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IMPACT OF ALARM FATIGUE AMONG ONCOLOGY NURSES ON NURSING SHORTAGE IN PAKISTAN: THE MEDIATING ROLES OF WORKLOAD AND BURNOUT

Original Research

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ABSTRACT

Background: Alarm fatigue is increasingly recognized as a critical occupational hazard in healthcare, particularly in high-acuity units such as oncology wards. Repetitive exposure to non-actionable alarms leads to cognitive overload and desensitization, compromising nursing performance. In resource-limited settings like Pakistan, where nurses already face overwhelming workloads and systemic challenges, alarm fatigue may exacerbate professional burnout and contribute to missed nursing care. Understanding this interplay is essential to guide interventions for safer and more effective oncology care.

Objective: To investigate the direct and indirect effects of alarm fatigue on nursing deficits among oncology nurses in Pakistan, with workload and burnout assessed as potential mediators through structural equation modeling.

Methods: A cross-sectional survey was conducted in March 2025, involving 200 registered oncology nurses across tertiary care hospitals in Pakistan. Data were collected using standardized tools: the Oncology Nurse Alarm Fatigue Scale (Cronbach's $\alpha = 0.865$), Maslach Burnout Inventory ($\alpha = 0.907$), and the Nurses' Self-Concept Questionnaire. Structural equation modeling (SEM) using AMOS 24.0 and bootstrapping with 5,000 resamples evaluated both direct and indirect effects. Model fitness was assessed using RMSEA and CFI indices.

Results: Alarm fatigue showed strong correlations with workload ($r = 0.492$), burnout ($r = 0.585$), and nursing deficit ($r = 0.613$), all significant at $p < 0.01$. SEM indicated a significant direct effect of alarm fatigue on nursing deficits ($\beta = 0.316$, $p < 0.05$). Indirect effects were mediated by workload ($\beta = 0.111$; 14.61%), burnout ($\beta = 0.187$; 24.61%), and a sequential path through both ($\beta = 0.159$; 20.92%). Collectively, indirect effects accounted for 60.13% of the total effect, while the direct path accounted for 39.87%. Model fit indices confirmed robustness (RMSEA = 0.056; CFI = 0.965).

Conclusion: Alarm fatigue substantially contributes to nursing care deficits in oncology settings, with workload and burnout acting as significant mediators. Targeted strategies addressing alarm burden, nurse workload, and psychological well-being are imperative to safeguard care quality and workforce sustainability.

Keywords: Alarm Fatigue, Burnout, Nursing Deficit, Oncology Nursing, Pakistan, Structural Equation Modeling, Workload.

INTRODUCTION

Missed nursing care, often referred to as the nursing deficit, is defined as the partial or complete omission, delay, or marked reduction in the quality of essential nursing interventions required for optimal patient care (1). This phenomenon has been widely acknowledged as a global threat to health systems, closely associated with adverse patient outcomes including infections, falls, prolonged hospital stays, delayed recovery, and increased mortality (2). The significance of comprehensive and timely nursing becomes even more critical in oncology settings, where patients undergo complex treatments such as chemotherapy, immunotherapy, and palliative care. In such high-acuity environments, any compromise in nursing care directly threatens patient safety and the effectiveness of therapeutic regimens (3). Alarm fatigue has recently emerged as a significant contributor to nursing errors, particularly in hospital oncology departments where nurses are exposed to frequent and often non-actionable alerts from medical devices (4). When repeatedly subjected to irrelevant or non-urgent signals from monitors, infusion pumps, and ventilators, nurses may experience desensitization, leading to delayed responses or even intentional ignoring of alarms (5). Although alarm fatigue has been extensively studied in intensive care units, its specific impact in oncology wards—where the use of life-sustaining technology and continuous monitoring is routine—remains underexplored (6). Oncology nurses juggle numerous responsibilities including medication administration, clinical monitoring, psychosocial care, and documentation, all while managing relentless alarm stimuli (7). These overlapping demands increase their vulnerability to cognitive and emotional overload. According to Kalisch's nursing deficit model, missed care typically results from inadequacies within the nursing environment, which can be exacerbated by alarm fatigue (8).

The effects of alarm fatigue extend beyond workflow disruption, as they also contribute to heightened psychological stress, which impairs a nurse's ability to provide complete care (9). While a direct association between nurse staffing shortages and empathy fatigue has not been clearly established, intermediary factors such as Burnout and excessive Workload have been suggested as possible links (10). Loud alarms, high alert frequency, and complex multitasking requirements create structural barriers to effective prioritization and decision-making (5). Nurses' workload encompasses not only physical tasks but also emotional and cognitive labor required during shifts (11), which includes managing clinical devices, maintaining accurate communication, and fulfilling documentation responsibilities (12). Frequent alarm interruptions escalate perceived exertion by inducing task switching and workflow fragmentation (13). When prolonged, these stressors can lead to Burnout—a syndrome marked by emotional exhaustion, depersonalization, and diminished professional efficacy—which in turn compromises clinical judgment, motivation, and attentiveness (14,15). In resource-constrained settings like Pakistan, oncology nurses often contend with outdated technology, chronic understaffing, and limited institutional support for effective alarm management (16). Despite these realities, the relationship between alarm fatigue and nursing outcomes remains poorly understood in the Pakistani context (17). Existing research largely originates from high-income countries and is predominantly focused on critical care settings, limiting its applicability in low- and middle-income nations (18). Given the unique challenges faced by Pakistani oncology nurses, there is a critical need to examine how alarm fatigue influences care delivery within this population (19). This study aims to explore how workload and Burnout mediate the relationship between alarm fatigue and nursing deficit among oncology nurses in Pakistan. By employing a structural equation modeling approach, the research investigates both the direct and sequential indirect effects of alarm fatigue on missed nursing care, thereby uncovering the complex mechanisms that compromise care quality in oncology settings.

METHODS

A cross-sectional study was carried out at a tertiary oncology hospital in Pakistan between March and April 2025 to investigate the mediating effects of workload and Burnout on the relationship between alarm fatigue and nursing care deficit among oncology nurses. The study population comprised registered nurses actively working in oncology units within tertiary healthcare hospitals in Punjab province. Participants were selected using convenience sampling. Eligibility criteria included registered nurses directly involved in patient care in oncology wards. Those excluded were student nurses, trainees, and individuals on rotational placements, as they did not have consistent exposure to oncology care environments. The sample size was based on the number of available nursing personnel in the oncology departments during the study period to ensure feasibility and adequate representativeness. Participation in the study was voluntary and based on informed consent. Ethical clearance was obtained from the relevant institutional ethics committee. All procedures

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adhered strictly to institutional guidelines for research involving human participants. To ensure confidentiality, the questionnaire was anonymous, and participants were informed of their right to withdraw at any stage without facing any negative consequences. Data were collected through a structured, self-administered digital questionnaire disseminated via nurse managers and head nurses in the participating hospitals. The survey took approximately 20–30 minutes to complete and included a summary of the study's purpose along with a consent prompt.

The data collection tool comprised four instruments. First, a demographic questionnaire gathered background information such as age, gender, marital status, educational level, and years of clinical experience. Second, alarm fatigue was measured using the Oncology Nurse Alarm Fatigue Scale, a 13-item instrument rated on a 5-point Likert scale (0–4), with reverse scoring for items 2–8 and 10–13. The total possible score ranged from 0 to 52, where higher scores indicated increased alarm fatigue. The internal consistency of the scale in this study was high, with a Cronbach's alpha of 0.865 (20). Third, Burnout was assessed using the Maslach Burnout Inventory (MBI), a 22-item scale comprising three subdomains: emotional exhaustion (9 items), depersonalization (5 items), and personal accomplishment (8 items). Each item was rated on a 7-point scale from 0 (never) to 6 (daily), yielding a total score between 0 and 132. The MBI demonstrated robust internal consistency, with a Cronbach's alpha of 0.907 (21). Lastly, the nursing care deficit was evaluated using the Nurses' Self-Concept Questionnaire (NSCQ), developed by Cowin, containing 36 items across six domains: general nursing self-concept, caring, staff relationships, communication, knowledge, and leadership. Responses were captured on an 8-point Likert scale ranging from 1 (certainly false) to 8 (definitely true). Previous studies have reported Cronbach's alpha values between 0.82 and 0.95 for its subscales (22), and the instrument maintains a strong theoretical and psychometric foundation. Data from approximately 200 eligible participants were obtained using simple random convenience sampling to achieve a diverse and inclusive respondent pool. Each eligible nurse had an equal opportunity to participate, and efforts were made to minimize selection bias by broadening hospital representation. Prior to analysis, a two-stage verification protocol was conducted to clean and validate the data. Descriptive statistics were used to profile categorical and continuous variables, presenting frequencies, means, and standard deviations as appropriate. Inter-variable relationships were explored using Pearson correlation matrices to examine association trends. Hierarchical regression models were constructed to assess predictive variables in a stepwise manner, evaluating changes in explanatory power. Structural equation modeling (SEM) was performed using AMOS version 24.0 to evaluate latent constructs and indirect pathways between variables. Maximum likelihood estimation guided model fitting, and respecifications were made based on theoretical rationale and fit indices. Mediation analysis was conducted using bootstrapping (5,000 iterations), and statistical significance was determined by 95% bias-corrected confidence intervals, with mediation confirmed only when zero was not included in the interval.

RESULTS

A total of 200 oncology nurses participated in the study, with an effective response rate of 95.2%. Participants ranged in age from 22 to 52 years (mean = 31.2, SD = 5.4). The majority were female (86.5%), with 13.5% identifying as male. Educational attainment revealed that 16.0% held a diploma or lower, 79.0% had a bachelor's degree, and 5.0% possessed a postgraduate qualification. In terms of clinical experience, 31.0% had less than 5 years of service, 40.5% had 5 to 10 years, and 28.5% had more than 10 years of oncology-related work. Regarding marital status, 65.5% were married and 34.5% were unmarried or divorced. Analysis of alarm fatigue, workload, burnout, and nursing deficit showed a moderate to high level of burden among the respondents. The mean score for alarm fatigue was 21.80 ± 5.90. The workload was assessed via two scales: the Task Load Index had a mean score of 93.40 ± 13.50, and the self-perceived workload score averaged 26.40 ± 5.40. Burnout scores were notable, with emotional exhaustion averaging 66.10 ± 11.20, depersonalisation at 52.80 ± 16.30, and low personal accomplishment at 26.90 ± 9.20. The oncology nursing care deficit score for specific clinical domains averaged 8.20 ± 6.10, while the total nursing deficit score was 60.50 ± 16.20. The most frequently missed care areas included psychosocial assessment, psychological support, individualized care planning, result follow-up, and timely reporting of abnormal clinical data.

Pearson correlation analysis revealed statistically significant positive correlations among all primary variables ($p < 0.01$). Alarm fatigue demonstrated moderate to strong correlations with workload ($r = 0.492$), burnout ($r = 0.585$), and nursing deficit ($r = 0.613$). Workload showed a strong positive correlation with both burnout ($r = 0.633$) and nursing deficit ($r = 0.596$). The highest correlation observed was between burnout and nursing deficit ($r = 0.867$), indicating a close interrelationship. Regression analysis further confirmed the mediating relationship. Alarm fatigue significantly predicted increased workload ($\beta = 0.214$, $t = 10.331$, $p < 0.05$) and was also a significant predictor of burnout ($\beta = 0.923$, $t = 8.411$, $p < 0.05$). Additionally, workload was a strong predictor of burnout ($\beta = 0.551$, $t = 10.919$, $p < 0.05$). All three variables—alarm fatigue ($\beta = 0.316$, $t = 2.821$, $p < 0.05$), workload ($\beta = 0.673$, $t = 6.012$, $p < 0.05$), and burnout

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($\beta = 0.390$, $t = 6.316$, $p < 0.05$)—were found to significantly predict nursing care deficits. Bootstrapped mediation analysis supported the significance of indirect pathways between alarm fatigue and nursing deficit. The indirect effect through burnout had an effect size of 0.187 (24.61%), while the pathway through workload had an effect size of 0.111 (14.61%). A sequential mediating path involving workload leading to burnout, which in turn led to nursing deficit, showed an effect size of 0.159 (20.92%). These indirect pathways collectively accounted for 60.13% of the total effect (0.457). The direct effect of alarm fatigue on nursing deficit remained statistically significant, with an effect size of 0.303 (39.87%). The total effect of alarm fatigue on nursing deficit was 0.760, confirming both direct and mediated pathways as clinically meaningful.

Table 1: Demographic characteristics

Characteristic	Category	Number (n)	Percentage (%)
Total Participants		200	100%
Effective recovery rate		190	95.2%
Age	Range	22–52 years	—
	Mean ± SD	31.2 ± 5.4	—
Gender	Male	27	13.5%
	Female	173	86.5%
Educational background	Diploma or below	32	16.0%
	Bachelor's degree	158	79.0%
	Postgraduate qualification	10	5.0%
Clinical experience	<5 years	62	31.0%
	5–10 years	81	40.5%
	>10 years	57	28.5%
Marital status	Married	131	65.5%
	Unmarried or divorced	69	34.5%

Table 2: Oncology Nurses' Scores for Alarm Fatigue, Workload, Burnout, and Nursing Deficit (x ± s)

Project	Score (x ± s)
Alarm Fatigue Scale	21.80 ± 5.90
Task Load Index Scale	93.40 ± 13.50
Self-evaluation of Load Feelings	26.40 ± 5.40
Maslach Burnout Scale – Emotional Exhaustion	66.10 ± 11.20
Maslach Burnout Scale – Depersonalisation	52.80 ± 16.30
Maslach Burnout Scale – Low Personal Fulfilment	26.90 ± 9.20
Oncology Nursing Care Deficit	8.20 ± 6.10
Total Nursing Deficit Score	60.50 ± 16.20

Table 3: Correlation (r-value) Between Alarm Fatigue, Workload, Burnout, and Nursing Deficit

Project	Alarm Fatigue	Workload	Burnout	Nursing Deficit
Alarm Fatigue	1.000			
Workload	0.492	1.000		
Burnout	0.585	0.633	1.000	
Nursing Deficit	0.613	0.596	0.867	0.971

Note: All correlations are significant at $p < 0.01$.

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Table 4: Chain Mediating Effect Regression Results

Dependent Variable	Predictor	β	Standard β	t-value	P-value
Workload	Alarm Fatigue	0.214	0.493	10.331	<0.05
Burnout	Workload	0.551	0.426	10.919	<0.05
	Alarm Fatigue	0.923	0.443	8.411	<0.05
Nursing Deficit	Alarm Fatigue	0.316	0.361	2.821	<0.05
	Workload	0.673	0.152	6.012	<0.05
	Burnout	0.390	0.368	6.316	<0.05

Table 5: Mediation Path Coefficients

Pathway	Effect Size	P-value	95% CI (unchanged)	Effect% % (of 0.76)
Alarm Fatigue → Workload → Nursing Deficit	0.111	<0.001	[0.039, 0.157]	14.61%
Alarm Fatigue → Burnout → Nursing Deficit	0.187	0.001	[0.087, 0.251]	24.61%
Alarm Fatigue → Workload → Burnout → Deficit	0.159	0.020	[0.082, 0.211]	20.92%
Total Indirect Effect	0.457	<0.001	[0.340, 0.475]	60.13%
Direct Effect	0.303	0.001	[0.160, 0.377]	39.87%
Total Effect	0.760	<0.001	[0.596, 0.740] *	100%

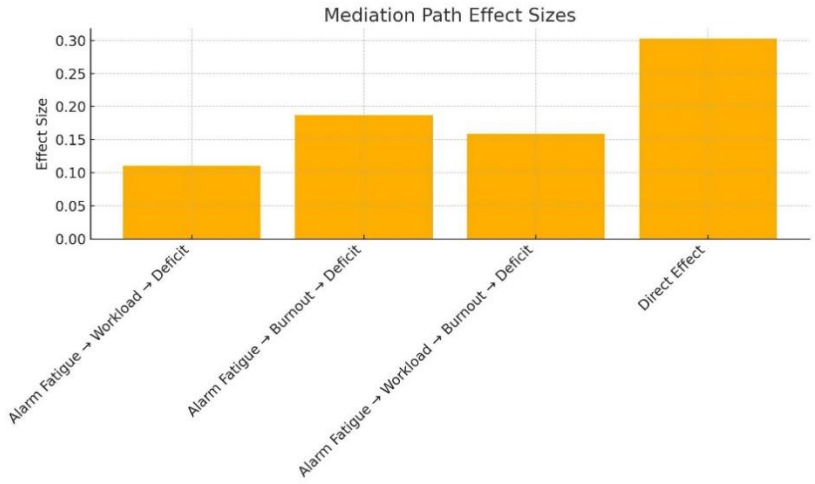

Figure 1 Mediation Path Effect Sizes

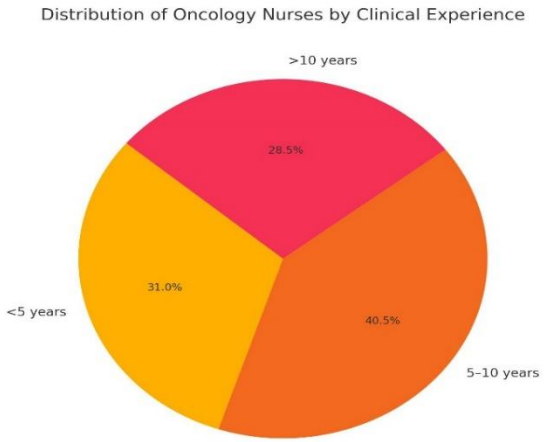

Figure 2 Distribution of Oncology Nurses by Clinical Experience

DISCUSSION

The findings of this study contribute to the growing body of evidence highlighting alarm fatigue as a significant occupational hazard in clinical nursing practice, particularly within oncology settings. Consistent with the physiological stress theory, frequent exposure to high-intensity stimuli, such as non-actionable clinical alarms, was shown to evoke adverse emotional and behavioral responses that impair clinical performance. Oncology nurses in this study exhibited a moderate level of alarm fatigue (mean score: 21.80 ± 5.90), which aligns with reports from other high-acuity departments like infusion and critical care units (16). The corresponding nursing care deficit score (mean: 60.50 ± 16.20) further confirmed that nurses in resource-constrained settings often struggle to meet essential care demands

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due to systemic limitations (17). Missed care was particularly evident in psychosocial support, individualized care planning, follow-up of clinical findings, and timely communication—functions that are critically important in oncology due to the rapidly evolving clinical conditions and heightened emotional needs of patients. Alarm fatigue was found to significantly correlate with workload, burnout, and missed nursing care, reinforcing the multidimensional nature of its impact. This interrelationship is well-documented in previous literature, which characterizes alarm fatigue as a source of cognitive overload, reduced attentiveness, and task desensitization (18,19). In oncology wards, where nurses manage multiple infusions, monitor immunosuppressive therapy, and engage in emotionally charged interactions, the burden of alarm fatigue becomes more complex and consequential. The strongest correlation was observed between burnout and nursing deficit, consistent with evidence suggesting that emotional exhaustion and psychological disengagement erode the capacity for attentive, compassionate care (20,21). These findings underscore the necessity of system-level interventions, including optimized alarm thresholds, noise reduction policies, and supportive work environments to mitigate burnout and its downstream impact on care quality.

Regression analyses supported a partial mediating role of workload in the relationship between alarm fatigue and missed care. This association indicates that the constant need to verify alarms contributes to task fragmentation, increases perceived workload, and reduces the time and mental bandwidth available for comprehensive care delivery (22). As workload becomes unmanageable, nurses may shift towards a task-oriented approach that deprioritizes essential yet less visible care components. Burnout further mediated this relationship, amplifying the risk of omissions in care due to diminished motivation, attention to detail, and emotional resilience (13,23). Given the emotionally intensive nature of oncology nursing, especially in palliative and terminal care scenarios, burnout serves as both a cause and consequence of suboptimal care delivery. The incorporation of peer support structures, staff rotation policies, and regular debriefing sessions could serve as practical countermeasures to mitigate the effects of cumulative stress. The structural equation model further confirmed a sequential chain mediation effect in which alarm fatigue increased perceived workload, which then contributed to burnout, ultimately leading to missed nursing care. This cascade validates theoretical models suggesting that environmental stressors undermine care quality through a combination of operational and emotional disruptions (24,25). Such a pathway demands multi-pronged intervention strategies that address not only technological inefficiencies but also psychological and organizational dynamics. While advanced AI-driven alarm systems capable of prioritizing alerts and filtering false positives offer promising solutions, their implementation may be challenging in under-resourced healthcare systems. Nonetheless, low-cost alternatives such as customized alert settings and periodic "quiet zones" can serve as interim measures to reduce alarm burden and preserve nurse focus.

The study presents notable strengths, including the use of validated instruments, a relatively large sample size, and sophisticated analytical methods such as structural equation modeling to explore complex mediation pathways. However, several limitations must be acknowledged. The cross-sectional design restricts causal inference, limiting the ability to confirm temporal sequencing between variables. Data collection was restricted to oncology nurses in Pakistan, which may constrain the generalizability of the results to other specialties or regions. The reliance on self-reported data raises the potential for response and social desirability biases. Additionally, the study design did not account for institutional variables such as staffing levels, leadership quality, or technological infrastructure, which may confound the observed relationships. Future research should employ longitudinal or mixed-method designs to capture the dynamic nature of alarm fatigue and its long-term consequences on nursing performance. Expanding the scope to include nurses from various clinical domains and geographic regions would enhance external validity. Incorporating objective workload metrics, such as patient-to-nurse ratios and alarm log data, would provide a more granular understanding of the burden and its triggers. The findings of this study highlight the critical need for integrated approaches that target both the root causes and mediating mechanisms through which alarm fatigue affects oncology nursing care.

CONCLUSION

This study concluded that alarm fatigue among oncology nurses significantly contributes to nursing care deficits, primarily through its impact on perceived workload and burnout. The interconnected nature of these variables underscores the complexity of challenges faced by nurses in high-acuity oncology settings, where technological demands intersect with emotional and cognitive strain. By identifying workload and burnout as mediators, the study highlights actionable targets for organizational interventions aimed at improving care quality and nurse well-being. These findings emphasize the urgent need for healthcare systems—particularly in resource-limited environments—to implement supportive strategies, optimize alarm systems, and invest in workforce resilience to ensure safer, more effective oncology care.

AUTHOR CONTRIBUTION

Author	Contribution
Uswa e Zahra Awan	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Tahira Nasreen	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Rubina bibi	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Amna Nawaz	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Muhammad Sohaib*	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published

REFERENCES

1. Chaboyer, W., et al., Missed nursing care: An overview of reviews. The Kaohsiung journal of medical sciences, 2021. 37(2): p. 82-91.
2. Su, T.W.-H., The Epidemiological and Clinical Characteristics of Infection-Related Falls in Older Adults: A Review of Literature. 2024, University of Pittsburgh.
3. Al-ghraiybah, T., The effect of the nursing practice environment, nurse staffing and nursing care processes on in-patient mortality, hospital-acquired infections, pressure injuries and patient falls. 2024, University of Wollongong.
4. Nyarko, B.A., et al., Nurses' alarm fatigue, influencing factors, and its relationship with Burnout in the critical care units: a cross-sectional study. Australian Critical Care, 2024. 37(2): p. 273-280.
5. Movahedi, A., et al., A grounded theory study of alarm fatigue among nurses in oncology department. Australian Critical Care, 2023. 36(6): p. 980-988.
6. Moghadam, M.P., A. Nasiri, and G. Mahmoudirad, Exploring the emotional concerns of oncology nurses: A qualitative study. Iranian Journal of Nursing and Midwifery Research, 2022. 27(5): p. 425-431.
7. Tigga, M.R., et al., NURSING SERVICE ADMINISTRATION. 2023: Xoffencerpublication.
8. Gallaher, S.C.J., Alarm Fatigue and Burnout in the ICU. 2023, The University of Arizona.
9. Joseph, A.L., E.M. Borycki, and A.W. Kushniruk, Alert fatigue and errors caused by technology: a scoping review and introduction to the flow of cognitive processing model. Knowledge management & e-learning, 2021(4): p. 500.
10. Maghsoud, F., et al., workload and quality of nursing care: the mediating role of implicit rationing of nursing care, job satisfaction and emotional exhaustion by using structural equations modeling approach. BMC nursing, 2022. 21(1): p. 273.
11. Rahimpoor, R., Physiological and Physical Effects of Sleep Disorder among Shift Work Nurses, in New Research in Nursing-Education and Practice. 2023, IntechOpen.
12. Fairchild, S.L. and R. O'Shea, Pierson and Fairchild's Principles & Techniques of Patient Care-E-Book: Pierson and Fairchild's Principles & Techniques of Patient Care-E-Book. 2022: Elsevier Health Sciences.
13. Tariq, S., et al., Alert fatigue in security operations centres: Research challenges and opportunities. ACM Computing Surveys, 2025. 57(9): p. 1-38.
14. Channawar, S., A study on the cause and effect of Burnout. History research journal, 2023. 29(6): p. 75-79.
15. Wei, H., et al., Impacts of nursing student burnout on psychological well-being and academic achievement. Journal of Nursing Education, 2021. 60(7): p. 369-376.
16. Anwarali, S., The prevalence of stress and stressors among pediatric oncology nurses working in pediatric oncology units in Pakistan-An analytical cross-sectional study. 2024.

17. Ahmad, A., et al., Assess the Knowledge and Attitude of Nurses Regarding High Alert Medication in Tertiary Care Hospital in Karachi: Knowledge and Attitude of Nurses on High Alert Medications. NURSEARCHER (Journal of Nursing & Midwifery Sciences), 2024: p. 23-27.
18. Macey, A., et al., Critical care nursing role in low and lower middle-income settings: a scoping review. BMJ open, 2022. 12(1): p. e055585.
19. Fayyaz, R., et al., The quality of patient care in oncology departments in Karachi, Pakistan: patients' perceptions. International journal of health care quality assurance, 2021. 34(1): p. 52-69.
20. Wunderlich, M.M., et al., A brief questionnaire for measuring alarm fatigue in nurses and physicians in oncology department. Scientific Reports, 2023. 13(1): p. 13860.
21. Shamsuddin, S., Exploring experiences of alarm response and alarm fatigue among nurses working in the ICU of a tertiary care hospital in Karachi, Pakistan: A qualitative study. 2023.
22. Mainz, H., et al., Prevalence of missed nursing care and its association with work experience: A cross-sectional survey. Int J Nurs Stud Adv, 2024. 6: p. 100196.
23. Xu, D., et al., Exploring ICU nurses' response to alarm management and strategies for alleviating alarm fatigue: a meta-synthesis and systematic review. BMC Nursing, 2025. 24(1): p. 412.
24. Altun Uğraş, G., et al., Health Problems and Reasons for Stress of Intensive Care Nurses During COVID-19. Florence Nightingale J Nurs, 2022. 30(1): p. 55-63.
25. Choudhury, A. and O. Asan, Role of Artificial Intelligence in Patient Safety Outcomes: Systematic Literature Review. JMIR Med Inform, 2020. 8(7): p. e18599.

