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Demographic and Environmental Factors Associated with Alarm Fatigue in Critical Care Nurses

Amanda Szczesniak
amanda.szczesniak@gmail.com

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Abstract

Purpose The purpose of this study is to explore what demographic and work environment factors in the critical care setting influence alarm fatigue in critical care nurses who have patients on continuous monitoring, if any. These influencing factors may allow for future interventions on alarm safety based upon demographics and unit set-up.

Background Alarm fatigue is a multi-dimensional issue in healthcare that can have harmful impacts on patients. Critical care nurses are among those who are consistently affected by the phenomenon. Current literature supports that alarm fatigue is a prevalent problem within the health care setting, but very few studies have investigated environmental or demographic factors may contribute to alarm fatigue.

Methods The study was cross-sectional, descriptive quantitative in design. Data was collected using a demographic tool was created and distributed along with The Healthcare Technology Foundation's (HTF) 2016 Clinical Alarms Survey. The survey was completed anonymously by critical care nurses in Western NY using an online survey platform.

Results A total of 23 nurses responded to this survey. Data was analyzed using SPSS 24. After assessing for normality, bivariate correlations of continuous variables were conducted using Pearson's correlation (r) and noncontinuous variables were conducted using point biserial (r_{pb}). Nursing demographic factors correlated with measures of alarm fatigue included age, level of education, hours worked per week, shift work, and years of nursing experience. Unit characteristics associated with alarm fatigue included average nurse to patient ratio, bedside monitors in each room, number of central monitors, and number of beds. Of the 29 alarm fatigue items, those that were correlated with either nursing or unit characteristics included nuisance alarms occur frequently; nuisance alarms disrupt care; nuisance alarms decrease trust/cause nurses to inappropriately turn off alarms; smart alarms would reduce false alarms; smart alarms would improve clinical response; properly setting alarms is too complex; alarms are adequate to alert staff of patient change; alarms cannot be heard or are missed; and clinical staff are sensitive to alarms and respond quickly.

Conclusions There are nurse demographic and unit characteristics that are significantly related to perceptions regarding alarm fatigue. Once a defined relationship with alarm fatigue is established, changes to the environment and alarm technology can be made accordingly. Interventions should be tested to address specific demographic or unit characteristics.

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Professor Tara Sacco

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Demographic and Environmental Factors Associated with Alarm Fatigue in Critical Care Nurses

By

Amanda Szczesniak

Submitted in fulfillment of the requirements for Academic Honors in Nursing

Supervised by

Tara L. Sacco MS, RN, CCRN-K, AGCNS-BC, ACCNS-AG

Wegmans School of Nursing

/

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nurses to inappropriately turn off alarms; smart alarms would reduce false alarms; smart alarms would improve clinical response; properly setting alarms is too complex; alarms are adequate to alert staff of patient change; alarms cannot be heard or are missed; and clinical staff are sensitive to alarms and respond quickly.

Conclusions There are nurse demographic and unit characteristics that are significantly related to perceptions regarding alarm fatigue. Once a defined relationship with alarm fatigue is established, changes to the environment and alarm technology can be made accordingly. Interventions should be tested to address specific demographic or unit characteristics.

Demographic and Environmental Factors Associated with Alarm Fatigue in Critical Care Nurses

For the average person, over time exposure to constant, repetitive noises such as a ticking clock begin to go unnoticed; the same principle applies to clinical alarms in a critical care setting. Alarm fatigue is defined as the systematic desensitization to alarm sounds that leads to a delay in response to critical alarms. Excessive false alarms result in caregiver apathy and desensitization such that real events are less likely to be acted on (Cvach, 2012). This is a phenomenon all health care staff can experience, however, nursing staff seem to be the most affected.

Alarm fatigue has become detrimental to patient outcomes. Ninety-eight alarm related events were reported to The Joint Commission between January 2009 and June 2012, of which 80 resulted in death of a patient, 13 in permanent loss of function, and 5 in extended stay or unexpected additional care (The Joint Commission, 2013). Ninety-four of the reported cases occurred within a hospital setting with the majority in telemetry, intensive care, general medicine, and emergency departments with major contributing factors of absent or inadequate alarm systems, improper alarm settings, alarm signals not audible in all areas, and alarm signals inappropriately turned off (The Joint Commission, 2013). A startling statistic reveals that 566 alarm-related patient deaths were reported between January 2005 and June 2010, which is considered to be underrepresented of the actual number of incidents, and showcases the need to understand and implement reduction strategies (The Joint Commission, 2013).

The Healthcare Technology Foundation (HTF) conducted their National Clinical Alarms Surveys in 2006, 2011, and 2016 in an effort to research clinical alarm hazards and management. When surveyed, “has your institution experienced adverse patient events in the last two years related to clinical alarms problems?”, in 2011, 18% of participants responded “yes” and in 2016,

30% of participants responded “yes”, showing the increased prevalence of alarm fatigue harming patients (Clark, 2016).

Review of the Literature

Device alarms are intended to alert clinicians of changes in condition and potential problems, but when exposed to too many alarms, workflow is disrupted and may result in error, omission, distraction, or inattention (Cvach, 2012). It is estimated that more than 300 physiological alarm signal events occur each day for each patient (Brantley et al., 2016). Within the critical care setting, there is a tendency for patients to have more continuous monitoring devices with increased complexity (Bridi, Louro, & Silva, 2014; Graham & Cvach, 2010). Data supports that nurses perceived intensive care units to have a higher noise level than measured, even when the measured noise was that above what is recommended for restorative sleep (White & Zomorodi, 2017). Alarm related issues have ranked within the Emergency Care Research Institute’s (ECRI) top three safety issues for the past three years (ECRI, 2015; ECRI, 2016; ECRI, 2017). To consistently have the same safety issue over time shows the complexity of the problem of alarm fatigue and the need for interventional changes in order to reduce it.

Quality improvement plans have been implemented in order to try and reduce the nuisance alarms that occur within the hospital setting. With a bundled set of interventions, including deletion of duplicate alarms, customization of alarm status, daily ECG electrode changes, standard skin prep, and use of disposable ECG monitoring leads, there was an 80% to 90% reduction in ECG alarms (Sendelbach, Wahl, Anthony, & Shotts, 2015). Further, a pilot study that changed the settings on ECG monitoring alarms in regards to premature ventricular contraction validated that minimizing alarms that did not require action enhanced the environment of care and added value, as there was overall reduction of noise on the unit related

to the telemetry alarms (Srinivasa, Mankoo, & Kerr, 2017). Although these interventions decreased alarms overall, they do not address the concerns related to nursing compliance with policies, education on alarms, or consistency in practice.

Alarm management policies have also been put into place. However, implementation of these policies needs to include ongoing staff education. Employee orientation should incorporate all of the management policies and procedures. With each new device that is brought onto a floor, a common occurrence in critical care, education on that device should include information regarding the alarm capabilities (Janetti, 2015). Considering policies and implementing new equipment, educational interventions have been piloted in order to reduce the number of nuisance alarms that occur. It has been found that after 40% of critical-care staff received education on alarm management, the number of non-ECG monitor alarms decreased 39%. Thus, a single brief educational intervention can significantly reduce the number of these alarm signal events. (Brantley et al., 2016).

Although these studies have shown that the adjustment of alarms does in fact decrease their number, current research also has found that alarm adjustment is not a consistent, current practice. It has also been found that nurses change heart rate alarm setting with wide variability and range, which lack consistency in adjustment magnitudes, causing adjustments that would typically be reactive to be ineffective and too late (Fidler et al., 2017). Current literature supports that alarm fatigue is a prevalent problem within the health care setting, and evidenced based practices can decrease alarm fatigue; however, very few studies have investigated environmental or demographic factors may contribute to alarm fatigue.

Purpose

The purpose of this study is to explore what demographic and work environment factors in the critical care setting influence alarm fatigue in critical care nurses who have patients on continuous monitoring, if any. These influencing factors may allow for future interventions on alarm safety based upon demographics and unit set-up. The nurse demographics of interest in this study included age, gender, years worked as a registered nurse, highest level of education, shift most often worked, and employment status. The unit characteristics of interest in this study included unit layout, average nurse to patient ratio, shift most often worked, unit classification, patient equipment, the number of central monitor stations on the unit, and the number of unit beds.

Methodology

The study was cross-sectional, descriptive quantitative in design. In order to gather sufficient data regarding demographics and unit environmental factors and their association with alarm fatigue, a demographic tool was created and distributed along with The Healthcare Technology Foundation's 2016 Clinical Alarms Survey. Formal permission to use the survey was obtained. The HTF's 2016 Clinical Alarms Survey consisted of 29 questions broken into 7 sections including nuisance alarms, experience with alarm systems, alarm notification, smart alarms, institutional requirements, clinical alarms management improvements, and adverse events, and the Joint Commission National Patient Safety Goal. The survey was distributed online through the use of an online survey platform. Participants' responses were anonymous and the study was approved by the St. John Fisher College Institutional Review Board. Data was collected from January 18th, 2018 to March 1st, 2018; a total of six weeks for participants to contact the researcher and respond.

Sample

The target population for this study was critical care nurses. The sample was obtained using the membership of the Greater Rochester Area Finger Lakes chapter of the American Association of Critical Care Nurses (GRAFL-AACN). Permission to access the GRAFL-AACN members was formally obtained from the organization's president and then the study was introduced at their January Education Dinner. Per the organization's policies, interested parties were asked to contact the researcher for the survey link via a posting on their website and social media pages. Anyone who was following the GRAFL-AACN Facebook page could share the information regarding the study, resulting in snowball sampling.

The survey received a total of 25 respondents, of that, 23 respondents met the inclusion criteria of being 18 years or older, a registered nurse, and employed in a critical care setting defined by a nurse to patient ratio of 1:4 or less. Demographic information is presented in Table 1.

Table 1. Demographic Factors

Age	
18-29	26.1%
30-39	34.8%
40-49	8.7%
50-59	21.7%
≥60	8.7%
Gender	91.3%
Male	8.7%
Female	
Highest Level of Nursing Education	13%
Associate's Degree	78.3%
Bachelor's Degree	8.7%
Master's Degree	
Years of Experience	34.8%
0-5	21.7%
6-10	17.4%

11-20	26.1%
≥21	
Shift Most Often Worked	56.5%
Days	30.4%
Nights	13.1%
Rotating	
Employment Status	87%
Full-time (≥36 hours/week)	8.7%
Part-time (≤35 hours/week)	4.3%
Per diem (as needed)	

Data Collection and Analysis Methods

Both descriptive and correlational analyses were used for this study. Scaled data was assessed for normality and measures of central tendency were calculated, including frequency, mean, median, standard deviation, and percentages. Ordinal and nominal data was examined using frequencies and percentages. When conducting correlational analysis, in order to associate normally distributed, scaled variables, Pearson's product moment correlation (r) was calculated. To associate normally distributed, scaled variables with ordinal or nominal variables, point biserial correlations were calculated (r_{pb}). Significance was set at $p < 0.05$ for all correlational analysis.

Results

Upon data analysis, demographic factors found to be associated with select alarm fatigue measures included age, educational level, employment status, shift most often worked, and years as a nurse (Table 2). Age was found to be significantly and negatively related to the item "nuisance alarms reduce trust in alarms and cause caregivers to inappropriately turn alarms off at times other than during set up or procedure" ($r_{pb} = -.469$; $p = .024$). Highest level of education was significantly and positively associated with the item "nuisance alarms occur frequently" (r_{pb}

= .577; $p = .006$), but significantly and negatively associated with the item, “smart alarms (e.g. where multiple parameters, rate of change of parameters, and signal quality, are automatically assessed in their entirety) would be effective to use for reducing false alarms” ($r_{pb} = -.489$; $p = .016$). Employment status was also significantly associated with the item, “nuisance alarms disrupt patient care” ($r_{pb} = -.737$; $p = .000$).

The shift the nurse most often worked was significantly and positively associated with the items, “nuisance alarms reduce trust in alarms and cause care givers to inappropriately turn alarms off at time other than during set up or procedures” ($r_{pb} = .476$; $p = .022$) and “smart alarms (e.g. where multiple parameters, rate of change of parameters, and signal quality, are automatically assessed in their entirety) would be effective to use for reducing false alarms” ($r_{pb} = .488$; $p = .018$). Years working as a registered nurse was significantly and negatively related to the item, “smart alarms (e.g. where multiple parameters, rate of change of parameters, and signal quality, are automatically assessed in their entirety) would be effective to use for reducing false alarms” ($r_{pb} = -.417$; $p = .048$).

Table 2. Nurse Demographics & Correlation to Alarm Fatigue

	Nuisance Alarms Occur Frequently	Nuisance Alarms Disrupt Care	Nuisance Alarms Reduce Trust/Inappropriately Turn Off Alarms	Smart alarms would reduce false alarms	Smart alarms would improve clinical response to alarms
Age	-.214 [†]	.149 [†]	-.469 ^{†*}	-.178 [†]	-.222 [†]
Highest Educational Level	.557 ^{†*}	.222 [†]	.201 [†]	-.498 ^{†*}	-.057 [†]
Employment Status (Full time/Part time)	-.224 [†]	-.737 ^{†*}	.132 [†]	-.117 [†]	-.104 [†]

Shift Worked (Days/Nights/Rotating)	.098 [†]	.199 [†]	.476 ^{†*}	.488 ^{†*}	.389 [†]
Years as a RN	.082 [^]	.110 [^]	-.315 [^]	-.339 [^]	-.417 ^{^*}

[†] = point biserial (r_{pb}); [^] = Pearson's Correlation (r); * = significant ($p < .05$)

When analyzing unit demographics, average nurse to patient ratio, bedside monitors in each room, number of central monitors, and the number of unit beds were found to have significant associations with select alarm fatigue items (Table 3). The average nurse to patient ratio was significantly and positively related to the items, “properly setting alarm parameters and alerts is overly complex on existing devices” ($r_{pb} = .597$; $p = .003$) and “there have been frequent instances where alarms could not be heard and were missed” ($r_{pb} = .484$; $p = .019$). Average nurse to patient ratio was also significantly, but inversely related to the items, “the alarms used on my floor/area of the hospital are adequate to alert staff of potential or actual changes in patient condition” ($r_{pb} = -.453$; $p = .030$) and the item “clinical staff is sensitive to alarms and responds quickly” ($r_{pb} = -.582$; $p = .004$).

Working on a unit where there were not bedside monitors in each room was related to the item, “there have been frequent instances where alarms could not be heard and were missed” ($r_{pb} = .439$; $p = .036$). The presence of more central patient monitors was significantly and positively associated with the items “nuisance alarms occur frequently” ($r_{pb} = .514$; $p = .012$), “nuisance alarms disrupt patient care” ($r_{pb} = .415$; $p = .049$), and “nuisance alarms reduce trust in alarms and cause caregivers to inappropriately turn alarms off at time other than during set up or procedures” ($r_{pb} = .487$; $p = .018$). The number of unit beds was significantly and positively correlated with the items, “nuisance alarms occur frequently” ($r_{pb} = .470$; $p = .024$) and “nuisance alarms reduce trust in alarms and cause caregivers to inappropriately turn off at times other than during set up or procedures” ($r_{pb} = .475$; $p = .022$).

Table 3. Unit Characteristics & Correlation to Alarm Fatigue

	Nuisance Alarms Occur Frequently	Nuisance Alarms Disrupt Care	Nuisance Alarms Reduce Trust/Inappropriately Turn Off Alarms	Properly Setting Alarms it too Complex	Alarms are Adequate to Alert Staff of Patient Change	Alarms cannot be Heard/are Missed	Clinical Staff are Sensitive to Alarms & Respond Quickly
Average RN:Patient	.204	.234	.238	.597*	-.453*	.484*	-.582*
Bedside Monitor in Every Room	.228	.221	.214	.363	-.143	.439*	-.071
Number of Central Monitors	.514*	.415*	.487*	.404	-.216	.260	-.107
Number of Beds	.407*	.393	.475*	.147	-.141	.365	-.231

All correlations are point biserial (r_{pb}); * = significant ($p < .05$)

No significant relationships were noted with the nurse demographics or unit characteristics and items addressing: new monitoring systems have solved problems with alarms, confusion among which device is alarming, background noise interfering with alarm recognition, alarm integration with notification systems, monitor watchers being helpful, education on alarm systems, requirement for documentation, policies and procedures being used effectively, clinical alarm improvement initiatives, instituting new technology, adverse patient events related to alarms, and Joint Commission National Patient Safety Goal effectiveness.

Discussion

Nurse Demographics

Alarm fatigue may be a contributing factor to nurse's perception of noise levels (White & Zomorodi, 2016). The data gathered support that as age increased, the perceptions of trust in alarms and caregivers inappropriately turning off alarms significantly decreased. Staff could avoid false alarms by suspending alarms for a short amount of time prior to patient manipulation, but this also leads to a lack of trust in turning off alarms at inappropriate times (Cvach, 2012). Also, it was found that having worked as a nurse longer was significantly related to perceiving that smart alarms would not be effective in improving response time to important alarms, quite possibly due to the increasing amounts of alarms. It has been shown that nurses change alarm parameters after disconnecting the patient from the monitor at very low rates, demonstrating that they may be unaware that disconnection results in alarm parameters being reverting to the default settings (Sowan, Tarriela, Gomez, Reed, & Rapp, 2015). Although nurses with more experience perceive that smart alarms would not be effective, they may not be educated on the proper features and procedures needed to ensure smart alarms function at their best capacity.

The data collected shows that nurses with higher levels of education perceived that nuisance alarms occurred more frequently and that smart alarms would not be effective in reducing false alarms. Nurses may perceive that alarms will still occur even though parameters are appropriately set using such tools. Sendelbach, Wahl, Anthony, and Shotts (2015) found that even while properly changing SpO₂ alarm signals from 90% down to 88%, when warranted by patient condition, it did not change alarm rates. Thus, regardless of a nurse's willingness to customize alarm parameters with smart alarms, alarm rates may not be significantly impacted.

It was found in this study that the more hours per week a nurse worked, the more they perceived nuisance alarms disrupted patient care. Also, working rotating shifts was significantly and positively related to perceptions of nuisance alarms decreasing trust in alarms and caregivers inappropriately turning alarms off, but also that smart alarms would be effective in reducing false alarms. Previous studies have concluded that nurses can distinguish only 6 to 14 different alarms, causing nurses only to distinguish a device correctly 31% of the time (Cho, Hwasoon, Lee, & Cho, 2016). These two demographic factors expose individuals to be exposed to more alarms because the individual is working longer and at different times of the day, potentially being exposed to a higher variety of alarms.

Unit Characteristics

With time, more technology has come available resulting in more monitors and alarms for those monitors. In this study, a higher nurse to patient ratio was significantly and negative related to perceptions that alarms are adequate to alert staff of changes in patient condition and that staff are sensitive to alarms and respond quickly. An increased nurse to patient ratio was significantly and positively related to the perception that setting alarm parameters is complex and that there are frequent instances where alarms cannot be heard/are missed increases as well. Humans are able to discriminate five to seven different categorical sounds, making the instances where alarms cannot be heard or missed increase (Cvach, 2012). With increases in technology and patient ratio, there are more alarms making it even more difficult for nurses to be able to listen for and understand which alarm is sounding and what the nurse should do next. Although adjustment is necessary for alarm fatigue, patient ratio and number of bedside monitors was shown to be a barrier to appropriately setting alarms.

Working on a unit where there are not bedside monitors in each room is significantly associated with the perception that alarms are not heard or are missed. Missed alarms have been shown to have negative impacts on patients directly (The Joint Commission, 2013). The greater the number of beds on a unit, the more nurses perceived nuisance alarms occurring frequently and perceived a lack of trust in alarms that leads caregivers to turn off alarms inappropriately. Having more central monitors on the unit was associated with a perception of more frequent nuisance alarms, more frequent disruptions in patient care from nuisance alarms, and that these alarms cause caregivers to turn off alarms inappropriately and more frequently. As seen in this study, the greater the number of monitors on the unit, the more nuisance alarms were perceived. Properly adjusting alarm thresholds has been shown to decrease noise associated with irrelevant alarms (Graham & Cvach, 2010; Lansdown, Strauss, & Scully, 2016).

Limitations

The most significant limitation to this study is the small sample size. In adherence to the organizational policies, participants had to contact the primary researcher for the link to the survey; the survey could not be freely distributed to all. This may have compromised their comfort in the anonymity of the study, resulting in a low response rate. Further, sample data was only gathered at one point in time. A longitudinal study providing data overtime would be beneficial in the future. This study was performed with a local sample from western New York. Other areas of the country and the world may have different technology or different unit set ups that were not seen locally. Even within this small sample various technology and unit designs were appreciated. Lastly, although the HTF Clinical Alarms Survey has been used since 2006, data regarding the validity and reliability of the survey tool is not readily available.

Conclusions

In this sample, there are both nurse demographic and unit characteristics that are significantly related to perceptions regarding alarm fatigue. To fully understand the relationships between nurse and unit characteristics with alarm fatigue, studies should be conducted with a larger sample size to provide more concrete evidence. Once a defined relationship with alarm fatigue is established, changes to the environment and alarm technology can be made accordingly. Interventions should be tested to address specific demographic or unit characteristics.

References

- Bridi, A., Louro, T., & Silva, R. (2014). Clinical Alarms in intensive care: Implications of alarm fatigue for the safety of patients. *Revista Latino-Americana De Enfermagem*, 22, 1034-1040. doi:10.1590/0104-1169.3488.2513
- Brantley, A., Collins-Brown, S., Kirkland, J., Knapp, M., Pressley, J., Higgins, M., & McMurtry, J. (2016). Clinical trial of an educational program to decrease monitor alarms in a medical intensive care unit. *AACN Advanced Critical Care*, 27, 283-289. doi:10.4037/aacnaac2016110
- Cho, O., Hwasoon, K., Lee, Y., & Cho, I. (2016). Clinical alarms in intensive care units: Perceived obstacles of alarm management and alarm fatigue in nurses. *Healthcare Informatics Research*, 22, 46-53. doi:10.4258/hir/2016.22.1.46
- Clark, T. (2016). HTF update: 2016 national clinical alarm survey results [PowerPoint Slides]. Retrieved from: <http://thehtf.org/clinical.asp>
- Cvach, M. (2012). Monitor alarm fatigue: An integrative review. *Biomedical Instrumentation & Technology*, 46, 268-77. doi:10.2345/0899-8205-46.4.268
- Emergency Care Research Institute. (2015). ECRI top 10 health technology hazards for 2015. *Health Devices*, 1-31.
- Emergency Care Research Institute. (2016). ECRI top 10 health technology hazards for 2016. *Health Devices*, 1-15.
- Emergency Care Research Institute. (2017). ECRI top 10 health technology hazards for 2017. *Health Devices*, 1-18.
- Sowan, A. K., Tarriela, A. F., Gomez, T. M., Reed, C. C., & Rapp, K. M. (2015). Nurses' perceptions and practices toward clinical alarms in a transplant cardiac intensive care

- unit: Exploring key issues leading to alarm fatigue. *JMIR Human Factors*, 2.
doi:10.2196/humanfactors.4196
- Fidler, R., Pelter, M., Drew, B., Palacios, J., Bai, Y., Stannard, D., Aldrich, M., Hu, X. (2017).
Understanding heart rate alarm adjustment in the intensive care units through an
analytical approach. *PLoS ONE*, 12. doi:10.1371/journal.pone/0187855
- Graham, K., & Cvach, M. (2010). Monitor alarm fatigue: Standardizing use of physiological
monitors and decreasing nuisance alarms. *American Journal of Critical Care*, 19, 28-34.
doi:10.4037/ajcc2010651
- Healthcare Technology Foundation. (2016). Clinical alarm hazards and management. Retrieved
from: <http://thehtf.org/clinical.asp>
- Jannetti, M. (2015). Managing medical device alarms in the hospital setting. (2015). *AORN
Journal*, 101, 13-14. doi:10.1016/S0001-2092(15)00227-6
- Lansdowne, K., Strauss, D., & Scully, C. (2016). Retrospective analysis of pulse oximeter alarm
settings in an intensive care unit patient population. *BMC Nursing*, 15(1), 1-6.
doi:10.1186/s12912-016-0149-3
- Sendelbach, S., Wahl, S., Anthony, A., & Shotts, P. (2015). Stop the noise: A quality
improvement project to decrease electrocardiographic nuisance alarms. *Critical Care
Nurse*, 35, 15-22. doi:10.4037/ccn2015858
- Srinivasa, E., Mankoo, J., & Kerr, C. (2017). An evidence-based approach to reducing cardiac
telemetry alarm fatigue: Reducing cardiac telemetry alarm fatigue. *Worldviews on
Evidence-Based Nursing*, 14, 265-273. doi:10.1111/wvn.12200
- The Joint Commission. (2013). Medical device alarm safety in hospitals. *The Joint Commission
Sentinel Event Alert*, 50, 1-2.

White, B., & Zomorodi, M. (2017). Perceived and actual noise levels in critical care units.

Intensive & Critical Care Nursing, 38, 18-23. doi:10.1016/j.iccn.2016.06.004

SAMPLE CHARACTERISTICS

- Ages: 18 to 60+
- 91.3% female & 8.7% male
- Highest Level of Education:
 - 13% held an Associates Degree
 - 78.3% held a Bachelor's Degree
 - 8.7% held a Master's Degree
- Shift Most Often Worked:
 - Days: 56.5%
 - Nights: 30.4%
 - Rotating: 13.0%
- Years of Experience:
 - Ranged from 0 to 21+ years
 - 0 – 5 years being the most common (34.78%)

FINDINGS

Table 1. Nurse Demographics & Correlation to Alarm Fatigue

	Nuisance Alarm Occur Frequency	Nuisance Alarm Disrupt Care	Nuisance Alarm Reduce Trust/Responsibility Turn Off Alarms	Smart alarms would reduce false alarms	Smart alarms would improve clinical response to alarms
Age	-.31*	-.14*	-.469*	-.178†	-.222†
Highest Educational Level	-.557*	-.222†	-.201†	-.498*	-.057†
Employment Status (Full Time/Part Time)	-.224†	-.737*	-.132†	-.117†	-.104†
Shift Worked (Days/Nights/Rotating)	.098†	.199†	-.476*	-.488*	-.389†
Years as a RN	-.082†	-.110†	-.315*	-.339*	-.417**

* = point biserial r_{pb} † = Pearson's Correlation (r) * = significant ($p < .05$)

FINDINGS

Table 2. Unit Characteristics & Correlation to Alarm Fatigue

	Nuisance Alarm Occur Frequency	Nuisance Alarm Disrupt Care	Nuisance Alarm Reduce Trust/Responsibility Turn Off Alarms	Priority Setting Alarms is too Cumbersome	Alarms are Confusing/Inadequate for Alert Staff or Patient Change	Alarms cannot be Used/are Annoying	Clinical Staff are Familiarity to Alarms & Response Quality
Antique All to Alarm Ratio	-.204	-.324	-.238	-.597*	-.432*	-.484*	-.582*
Bedside Number in Extra Room	.228	.221	.214	.363	.143	.439*	-.071
Number of Cardiac Monitors	.514*	.415*	.487*	.404	-.216	.260	-.107
Number of Beds	.402*	.393	.475*	-.147	-.141	.365	-.231

All correlations are point biserial r_{pb} * = significant ($p < .05$)

FINDINGS

No significant relationships were noted with the nurse demographics or unit characteristics and the following:

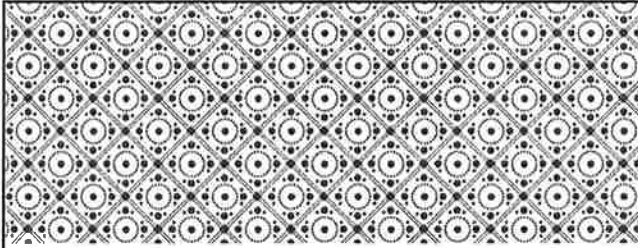
- New monitoring systems have solved problems with alarms
- Confusion among which device is alarming
- Background noise interfering with alarm recognition
- Alarm integration with notification systems
- Monitor watchers being helpful
- Education on alarm systems
- Requirement for documentation
- Policies and procedures being used effectively
- Clinical alarm improvement initiatives
- Instituting new technology
- Adverse patient events related to alarms
- Joint Commission National Patient Safety Goal effectiveness

DISCUSSION: NURSE DEMOGRAPHICS

- As age increased, perceptions of trust in alarms and caregivers inappropriately turning off alarms significantly decreased.
- Nurses with higher levels of nursing education perceived that nuisance alarms occurred more frequently and that smart alarms would not be effective in reducing false alarms.
- The more hours per week a nurse worked, the more they perceived nuisance alarms disrupted patient care.

DISCUSSION: NURSE DEMOGRAPHICS, CON'T

- Working rotating shifts was significantly and positively related to perceptions of nuisance alarms decreasing trust in alarms and caregivers inappropriately turning alarms off but also that smart alarms would be effective in reducing false alarms.
- Having worked as a nurse longer was significantly related to perceiving that smart alarms would not be effective in improving response time to important alarms.



DEMOGRAPHIC AND ENVIRONMENTAL FACTORS ASSOCIATED WITH ALARM FATIGUE IN CRITICAL CARE NURSES

Amanda Szczeniak
St. John Fisher College
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INTRODUCTION TO ALARM FATIGUE



- Alarm fatigue can be defined as the systematic desensitization to alarm sounds that leads to a delay in response to critical alarms
- Device alarms are intended to alert clinicians of changes in condition and potential problems, but when exposed to too many alarms, workflow is disrupted and may result in error, omission, distraction, or inattention (Cvach, 2012)
- Within critical care settings, there is a tendency for patients to have more continuous monitoring devices with increased complexity (Graham & Cvach, 2010; Birdi, Louro, & Silva, 2014)
- Significant within health care in general but nursing, specifically critical care nurses, are more likely to experience this phenomenon

LITERATURE SUMMARY & PURPOSE



• Current research shows that alarm fatigue is a well defined and chronic issue but has not focused on factors that are related to alarm fatigue.

• The purpose of this study was to explore what demographic and environmental factors are associated with alarm fatigue in critical care nurses, if any.

• Nurse demographics of interest: age, gender, years worked as a Registered Nurse, highest level of education, shift worked, & employment status

• Unit characteristics of interest: unit layout, average RN to patient ratio, shift most often worked, unit classification, patient equipment, the number of unit central monitors, and the number of unit beds

METHODOLOGY



• Cross-sectional, descriptive quantitative design

• Survey:

- A demographics tool was created gather participants' demographic information as well as information regarding their specific unit.
- The Healthcare Technology Foundation's 2016 Clinical Alarms Survey
 - 29 questions in 7 sections
 - Nuisance Alarms
 - Experience with Alarm Systems
 - Alarm Notification
 - Smart Alarms
 - Institutional Requirements
 - Clinical Alarms Management Improvements
 - Adverse Event & The Joint Commission National Patient Safety Goal

SAMPLE



• Target population: Critical Care Nurses

• Sampling frame: Members of the Greater Rochester Area Finger Lakes chapter of the American Association of Critical Care Nurses

• Inclusion criteria included: Registered Nurse, 18 years or older, employed in a critical care setting defined by a nurse to patient ratio of 1:4 or less.

• $n = 23$

DATA ANALYSIS



• Descriptive analysis

- Scaled data was assessed for normality
- Descriptive statistics, including frequencies, mean, median, standard deviation, and percentages were reviewed

• Correlational analysis

- To associate scaled variables & normally distributed variables, Pearson's product moment correlation (r) was calculated
- To associate scaled & normally distributed variables with categorical or ordinal variables, Point biserial correlations were calculated (r_{pb})
- Significance was set at $p < 0.05$

DISCUSSION: UNIT CHARACTERISTICS



- An increased nurse to patient ratio was significantly and negatively related to perceptions that alarms are adequate to alert staff of changes in patient condition and that staff are sensitive to alarms and respond quickly.
- An increased nurse to patient ratio was significantly and positively related to the perception that setting alarm parameters is complex and that there are frequent instances where alarms cannot be heard/are missed increases as well.
- Working on a unit where there are not bedside monitors in each room is significantly associated with the perception that alarms are not heard or are missed.

DISCUSSION: UNIT CHARACTERISTICS, CON'T



- The greater the number of beds on a unit, the more nurses perceived nuisance alarms occurring frequently and perceived a lack of trust in alarms that lead caregivers to turn off alarms inappropriately.
- Having more central monitors on the unit was associated with a perception of more frequent nuisance alarms, more frequent disruptions in patient care from nuisance alarms, and that these alarms cause care givers to turn off alarms inappropriately and more frequently.

DISCUSSION: CONNECTION TO THE LITERATURE



- Alarm fatigue may be a contributing factor to nurses' perceptions of noise levels (White & Zomorodi, 2016)
- As seen in this study, the more central monitors and bedside monitors, the more nuisance alarms were perceived.
- Properly adjusting alarm thresholds has been shown to decrease noise associated with irrelevant alarms (Lansdowne, Strauss, & Scully, 2016; Graham & Cvach, 2010)
- Increasing nurse to patient ratios was positively correlated with the item properly setting alarms is too complex
- Although adjustment is necessary for alarm fatigue, patient ratio and number of bedside monitors is a barrier to appropriately setting alarms
- Nuisance alarms occurring frequently and disrupting care are both correlated with RN age, education level, employment status, shift most often worked, years of experience, RN to patient ratio, number of central monitors, having bedside monitors, and number of unit beds

LIMITATIONS



- Small sample size
- Sample data was only gathered at one point in time, a longitudinal study providing data overtime would have been beneficial
- Local sample only, other areas of the country/world may have different technology or different unit set up styles
 - Even within this sample, technology & unit set up varied
- Though this tool has been used since 2006, validity and reliability data is not readily available

CONCLUSIONS



- In this sample, there are both nurse and unit characteristics that are significantly related to perceptions of alarm fatigue
- To fully understand the relationships between nurse and unit characteristics with alarm fatigue, studies should be conducted with larger sample sizes
- Once a defined relationship with alarm fatigue is established, changes to the work environment & alarm technology can be made accordingly
- Interventions should be tested to address specific demographic or unit characteristics
- The effects of alarm fatigue on patient outcomes directly is yet to be determined

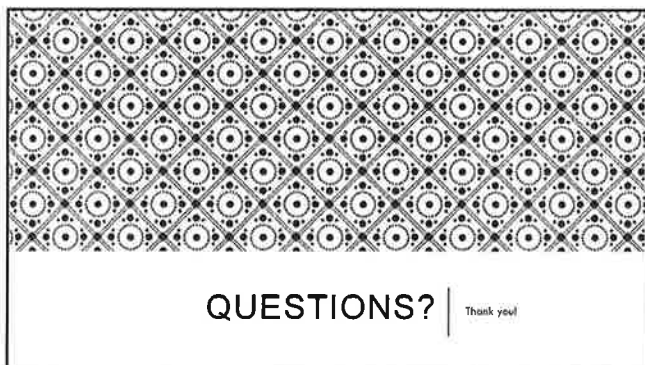
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REFERENCES



- Bridl, A., Louro, T., & Silva, R. (2014). Clinical Alarms in Intensive care: Implications of alarm fatigue for the safety of patients. *Revista Latino-Americana De Enfermagem*, 22(6), 1034-1040.
- Cvach, M. (2012). Monitor alarm fatigue: An integrative review. *Biomedical Instrumentation & Technology*, 46(4), 268-77.
- Graham, K., & Cvach, M. (2010). Monitor alarm fatigue: Standardizing use of physiological monitors and decreasing nuisance alarms. *American Journal of Critical Care: An Official Publication, American Association of Critical-Care Nurses*, 19(1), 28-34.
- Lansdowne, K., Strauss, D., & Scully, C. (2016). Retrospective analysis of pulse oximeter alarm settings in an intensive care unit patient population. *BMC Nursing*, 15(1).
- White, B., & Zamoradi, M. (2017). Perceived and actual noise levels in critical care units. *Intensive & Critical Care Nursing*, 38, 18-23.