Alarm Fatigue among Nurses Working in a Private Hospital of Lalitpur: A Cross-sectional Analytical Study

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A continuous and high frequency of alarms from monitoring and treatment devices can lead to nurses' sensory exhaustion and alarm fatigue in a critical care setting, which may adversely affect nurses' efficiency and concentration on their tasks. This study was conducted to assess the level of alarm fatigue among nurses working in a private hospital in Lalitpur, Nepal. A cross-sectional analytical study was adopted using probability, proportionate stratified random sampling with 105 nursing staff of B&B Hospital. A self-administered semi-structured questionnaire was used to collect data from 8 to 20 April 2024. Before data collection, ethical approval was obtained from the Institutional Review Committee (IRC) of B & B Hospital. Data was analyzed with descriptive as well as inferential statistics (chi-square test). Among 105 nurses, more than half (55.2%) experienced moderate alarm fatigue. Alarm fatigue showed a significant association with religion (p=0.02), professional qualification (p=0.02), awareness of alarm fatigue (p=0.03), difficulty in setting alarms properly (p=0.01), difficulty in identifying the source of an alarm (p=0.04), difficulty in hearing alarms when they occur (p=0.002), and overreliance on alarms to call attention to patient problems (p=0.002). Based on findings of the study it is confirmed that more than half of the respondents had moderate level of alarm fatigue, it is recommended to implement strategies to enhance the quality of care and patient safety, such as providing critical care nurses with appropriate training on setting alarm properly as well as practical and safe management source of alarm, hearing alarms, overreliance on alarms.

Keywords: alarm fatigue, critical care, nurses.

A clinical alarm is defined as the signal that notifies caregivers when the patient is in, or potentially in, a hazardous situation and needs immediate assistance.[1] Clinical alarms are alarm systems that are either integrated into or connected to medical devices and monitoring systems. They are activated by changes in the patient's physiological state, by differences in parameters that are measured, or by issues with the system itself.[2] Medical devices, such as mechanical ventilators, syringe or infusion pumps, air bed mattress alarms, pneumatic compression devices, and patient call systems, are among the therapeutic devices that generate clinical alarms in the intensive care unit.[3] These devices may generate a lot of alerts, which could interfere with the nurses' ability to respond to alarms, interrupt them, and cause sensory exhaustion while they're working, a condition known as alarm fatigue.[4]

A real alarm that is sounding appropriately according to the default settings, but for an incident for which there is no clinical action needed. A right triggering event in the patient or equipment is a true-positive alarm situation. Determining the causes of false and non-actionable alarm signals and systematically addressing these causes can have a positive effect on patient safety.[5] Nurses receive the greatest number of clinical alerts because they are the primary healthcare providers at patients' bedsides (the majority of which are false or non-actionable). Known techniques to prevent alarm fatigue consist of developing an alarm management protocol, establishing a multidisciplinary team to work with the medical device maker, and modifying alarms, including limitations, delays, and settings. To minimize patient danger and avoid alarm fatigue among nurses, it could be necessary to implement optimal clinical alarm management.[6] A descriptive analytical study conducted among critical care nurses in Golestan, among 308 critical care nurses from 11 hospitals, reported a mean alarm fatigue score of 24.1±6.52. Additionally, 63.3% of the nurses experienced moderate alarm fatigue.[7] Despite these findings, data on alarm fatigue among nurses in private hospitals in Nepal remain limited. Therefore, the objective of this study is to assess the level of alarm fatigue among nurses working in a private hospital in Lalitpur.

Methodology

A cross-sectional analytical study design was adopted. The study was conducted in B& B Hospital, Gwarko, Lalitpur. Before the data collection, ethical approval was obtained from the Institutional Committee of B&B Hospital, Gwarko, Lalitpur (Ref: B&BIRC-24-36). Administrative approval

was taken from B& B Hospital. Informed consent was taken from all the respondents. Privacy and confidentiality were maintained throughout the study.

Nurses who were working in the critical units such as POW, HDU, CCU, Emergency, and highly critical units, including ICU, NICU, ASU/HCU of B&B Hospital Gwarko, Lalitpur, were included in the study. Those not willing to participate in the study were excluded. The calculated sample size using a prevalence of 69%,[8] and an error 5% was 329 through Cochrane's formula. With finite correction (N=133), the sample size was 95, and adding a 10% non-response rate, the total sample size was 105. A non-probability purposive sampling technique was adopted. A self-administered questionnaire technique was used to collect data from 8 to 20 April 2024.

An alarm fatigue questionnaire was used to collect data. There were 13 questionnaires scored on a 5-point Likert scale, from 0 to 4. Where, 0=never, 1=seldom, 2=occasionally, 3=generally, 4=constantly. A total of 11 items are negative statements, while statements 2 and 9 were positive. The total number of points was 0 to 44. The level of alarm fatigue was classified into four levels based on respondents' scores.[7]

1. No Alarm Fatigue Scores (<7)
2. Low Alarm Fatigue Scores (8-20)
3. Moderate Alarm Fatigue Scores (21-32)
4. Severe Alarm Fatigue Scores (>33)

The questionnaire was pretested in a similar population at Alka Hospital Pvt. Ltd on 6th April, 2024. Data analyses were performed using SPSS version 20. Descriptive statistics like frequency, percentage, mean score, and standard deviation for descriptive variables. Inferential statistics, i.e., Chi-Square test (Continuity correction), was used to find out the association between the level of alarm fatigue and selected variables at a p-value <0.05 level of significance.

Results

Table 1 shows that about half of the participants were ≤25 years (51.4%), and represented Brahmin/Chhetri ethnic groups (46.7%). About 60% were unmarried (60.0%). Most of the participants were Hindu (80.0%) and resided in urban areas (71.4%). Over half held a Bachelor's in Nursing (54.3%), and the majority had <5 years of professional experience (76.2%). Critical care experience was nearly evenly split (≤1 year: 47.6%; >1 year: 52.4%). About 48.6% were in critical and 51.4% were in highly critical units. Most participants worked in units with a nurse–patient ratio of ≤1:2 (61.0%) or morning shifts (56.2%). Few had attended training or had alarm management protocols (21.0% each), while most shared responsibility for alarm setting (82.9%). Around half reported

Table 1: Socio-demographic characteristics of the respondents (n=105)

Variables	n	%
Age (in years)		
≤25	54	51.4
>25	51	48.6
Ethnicity		
Brahmin/Chhetri	49	46.7
Others*	56	53.3
Religion		
Hindu	84	80.0
Non-Hindu	21	20.0
Marital Status		
Married	42	40.0
Unmarried	63	60.0
Place of Residence		
Urban	75	71.4
Rural	30	28.6
Professional Qualification		
PCL Nursing	48	45.7
Bachelor's in Nursing	57	54.3
Professional Experience		
<5 years	80	76.2
≥5 years	25	23.8
Critical Care Experience		
≤1 year	50	47.6
>1 year	55	52.4
Current Working Unit		
Critical	51	48.6
Highly Critical	54	51.4

PCL-Proficiency Certificate Level, *Others: Dalit and Muslim

difficulties in setting, hearing, or prioritizing alarms, with frequent false alarms (57.1%) and inadequate staff (67.6%) being common. Use of monitor watchers (36.2%), alarm improvement initiatives (29.5%), and technological solutions (30.5%) were limited, and over half were unsure of their availability (56.2%), as shown in **Table 2.**

Table 3 shows the respondents' level of alarm fatigue. The obtained mean score was the highest (2.95±1.09) for "*I turn off the alarm at the beginning of every shift*" and the lowest (0.92±1.14) score was for "*At visiting hours, I pay less attention to the alarms of the equipment*". The overall mean score of alarm fatigue among nurses was 22.00±6.58 out of 44.

Table 4 shows the respondents' level of alarm fatigue. Out of 105 respondents, more than half (55.2%) had a moderate level of alarm fatigue, while less than half (37.1%) had a low level of alarm fatigue. **Table 5** shows the association between participants' sociodemographic, professional, and organizational characteristics and the level of alarm fatigue. Significant associations were observed for religion (p=0.02), professional qualification (p=0.02), difficulty in setting (p=0.01), and hearing alarms (p=0.002), identifying the source of alarms (p=0.04), overreliance on alarms (p=0.002), and hearing about alarm fatigue (p=0.03).

Table 2: Profession- and organizational-related variables (n=105)

Variables	n	%
Nurse–Patient Ratio		
≤1:2	64	61.0
≥1:3	41	39.0
Working Shift		
Morning	59	56.2
Others	46	43.8
Attended Training on Alarm Management		
Yes	22	21.0
No	83	79.0
Availability of Protocol on Alarm Management		
Yes	22	21.0
No	83	79.0
Responsible for Alarm Setting		
Both (Doctor & Nurse)	87	82.9
Anyone	18	17.1
Difficulty Setting Alarm		
Yes	51	48.6
No	54	51.4
Difficulty Hearing Alarm		
Yes	52	49.5
No	53	50.5
Difficulty Identifying Source of Alarm		
Yes	49	46.7
No	56	53.3
Difficulty Understanding Priority		
Yes	49	46.7
No	56	53.3
Frequent False Alarms		

Yes	60	57.1
No	45	42.9
Inadequate Staff to Respond		
Yes	71	67.6
No	34	32.4
Overreliance on Alarms		
Yes	44	41.9
No	61	58.1
Noise Competition		
Yes	44	41.9
No	61	58.1
Heard About Alarm Fatigue		
Yes	56	53.3
No	49	46.7
Adverse Patient Events (2 years)		
Yes	12	11.4
No	32	30.5
Not sure	61	58.1
Use of Monitor Watchers		
Yes	38	36.2
No	22	21.0
Not sure	45	42.8
Alarm Improvement Initiative (2 years)		
Yes	31	29.5
No	15	14.3
Not sure	59	56.2
Technological Solutions Available		
Yes	32	30.5
No	14	13.3
Not sure	59	56.2

Table 3: Responses for alarm fatigue (n=105)

S.N.	Statements	Never	Seldom	Occasionally	Generally	Constantly	Mean±SD
1	I regularly readjust the limits of the alarm based on the clinical alarm	22(21.0)	21(20.0)	47(44.8)	11(10.5)	4(3.8)	1.56 ±1.05
2	I turn off the alarms at the beginning of every shift[#]	45(42.9)	23(21.9)	26(24.8)	9(8.6)	2(1.9)	2.95 ±1.09
3	Generally, I hear a certain amount of noise in the ward	11(10.5)	28(26.7)	34(32.4)	22(21.0)	10(9.5)	1.92± 1.13
4	I believe much noise in the ward is from the alarms of the monitoring equipment	10(9.5)	26(24.8)	34(32.4)	30(28.6)	5(4.8)	1.94±1.05
5	I pay more attention to the alarms in certain shifts	13(12.4)	20(19.0)	34(32.4)	14(13.3)	24(22.9)	2.15±1.31
6	In some shifts, the heavy workload in the ward prevents my quick response	13(12.4)	21(20.0)	39(37.1)	20(19.0)	12(11.4)	1.97±1.164
7	When alarms go off repeatedly, I become indifferent to them	24(22.9)	33(31.4)	31(29.5)	13(12.4)	4(3.8)	1.43±1.09
8	Alarm sounds make me nervous	34(32.4)	30(28.6)	25(23.8)	11(10.5)	5(4.8)	1.27±1.16
9	I react differently to the low volume(yellow) and high volume (red) alarms of the ventilator#	14(13.3)	22(21.0)	36(34.3)	25(23.8)	8(7.6)	2.09±1.13

10	When I'm upset and nervous, I'm more responsive to alarm	30(28.6)	34(32.4)	24(22.9)	11(10.5)	6(5.7)	1.32±1.16
11	When alarms go off repeatedly and continuously, I lose my patience	37(35.2)	24(22.9)	31(29.5)	10(9.5)	3(2.9)	1.22±1.11
12	Alarm sounds prevent me from focusing on my professional duties	38(36.2)	23(21.9)	29(27.6)	10(9.5)	5(4.8)	1.25±1.18
13	At visiting hours, I pay less attention to the alarms of the equipment	55(52.4)	17(16.2)	22(21.0)	8(7.6)	3(2.9)	0.92±1.14
	Total mean score						22.00±6.580

#Reverse statements

Table 4: Level of alarm fatigue among nurses (n=105)

Level of Alarm Fatigue	Number (No.)	Percent (%)
No Alarm Fatigue (<7 scores)	3	2.9
Low Alarm Fatigue (8-20 scores)	39	37.1
Moderate Alarm Fatigue (21-32 scores)	58	55.2
Severe Alarm Fatigue (>33 scores)	5	4.8
Total	**105**	**100.0**

Table 5: Association between levels of alarm fatigue and background variables (n=105)

Variables	Level of Alarm Fatigue, n(%)		X^2	p-value
	None to Low	Moderate to Severe		
Age (in years)				
≤25	21(50.0)	33(52.4)	0.05	0.81
>25	21(50.0)	30(47.6)		
Ethnicity				
Brahmin/Chhetri	17(40.5)	32(50.8)	1.07	0.29
Others**	25(59.5)	31(49.2)		

Religion				
Hindu	38(90.5)	46(73.0)	4.8	0.02[*]
Non-Hindu	4(9.5)	17(27.0)		
Marital status				
Married	16(38.1))	26(41.3)	0.1	0.74
Unmarried	26(61.9)	37(58.7)		
Place of residence				
Urban	31(73.8)	44(69.8)	0.19	0.65
Rural	11(26.2)	19(30.2)		
Professional Qualification				
PCL Nursing	25(59.5)	23(36.5)	5.37	0.02[*]
Bachelor's in Nursing	17(40.5)	40(63.5)		
Total Professional Experience (In years)				
<5	35(83.3)	45(71.4)	0.41	0.61
≥5	7(16.6)	18(28.5)		
Working Experience in a critical area (in years)				
≤1	18(42.9)	32(50.8)	0.63	0.42
>1	24(57.1)	31(49.2)		
Current Working Unit				
Critical	21(50.0)	30(47.6)	0.05	0.81
Highly critical	21(50.0)	33(52.4)		
Nurse Patient Ratio				
≤1:2	25(59.1)	39(61.9)	0.06	0.8
≥1:3	17(40.5)	24(38.1)		
Working shift				
Morning	24(57.1)	35(55.6)	0.02	0.87
Others	18(42.9)	28(44.4)		
Difficulty in setting the alarm properly				
Yes	14(33.3)	37(58.7)	6.5	0.01[*]
No	28(66.7)	26(41.3)		
Difficulty in hearing alarms when they occur				
Yes	13(31.0)	39(61.9)	9.65	0.002[*]

No	29(69.0)	24(38.1)		
Difficulty in identifying the source of an alarm				
Yes	23(54.8)	26(41.3)	3.97	0.04[*]
No	19(45.2)	37(58.7)		
Frequent false alarms				
Yes	21(50.0)	39(61.9)	1.45	0.22
No	21(50.0)	24(38.1)		
Overreliance on an alarm to call attention to a patient's problem				
Yes	10(23.8)	34(54.0)	9.41	0.002[*]
No	32(76.2)	29(46.0)		
Heard about alarm fatigue				
Yes	17(40.5)	39(61.9)	4.64	0.03[*]
No	25(59.5)	24(38.1)		
Use monitors and watchers in a central viewing area to observe				
Yes	13(31.0)	25(39.7)	2.56	0.27
No	12(28.6)	10(15.9)		
Not sure	17(40.5)	28(44.4)		
Available technological solutions to reduce alarm fatigue				
Yes	8(19.0)	24(38.1)	4.4	0.11
No	7(16.7)	7(11.1)		
Not sure	27(64.3)	32(50.8)		

* p-value<0.05 **Others-Dalit and Muslim

Discussion

According to the present study's findings, 55.2% experienced moderate alarm fatigue, which means that more than half of the respondents felt alarm fatigue. Total obtained Mean± SD 22.0± 6.58 out of 44. In line with our findings, Karahan et al. reported that more than half of the nurses experienced problems due to false alarms.[9] Salameh, B. et al from Palestine similarly reported a slightly higher mean overall alarm fatigue score was 23.36±5.57.[10] However, the prevalence of alarm fatigue was higher in a study from Iran, where 63.3% had a moderate level of alarm fatigue.[7] The overall mean score was reported as higher by Lewandowska, K. (25.8±5.8).[11] In contrast to our prevalence, a study from Korea also reported a higher alarm fatigue score is 24.1±6.52.[8] Another study was conducted in Saudi Arabia; the findings of this study are contrary, where

the mean score of alarm fatigue was 26.38±8.30 out of 44.[4] Another study conducted in Dhulikhel, Kavre, reported a much higher overall mean score of alarm fatigue (28.03±12.81).[12]

The respondent's highest score was observed for the statement, *"I turn off the alarm at the beginning of every shift"*. The lowest scores were observed for the statement, *"At visiting hours, I pay less attention to the alarms of the equipment"*. This finding was supported by another study conducted in Dhulikhel, Kavre.[12]

In this study, there is no significant association between the level of alarm fatigue and religion (p-value=0.02), and professional qualification (p-value=0.02). However, a study from Saudi Arabia showed an association between the level of alarm fatigue and the length of experience, and working shift.[4] A study from Ghana contradicts our findings, where no association was observed between the level of alarm fatigue and professional qualification, but it was significantly associated with age, working experience in critical care units, and professional experience.[13] In contrast, Karahan et al from Turkey found that the alarm fatigue decreased with increasing age and working years.[9] Contrary to our findings, Salameh, B. et al. showed that the nurse-to-patient ratio, gender, and years of experience.[10] Opposing our findings, Er ÖS found that

scores differed significantly between surgical ICU nurses and OR nurses.[14] Likewise, a study by Ding et al. found that critical care nurses experienced moderate alarm fatigue levels, which is not found in our results.[15] This study was limited to the nursing staff of only one private hospital.

Conclusion

Based on the findings, it is clear that more than half of the respondents have a moderate level of alarm fatigue. The mean score is highest in the statement; *I turn off the alarm at the beginning of every shift*. The level of alarm fatigue is statistically significant with religion, professional qualification, difficulty in setting the alarm properly, difficulty in hearing alarms when they occur, difficulty in identifying the source of an alarm, overreliance on the alarm to call attention to a patient's problem, and having heard about alarm fatigue. Targeted training programs, improved alarm management protocols, and strategies to reduce alarm overreliance should be implemented to minimize alarm fatigue, particularly among nurses with identified risk factors.

Abbreviations

PCL: Proficiency Certificate Level

ICU: Intensive Care Unit

HDU: High Dependency Unit

POW: Post Operative Ward

NICU: Neonatal Intensive Care Unit

CCU: Cardiac Care Unit

ASU/HCU: Acute Stroke Unit/High Care Unit

References

1. Sowan AK, Tarriela AF, Gomez TM, Reed CC, Rapp KM. Nurses' Perceptions and Practices Toward Clinical Alarms in a Transplant Cardiac Intensive Care Unit: Exploring Key Issues Leading to Alarm Fatigue. JMIR Hum factors. 2015 Mar;2(1):e3.

2. Bauld T. Clinical Alarm Effectiveness: Recognizing & Mitigating Risk to Patient Care.

3. Obeid AS, CN M, Hassan H. Effectiveness of Instruction Program on Nurses' Knowledge about Clinical Devices Alarm in Intensive Care Unit. Pakistan J Med Heal Sci. 2021;15(5):1424–7.

4. Alkubati SA, Alsaqri SH, Alrubaiee GG, Almoliky MA, Alqalah TAH, Pasay-An E, et al. Levels and Factors of Nurses' Alarm Fatigue in Critical Care Settings in Saudi Arabia: A Multicenter Cross-Sectional Study. J Multidiscip Healthc. 2024;17(February):793–803.

5. Cosper P, Zellinger M, Enebo A, Jacques S, Razzano L, Flack MN. Improving clinical alarm management: Guidance and strategies. Biomed Instrum Technol. 2017;51(2):109–15.

6. Lee SJ, Lee YM, Seo EJ, Son YJ. Impact of hospital nurses' perception on clinical alarms and patient safety culture on alarm management practice. Int J Environ Res Public Health. 2021;18(8). doi: 10.3390/ijerph18084018.

7. Yahyaei S, Khoddam H, Alinaghimaddah S, Modanloo M. Prevalence of alarm fatigue and its relevant factors in critical care nurses: A cross-sectional study. J Res Dev Nurs Midwifery. 2023;20(1):20–3.

8. Cho OM, Kim H, Lee YW, Cho I. Clinical alarms in intensive care units: Perceived obstacles of alarm management and alarm fatigue in nurses. Healthc Inform Res. 2016;22(1):46–53.

9. Karahan A, Kav S, Çevik B, Çıtak EA, Uğurlu Z, Fulser B. Alarm fatigue among nurses working in intensive care and other inpatient clinics. Work. 2023;76(2):793–801.

10. Salameh B, Abdallah J, Alkubati SA, ALBashtawy M. Alarm fatigue and perceived stress among critical care nurses in the intensive care units: Palestinian perspectives. BMC Nurs [Internet]. 2024;23(1):261. Available from: https://doi.org/10.1186/s12912-024-01897-x

11. Lewandowska K, Mędrzycka-Dąbrowska W, Tomaszek L, Wujtewicz M. Determining Factors of Alarm Fatigue among Nurses in Intensive Care Units—A Polish Pilot Study. Vol. 12, Journal of Clinical Medicine. 2023.

12. Regmi B, Shrestha B, Khanal S, Moktan S, Byanju R. Alarm Fatigue among Nurses Working in Critical Care Setting in a Tertiary Hospital, Nepal. Kathmandu Univ Med J. 2023;21(1):28–32.

13. Nyarko BA, Yin Z, Chai X, Yue L. Nurses' alarm fatigue, influencing factors, and its relationship with burnout in the critical care units: A cross-sectional study. Aust Crit Care. 2023;(xxxx).

14. Er ÖS, Gül İ. The impact of alarm fatigue on patient safety climate among nurses: The mediating role of moral courage. Nurs Crit Care. 2025 Mar;30(2):e70002.

15. Ding S, Huang X, Sun R, Yang L, Yang X, Li X, et al. The relationship between alarm fatigue and burnout among critical care nurses: A cross-sectional study. Nurs Crit Care [Internet]. 2023 Nov 1;28(6):940–7. Available from: https://doi.org/10.1111/nicc.12899