept interviews. In-depth interview is the most suitable in this study because we seek to explore the Critical Care nurses' experiences in alarm fatigue and their moral distress ethical dilemma. In-depth interview allows the Critical Care nurses to share their intimate ethical dilemma which they may not share if the interview is conducted in a group. The in-depth interview was conducted from June to August 2023, at the convenience of the participants, face-to-face in a conference room of Critical Care. An interview guide was developed and contains an open-ended question. We started with an opening question: *What was it like to deal* with alarm fatigue and moral distress in patient care, *and what challenges do you face?* We were also asked probing questions to encourage the participants to elaborate: *What does that mean to you? Tell me more. How do you feel? How do you cope with the ethical dilemma?* The participants were encouraged to talk freely about their experiences in dealing with alarm fatigue and moral distress in patient care. All interviews took approximately 35 to 60 minutes. Data was collected until data saturated.

Data Analysis

We used Colaizzi data analysis in this study. The data was collected until further data do not provide any new information or new insights for the researchers to develop categories (Creswell & Poth, 2017; Patton, 2014). The interviews were voice recorded and transcribed verbatim. The researchers respected the participants' right not to perform face and video recording. Colaizzi's phenomenological methodology can be used reliably to

understand people's experiences (Creswell & Poth, 2017; Patton, 2014). Credibility, transferability, dependability and confirmability guided our study's data authenticity.

Ethical Considerations

The ethical agreement for this study was obtained from the Ethical Committee of Centre for Research and Innovation, Open University Malaysia, with approval number of OUM-IRF-2022-014 on 21 November 2022. Subsequently, approved by Medical Research and Ethics Committee, Ministry of Health (Approval number: NMRR ID-23-00976-MDM) on 26 June 2023. All participants were consented for their voice recording only. Directors of Nursing, and Nursing Managers of the hospital. The consequences of the interview may trigger unnecessary stress to the Critical Care nurses when sharing their recalled experiences of ethical dilemma on alarm fatigue and moral distress. If the need arises, we would refer the distress participants to the psychologist identified for further counselling session.

RESULT

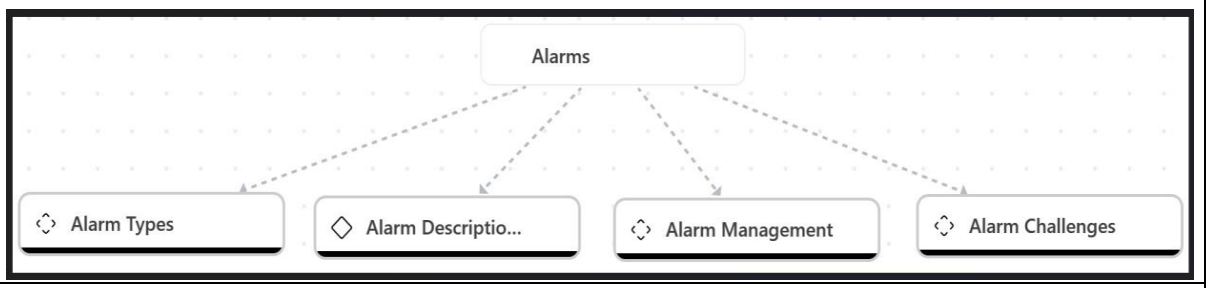
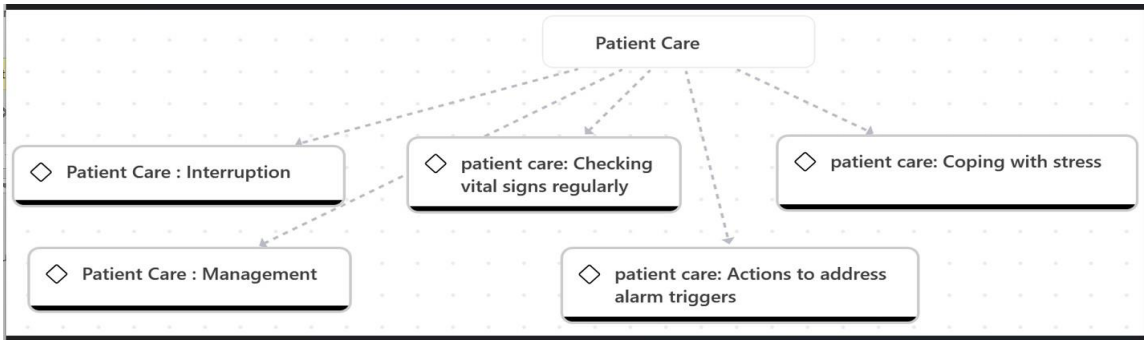
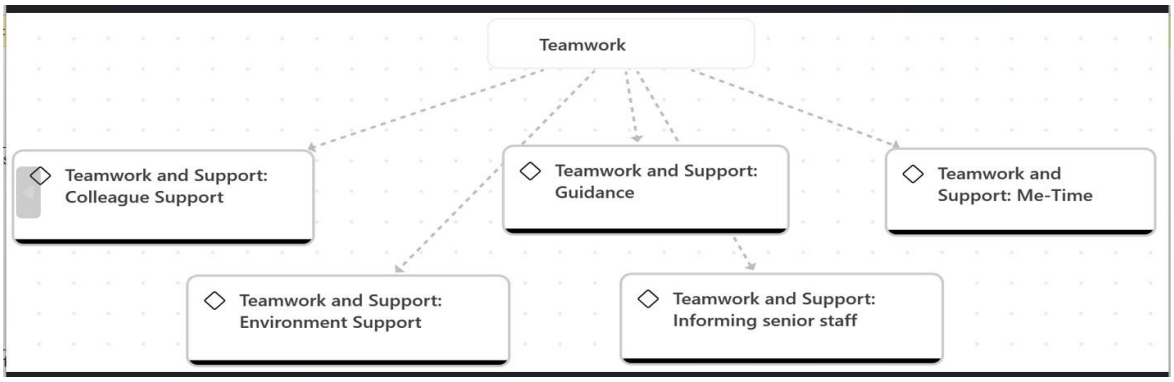
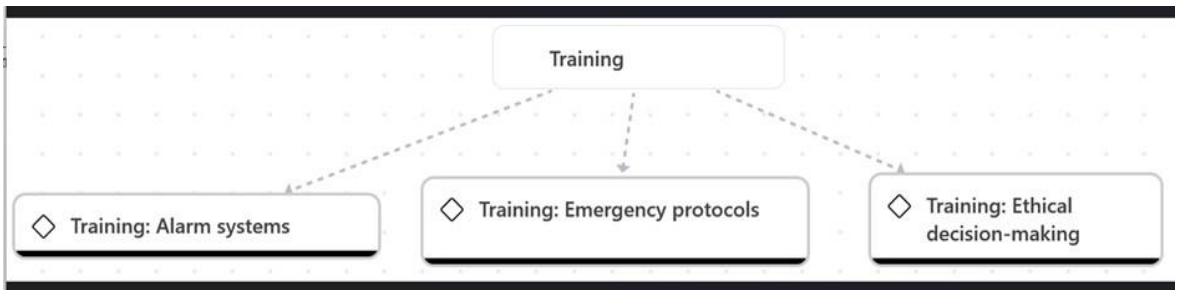
This study was conducted on 11 registered nurses in a selected government adult intensive care unit in Klang Valley. The characteristics of the participants are shown as below (Table 1).

Table 1: Characteristics of the Participants

Characteristics	**Frequency (f)**	**Percentage (%)**
Gender		
Male	0	0%
Female	11	100%
Age		
>30 years old	3	27.27%
31- 40 years	5	45.46%
>40 years	3	27.27%
Highest Education		
Diploma	5	45.46%
Post-Basic/ Advanced Diploma	6	54.54%
Degree	0	0%
Master	0	0%
Marital Status		
Married	7	63.64%
Unmarried	4	36.36%
Widow/Widower	0	0%
Experience of working in ICU		
1-5 years	5	45.46%
6-10 years	3	27.27%
>10 years	3	27.27%
Total	**11**	**100%**

The participants were all female (100%), with predominantly having post-basic or advanced diploma education (54.54%), married (63.64%) and working experience in ICU of more than 5 years (54.54%). The participants' experiences of alarm fatigue and moral distress consists of five themes: alarms, patient care, stress, teamwork and support, and training. Their sub-themes are displayed in the table below.

Table 2: Themes and Sub-Themes for Experiences of Alarm Fatigue Amongst Malaysian Critical Care Unit Nurses

Themes	Sub-themes displayed in visual
Alarms	
Patient Care	
Stress	
Teamwork and Support	
Training	

Navigating Alarm Management in ICU: Stress, Teamwork, and Patient Safety

Our study explored the multifaceted impact of alarm management in the ICU, uncovering themes related to alarm types, patient care, stress, teamwork, and training. The results highlight the challenges of alarm fatigue and its implications for both nurses and patient safety.

Alarms: A Ubiquitous Challenge

ICU nurses face a wide array of alarms, each carrying varying degrees of urgency and complexity. Participants noted that alarms originate from multiple devices, including ECG monitors, ventilators, infusion pumps, and even beds. As one nurse shared, *"Even the bed has an alarm. If we forget to lock it, it goes 'beep beep beep beep'"* (RN2). This underscores the omnipresence of alarms as stressors in the ICU environment.

The nature of alarm sounds often complicates their interpretation. *"For example, an alert patient in ICU might remove the SpO2 monitor, triggering an alarm that creates unnecessary stress for the patient and us,"* explained another participant (RN2). These instances reflect how non-urgent alarms can disrupt workflows and amplify stress levels among both staff and patients.

Alarm management is further complicated by the frequency of overlapping signals. A nurse described, *"One moment it's the infusion pump, then the ECG monitor, then the ventilator. It's constant, and we're always alert, checking the patient over and over"* (RN1). Such experiences highlight the chaotic nature of alarm fatigue, which demands rapid prioritization and decision-making.

Patient Care Amidst Alarm Fatigue

The constant barrage of alarms disrupts critical care delivery, creating a tension between attending to alarms and focusing on patient needs. Participants frequently expressed frustration at these interruptions. *"Honestly, deep down, I wish I could ignore it, but what if it's important?"* reflected one nurse (RN10). Another shared, *"While doing sterile procedures, I sometimes use my elbow to silence the alarm, which feels like I'm compromising care"* (RN11).

Despite these challenges, nurses emphasized their commitment to patient safety. *"I just tell myself, 'It's okay, it's only a machine, but my patient is my priority,'"* one participant affirmed (RN4). This sentiment illustrates the inner conflict between addressing alarms and fulfilling nursing responsibilities, underscoring the importance of technological and organizational interventions to minimize disruptions.

Stress and Coping Mechanisms

Alarm systems, designed to ensure safety, often induce stress by creating a perpetual state of heightened vigilance. A participant explained, *"Even if I'm doing another procedure, if an alarm triggers, I have to stop because it makes me unable to focus otherwise"* (RN9). This constant exposure to alarms can cloud judgment, as noted by another nurse: *"When multiple alarms go off at once, it really clouds my judgment. For a moment, I'm unsure which one is most critical"* (RN5).

To cope with these stressors, participants highlighted the importance of teamwork and personal strategies. One nurse remarked, *"The teamwork here is amazing. When I take a break, my colleague watches over my patients' alarms, so I can eat without worry"* (RN7). Others pointed to training and mindfulness as crucial coping mechanisms. *"Knowing the cause of the alarm helps me manage the problem better. It's something we're taught in nursing school,"* shared a participant (RN8).

The Role of Teamwork and Support

Collaborative environments emerged as pivotal in mitigating the stress associated with alarm fatigue. Participants described the importance of mutual support in handling alarms and maintaining patient safety. *"You know, it's like a team effort. We cover for each other during breaks and help with neighbouring patients when it's busy."* explained one nurse (RN7).

Supportive leadership also played a key role in fostering resilience. As one participant noted, *"Our senior staff always remind us, 'You're not alone here.' That guidance really helps during difficult times"* (RN2). Personal downtime, or "me-time," was another recurring theme. *"One of the seniors told me, always prioritize my mental health. Frequent 'me-time' helps me recharge,"* shared a nurse (RN9).

Training: The Foundation for Effective Alarm Management

Effective training is essential for navigating the complexities of ICU alarm systems. Participants reported reliance on bedside learning due to the absence of formal training. *"There was never any formal training on the alarms—it was all on-the-job learning,"* said one nurse (RN6). This experiential approach, while valuable, highlights the need for structured programs to ensure consistency and preparedness.

Training also prepares nurses for emergency protocols and ethical dilemmas. *"We're trained to work as a team during emergencies. From the start, we're told, 'You don't work alone here,'"* a participant emphasized (RN2). Ethical challenges, such as deciding which alarms to prioritize, further underscore the importance of robust training. *"Ignoring an alarm that indicates an abnormal sound is unethical—it puts the patient at risk,"* one nurse reflected (RN4).

These findings reveal the intricate interplay between alarm fatigue, stress, teamwork, and patient care in the ICU. By addressing these challenges through improved training, supportive work environments, and technological refinements, healthcare institutions can better equip nurses to navigate the demands of ICU alarm management while prioritizing patient safety and well-being.

DISCUSSION

Alarms: Types, Descriptions, Management, and Challenges

The intricate challenges of ICU alarm management are best understood through the lens of alarm types, descriptions, management strategies, and the persistent obstacles they present. Alarms vary from critical, high-priority signals to routine notifications, requiring nurses to rely on auditory distinctions to prioritize their responses. However, the sheer volume of alarm types contributes to auditory and cognitive overload, as highlighted in previous studies (Simpson & Lyndon, 2019; Liu et al., 2023). Standardizing alarm sounds and thresholds could alleviate this strain, streamlining response efficiency. Alarm descriptions further complicate the landscape, as nurses often depend on personal experience to interpret tones as indicated in our study. The lack of uniformity in alarm designs introduces ambiguity, delaying critical interventions (Sendelbach & Funk, 2013). Enhancing alarm clarity through intuitive designs and tailored training programs is essential for improving response accuracy (Fujita et al., 2020). In our study, alarm management involves diverse strategies, including silencing non-critical alarms or delegating tasks to team members. While these practices align with recommended guidelines for teamwork in critical care (The Joint Commission, 2013), they demand caution to preserve clinical judgment. Emerging technologies, such as smart alarms, offer promise but require careful integration to ensure safety and reduce unnecessary reliance (Silverman et al., 2022). False alarms, commonly referred to as "cry wolf" scenarios, are a significant barrier to effective alarm management. These frequent disruptions desensitize staff, fostering alarm fatigue and moral distress (Simpson & Lyndon, 2019; Gazarian et al., 2019). Addressing these challenges through collaborative efforts and research-based interventions is pivotal for optimizing both nurse and patient outcomes.

Patient Care and Alarm Fatigue

Alarm fatigue profoundly impacts patient care in critical care settings, creating conflicts in task prioritization and contributing to moral distress. Our study indicating that frequent alarms disrupt workflows, delaying routine tasks and forcing nurses to make high-stakes decisions under pressure. These findings resonate with earlier research linking alarm fatigue to workflow inefficiencies and job dissatisfaction (Borhani et al., 2015; Cvach, 2012). Our study also reported that false and non-urgent alarms exacerbate these issues by interrupting patient-centered care. Nurses in this study described the strain of balancing sterility during procedures while addressing alarms. Such disruptions compromise care quality, as echoed in studies emphasizing the detrimental effects of

alarms on nursing efficiency (Oliveira et al., 2018). Vital monitoring, a cornerstone of critical care nursing, is similarly hindered by excessive alarms. Nurses stressed the importance of prioritizing direct patient assessments over automated signals, advocating for revised protocols that support streamlined alarm prioritization (Sendelbach & Funk, 2013). While personal resilience and adaptability were frequently cited as coping strategies, systemic solutions like mindfulness training and peer support programs remain crucial for long-term stress management (Zakaria et al., 2022). Alarm customization, including recalibrating thresholds, was highlighted as a practical approach to minimizing unnecessary alerts in our study, and it is aligning with Cvach's (2012) recommendations for patient-centered care.

Stress and Alarm Fatigue

Stress is an unavoidable component of ICU nursing, driven largely by alarm systems that maintain patient safety while introducing significant psychological challenges. Our study showed that constant exposure to alarms induces a state of heightened alertness, impairing decision-making and focus. This phenomenon of alarm fatigue mirrors findings that highlight its role in increasing cognitive load and anxiety (Razieh et al., 2018; Zakaria et al., 2022). Coping mechanisms, including teamwork and individual resilience, emerged as vital for managing alarm-related stress. In our study, participants emphasized the importance of supportive workplace cultures, where collaboration and shared responsibilities mitigate individual burdens (Mealer & Moss, 2016). Additionally, training programs that incorporate stress management strategies have shown promise in improving nurse well-being and care outcomes (Zakaria et al., 2022). Technological interventions, such as adjusting alarm thresholds and employing smart systems, offer practical solutions to reduce unnecessary noise and enhance focus. These strategies, coupled with resilience-building initiatives, can significantly alleviate alarm fatigue and its associated stressors (Liu et al., 2023).

Teamwork and Support

Our study indicated that teamwork plays a central role in addressing alarm fatigue, fostering resilience, and ensuring consistent patient care. Participants underscored the importance of peer collaboration and mutual support in managing the demands of ICU environments. These findings align with evidence showing that teamwork enhances cohesion and reduces stress in high-pressure settings (Mealer & Moss, 2016; Abou Hashish, 2017). A supportive work environment, bolstered by strong leadership and adequate resources, further enables nurses to navigate alarm fatigue effectively. Transparent communication with senior staff fosters trust, empowering nurses to seek guidance when needed (Zakaria et al., 2022). Personal downtime, or "me-time," was also emphasized as critical for emotional recovery, underscoring the need for structured self-care opportunities (Soleimani et al., 2019).

Training as a Catalyst for Improved Alarm Management

Training is fundamental to equipping nurses with the skills needed to manage ICU alarms effectively. Participants in our study highlighted the importance of structured education on alarm systems, which remains underdeveloped in many critical care settings. Simulation-based training programs offer controlled environments for practicing alarm responses, helping to reduce desensitization and improve decision-making (Cvach, 2012). Emergency protocol training also emerged as essential for navigating high-pressure scenarios. Regular drills and standardized guidelines improve team coordination and reduce errors, as evidenced in prior research (Wynne et al., 2021). Similarly, education on ethical decision-making enables nurses to navigate moral dilemmas, balancing alarm responses with patient-centred care (Tollefsen et al., 2021). A robust training framework, encompassing alarm systems, emergency protocols, and ethical principles, is necessary for fostering resilience, reducing errors, and enhancing patient outcomes. As this study concludes, combining bedside training with structured educational programs can better prepare nurses for the complexities of ICU alarm management, ultimately improving both staff well-being and patient safety.

Implications to Nursing Practice

Our study highlights how alarm fatigue and stress management impact not only patient care but also the moral distress faced by critical care nurses. Alarm fatigue frequently presents ethical dilemmas, such as choosing

between responding to repetitive alarms and attending to critical patient tasks, often resulting in guilt and moral distress. To address these challenges, nursing practices should integrate strategies that consider both technical and emotional dimensions. For instance, implementing alarm management protocols, such as adjusting thresholds and reducing non-essential alerts, can minimize distractions and alleviate stress. Incorporating stress-coping techniques and ethical decision-making into nursing education equips nurses to navigate high-pressure situations more effectively. A supportive workplace, characterized by engaged leadership, open communication, and strong teamwork, further reduces isolation and moral distress. Additionally, access to mental health resources and fostering self-care among nurses can help manage the emotional toll of their roles. These comprehensive measures can enhance nurse well-being and improve patient outcomes.

Limitations

Our study has its limitations due to it has a relatively small number of participants and all of them are from a single hospital. In the future, we reckon that the research could be conducted in different regions of Malaysia. Thereby, making the results more representative. We also suggest future researcher to expand the study into mixed-method research, thus, to attain more rich and complex data.

CONCLUSION

In conclusion, managing alarms in critical care settings requires a multifaceted approach to ensure patient safety while minimizing the emotional and cognitive strain on nurses. Alarm fatigue profoundly impacts patient care, leading to interruptions, stress, and ethical dilemmas. Nurses employ strategies like recalibrating alarm thresholds, fostering teamwork, and prioritizing patient-first approaches to navigate these challenges effectively. Training and education play pivotal roles in equipping nurses with the skills needed to manage stress and alarms, emphasizing the importance of foundational knowledge and continuous professional development. Furthermore, organizational support, such as leadership engagement and collaborative environments, complements individual resilience, enabling nurses to maintain focus and deliver high-quality care. By addressing alarm fatigue through a combination of technical, personal, and systemic interventions, healthcare institutions can enhance nurse well-being and optimize outcomes in critical care units.

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Conflict of Interest

The authors declare that they have no competing interests.

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