A CALL FOR HELP: HOURLY ROUNDING TO REDUCE ALARM FATIGUE

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A DNP Project Manuscript
Submitted in Partial Fulfillment of the Requirements for the
Doctor of Nursing Practice Degree

University of Maryland School of Nursing
May 2019

Abstract

BACKGROUND/LOCAL PROBLEM: Frequent call lights and alarm fatigue were identified by nursing staff and leadership as a quality concern on a Heart Vascular Unit in the mid-Atlantic region. Alarm fatigue negatively effects safety and patient and nurse satisfaction. Structured hourly rounds can reduce patient call lights. The purpose of this DNP project was to implement and evaluate the effectiveness of nurse hourly rounding on call light frequency on a 30-bed inpatient Heart Vascular Unit.

METHODS: This was a quality improvement project with pre- and post-implementation assessments on alarm fatigue and call light quantity. The nursing staff was measured with a self-reporting instrument. Call light quantity was measured through alarm reports. Paper tracking forms audited staff adherence.

INTERVENTIONS: Hourly nurse rounding was implemented over 14 weeks. Staff were trained in teaching sessions. Each hour a member of the nursing staff entered the patient's room and assessed their needs. Rounds were recorded on the tracking forms.

RESULTS: The clinical outcomes were number of call lights that occurred in a 24-hour period. There was no significant change between pre- and post-implementation measures. The perceptual outcome was alarm fatigue in bedside nursing staff; improvement was seen in the majority of assessment responses.

CONCLUSION: Structured nurse hourly rounding reduced the perceived and measured alarm fatigue among bedside staff. No significant difference was seen in the quantity of call lights. Hourly rounding may reduce alarm fatigue and improve patient and nursing satisfaction.

Keywords: alarm fatigue, hourly rounds, call light, nursing

A Call for Help: Hourly Rounding to Reduce Alarm Fatigue

Introduction

Clinical alarms are a frequent occurrence on inpatient units, originating from electrocardiographic, pulse oximetry, and patient call light devices (Cho, Kim, Lee, & Cho, 2016). This places nurses at risk for desensitization to alerts and is stated as alarm fatigue (Cho et al., 2016; Olrich, Kalman, & Nigolian, 2012; Sendelbach, Wahl, Anthony & Shotts, 2015). Alarm fatigue compromises workflow, patient safety, and nursing satisfaction, and is a chief concern of hospital administration and The Joint Commission (Cho et al., 2016; Mitchell, Lavenberg, Trotta, & Umscheid, 2014; The Joint Commission, 2015). Call lights in particular are used to gauge staff response and patient satisfaction as assessed on the Hospital Consumer Assessment of Providers and Systems survey, which is a driver for healthcare reimbursement (Centers for Medicare and Medicaid Services, 2017). Moreover, when nurses are exposed to alarms from patients that they are not assigned to, this excessive number of alerts negatively impacts nurse satisfaction and response time (Mitchell et al., 2014; Petras, Dudjak, & Bender, 2013). The frequency of call lights was identified by nursing staff as the primary source of excess noise and thus as a quality improvement issue at a mid-Atlantic suburban hospital.

The purpose of this doctor of nursing practice (DNP) project was to implement and evaluate the effectiveness of nurse hourly rounding on a cardiovascular unit. The short-term goals of the DNP project were to reduce the number of patient call lights received by nursing staff over a 24-hour period, and to decrease alarm fatigue in nursing staff as measured on a self-reporting tool after six weeks (Krepper et al., 2014; Mitchell et al., 2014; Olrich et al., 2012; Petras et al., 2013; Torabizadeh, Yousefinya, Zand, Rakhshan, & Fararooei, 2017). The long-

term goals of the DNP project were to increase unit nursing satisfaction and patient satisfaction (Krepper et al., 2014; Mitchell et al., 2014; Olrich et al., 2012; Petras et al., 2013).

Literature Review

The intervention of structured hourly rounding by nursing staff was based upon a review of current literature. Sources included systematic reviews, quasi-experimental studies, and a quality improvement project. Evidence for staff education on the initiative, components of hourly rounds, and impact of hourly rounding on call light outcomes will be discussed.

The quasi-experimental study by Olrich et al. (2012) used education sessions taught by a clinical nurse specialist, detailing hourly rounding components for unit and float nursing staff; a course update followed four months after implementation. Similarly, Krepper et al. (2014) began their non-experimental study with a 4-hour training session covering the reasons for hourly rounding and its content, with a presentation and role playing, and then reinforcing with regular informal training by researchers and unit leaders. Petras et al. (2013) also utilized a 4-hour seminar for educating staff on their quality improvement (QI) project, detailing the reasons for hourly rounding, its script, charting, and responsibilities of staff members. Baseline data was first reviewed by authors and they provided supporting literature for nurses along with a method for staff input (Petras et al., 2013). In sum, training nursing staff on hourly rounds in a seminar, to include its purpose, objective, tasks, and documentation, supports successful implementation (Krepper et al., 2014; Olrich et al., 2012; Petras et al., 2013). Also, reinforcing training and sharing supporting research promotes best practice and its ownership among staff (Krepper et al., 2014; Olrich et al., 2012; Petras et al., 2013).

After education is program implementation. Structured hourly rounds have consisted of a written script for nursing staff which guides the assessment of pain, positioning, elimination,

nutrition, fluids and the patient's environment with the call light within reach (Krepper et al., 2014; Olrich et al., 2012; Petras et al., 2013). Staff introduced themselves during the first round of each shift, gave an overview of hourly rounds, what patients and families may expect, and then recorded each round on a paper log (Krepper et al., 2014; Olrich et al., 2012; Petras et al., 2013). Patient rounds every one hour during the day and every two hours at night were used by Olrich et al. (2012) and Krepper et al. (2014); Petras et al. (2013) initiated 2-hour rounding by nurses and as needed by support staff. Hourly rounding programs were similar when implemented in acute care settings among adult patients, supporting generalizability to like settings (Krepper et al., 2014; Olrich et al., 2012; Petras et al., 2013). Limitations include a lack of randomization in each study, a small sample size (Petras et al., 2013), and a confounding factor (Olrich et al., 2012). In conclusion, structured rounds benefit adult patients and recording hourly rounds allows for audit of staff participation (Krepper et al., 2014; Olrich et al., 2012; Petras et al., 2013).

Lastly, an outcome of interest was call light frequency. Krepper et al. (2014) and Olrich et al. (2012) extracted data on call light volume per day from the information system before and during the hourly rounding initiative; alternatively, Petras et al. (2013) used paper logs to record call light frequency. Quantifying call lights with information technology rather than paper logs reduced bias for results (Krepper et al., 2014; Mitchell et al., 2014; Olrich et al., 2012). A statistically significant initial reduction in call lights was found following an hourly rounding intervention (Krepper et al., 2014; Olrich et al., 2012). Petras et al. (2013) saw a small reduction in call lights during 2-hour rounding; moreover, a greater reduction resulted when staff rounded hourly versus every two hours. This proportional decrease of call lights to rounding intervals was also seen in the systematic review by Mitchell et al. (2014). While a lack of experimental trials

and variance in reporting techniques limited authors' conclusiveness, Mitchell et al. (2014) followed established guidelines, had a sufficient number of sources, and found an overall reduction in call lights. In summary, increased frequency of nurse rounding decreases call lights, whether rounds occur hourly or every two hours (Krepper et al., 2014; Mitchell et al., 2014; Olrich et al., 2012; Petras et al., 2013).

Theoretical Framework

The patient care delivery model conceptualized the phenomenon of interest, alarm fatigue, and its two concepts, patient call lights and staff response (Cho et al., 2016; Krepper et al., 2014; Mitchell et al., 2014; O'Brien-Pallas, Meyer, Hayes, & Wang, 2010; Figure 1). This middle range theory described the relationships between variables within a hierarchy of open systems, and is comprised of inputs, or characteristics of nurses and patients, which preceded throughputs, that included the intervention and subsystem; subsequently, these influenced outputs which consisted of outcomes and their measurement, for patients, staff, and the system (O'Brien-Pallas et al., 2010). This depicted the interrelatedness of nurses, the organization, the care environment, and patient outcomes that occur during the provision of care (O'Brien-Pallas et al., 2010). Moreover, this model encompassed both patient care and environmental complexity and acknowledged the effect of clinical alarms on nurses (Mitchell et al., 2014; O'Brien-Pallas et al., 2010; Petras et al., 2013). In its utility, the patient care delivery model informed nursing interventions, unit leadership, systems-level decisions, and policy changes addressing alarm fatigue and patient safety and (Cho et al., 2016; Krepper et al., 2014; Olrich et al., 2012; TJC, 2015). The model demonstrated propositions between individual and systems factors, while centered on patient care, which together contributed to organizational outcomes (O'Brien-Pallas et al., 2010). Hourly rounding, as a throughput, reduces patient call lights, the output, thereby

decreasing environmental complexity (Krepper et al., 2014; Mitchell et al., 2014; O'Brien-Pallas et al., 2010). Its utility was also seen as the concepts of patient call lights and staff response were interrelated with nursing interventions; that is, the care environment and nursing actions affected one another (Mitchell et al., 2014; O'Brien-Pallas et al., 2010; Petras et al., 2013). By altering inputs and throughputs, alarms are reduced, contributing to overall patient and staff safety and the satisfaction of nurses (Krepper et al., 2014; Mitchell et al., 2014; O'Brien-Pallas et al., 2010).

Implementation Plan

This DNP project implemented hourly rounding by bedside nursing staff as a proactive strategy to address alarm fatigue and meet patient's needs in a more predictable and efficient manner (Krepper et al., 2014; Mitchell et al., 2014; Olrich et al., 2012; Petras et al., 2013). The structured rounds served to prevent call lights from being initiated and promote patient safety and satisfaction, and may positively influence nursing satisfaction (Krepper et al., 2014; Mitchell et al., 2014; Olrich et al., 2012; Petras et al., 2013).

This QI project used a design with pre- and post-implementation assessments. The sample is comprised of bedside registered nurses (n = 50) and patient care technicians (n = 25). These individuals were selected for their respective licensure or certification, unit employment, willingness to participate, and role in direct patient care, and thereby exposure to alarms. All bedside nursing staff were included with no exclusion criteria. The setting was a 30-bed cardiovascular unit.

The implementation was over 14-weeks. In the first two weeks, the DNP project leader instructed the two clinical champions on the hourly rounding initiative and their role. Staff education sessions were promoted at shift huddles by the unit manager and project leader. The pre-intervention 10-item alarm fatigue assessment was distributed via online survey software,

using an adapted questionnaire (Torabizadeh et al., 2017; Appendix A). During week three, staff nurses and technicians were trained on hourly rounding in a 30-minute in-person teaching session led by the project leader and scheduled to permit attendance by both night and day staff and on both weekday and weekend shifts. Charge nurses were tasked to orient float staff, nursing instructors, and students on hourly rounding, and were briefed individually and emailed talking points. The baseline alarm report was extracted from the Rezcare database by biomedicine. Over weeks four through nine, hourly rounding was initiated with both the go-live and conclusion occurring midweek. The project leader visited the site weekly to promote the project and obtain feedback from the clinical champions, staff, and unit manager; communication through email and phone also occurred. During weeks 10 to 11, post-implementation alarm fatigue was assessed by distributing the same survey as previously and obtaining a repeat measure of call light quantity. In weeks 12 to 14, data was initially reviewed and analyzed and alarm reports were verified with biomedicine personnel.

The baseline data consisted of the alarm fatigue assessment as an outcome measure and was distributed using email links to an online survey. The original 13-item instrument was developed by Torabizadeh et al. (2017) among a similar setting and population, previously published, and written permission for both its use and modification was obtained prior to this project. The survey was then adapted to the context of the project (Appendix A). This instrument showed reliability (Spearman-Brown coefficient = 0.99, Guttman split-half coefficient = 0.79, and Cronbach's alpha = 0.91) and validity (face validity and content validity with CVR > 0.62, S-CVI/Ave = 0.92; Torabizadeh et al., 2017). Nurses and technicians were assessed separately. The first question reported years of experience and the remaining nine were Likert-type responses indicating agreement on a scale of from 1 ("Always") to 5 ("Never"). The outcome of

call light quantity was measured by generating alarm reports pre- and post-implementation in collaboration with biomedicine staff. This electronic data detailed the number of call lights from patient rooms and bathrooms that occurred in a 24-hour period and staff and patient census for those days were also collected from the unit manager. Staff compliance as a process measure was tracked on paper logs on patient room doors over the six weeks of implementation, specifying the date, hour, and room number (Appendix B). While the reliability and validity of alarm reports and tracking logs has not been explicitly studied, these methods were used consistently in the literature (Krepper et al., 2014; Olrich et al., 2012; Petras et al., 2013).

Data from the alarm fatigue assessments were analyzed and summarized using descriptive statistics to quantify the number of responses for each question, the average weight of responses, and identify themes or differences. Analysis of demographic data was to qualify and contrast nurse and technician responses with years of experience. The data from the alarm reports was entered into an Excel spreadsheet, with the number of alarms for the two measured 24-hour periods, and the number of staff and patients on the unit during that time. Descriptive statistics was used to compare the count of call lights before and after implementation and assess for a difference. Data from the tracking forms, were placed into an Excel spreadsheet with the date, room number, shift, and number of rounds completed by a nurse or technician; findings were evaluated and summarized using descriptive statistics.

Permission to conduct Non-Human Subjects Research was obtained from the University of Maryland Baltimore Institutional Review Board and the organizational Clinical Quality Review Committee prior to implementation. Protected health information was not removed from the facility, recorded on tracking forms, or on alarm reports. Staff participation was voluntary and survey responses were anonymous. The project leader denied any conflict of interest.

The DNP project leader conducted three staff training sessions on three different days, after promoting these sessions with a flyer on the unit and announcing at morning huddles. A total of 34 staff members attended the sessions and the supporting literature was placed in the breakroom for staff to review. The baseline alarm fatigue assessment and alarm report were obtained. The initiative of hourly rounding to reduce call lights and alarm fatigue was implemented over 6 weeks, with frequent interactions to promote the project and encourage participation (Krepper et al., 2014; Mitchell et al., 2014; Olrich et al., 2012; Petras et al., 2013). Paper flyers entitled "Fast Facts" contained key points on hourly rounding and were hung on bulletin boards throughout the unit and in the staff breakroom as a quick reference and visual reminder of the initiative. The site was visited the project site once each week at the morning staff huddle and participation was encouraged among nursing staff, including day shift, night shift, unit leadership, and nursing students. Additionally, the Clinical Site Representative (CSR) reinforced the initiative each weekday morning. Project participation was tracked with paper forms placed on patient room doors and completed by nursing staff. Tracking forms were changed daily by the unit secretary on weekdays and by the night charge nurse on weekends. Completed forms were obtained weekly by the project leader and staff were encouraged in their role of replacing forms daily. Weekly status reports were obtained from the CSR and clinical champions via email or discourse. Input was also obtained from charge nurses and bedside staff to gauge the degree of participation and address questions or concerns. The strategy employed in the project promotion was discourse with unit staff and the tactic was one-to-one in person, group in-person, and email (Guidry, Vischi, Han, & Passons, 2014). Meetings were held with key staff from the biomedicine department and unit leadership, to include the unit manager (i.e., the CSR) and the unit nurse educator.

Results

The implementation and evaluation of this quality improvement project noted staff readily participated in both the project and its tracking method. Collected data consisted of the alarm fatigue assessments completed by staff with 26% (n = 13) of registered nurses (RNs) and 24% (n = 6) of patient care technicians (PCTs) responding to the pre-implementation survey (Table 1). The post-implementation alarm fatigue assessment was completed by 34% (n = 17) of RNs and 40% (n = 10) of PCTs (Table 2). Descriptive statistics were used to summarize years of experience (Figures 2 and 3). The highest areas of concerns for PCTs, based upon weighted response, were the amount of alarms and the perceived interference of workload on response time. Chief concerns for RNs were also the quantity of alarms as well as the overall amount of noise on the unit. Post-implementation, the highest areas of concern for RNs was the quantity of alarms and the overall amount of noise on the unit, which were unchanged from baseline. Among PCTs, the highest scoring areas were the perception of patient load as a hinderance to timely response to call lights, and the proportion of noise from alarms on the unit. The weighted scores for responses from RNs decreased (i.e., improved) in 8 out of 9 questions; likewise, the scores for PCTs on alarm-related questions improved in 6 out of 9 questions.

There is anecdotal evidence for a reduction in the perceived number of call lights and alarm fatigue as reported by bedside staff. The measured quantity of call lights in a 24-hour period at baseline was 53 on a report queried by biomedicine, and the post-implementation quantity was 54. This was an increase of 1.9% in the number of call lights from baseline and therefore no significant reduction was seen (Table 4). The tracking forms with the date, room number, and completion of hourly rounding were reviewed, summarized and analyzed using descriptive statistics. A total of 25,153 hourly rounds were documented by staff, with a weekly

mean of 4,192. The documented weekly participation rates, defined as the number of completed rounds out of the total opportunities for rounds, averaged 41.6% among bedside nurse and PCTs over the six weeks of implementation (Table 5).

The ready adoption of the initiative by nursing staff and a teaching facility supported the implementation and its perceptual outcomes. The pace and higher acuity of a cardiovascular unit could negatively impact the rate of completing and documenting hourly rounds, and the regular presence of float staff that may have been unaware of the initiative.

An unintended consequence of hourly rounding was waking patients at night and possible sleep disruption, particularly among independent patients. Therefore, the frequency of nighttime rounds was decreased to every other hour from every hour, for independent patients only, in the third week of the project. This approach has been used in the literature without indication for negative impact on outcomes (Krepper et al., 2014; Mitchell et al., 2014; Olrich et al., 2012; Petras et al., 2013). This change was made in collaboration with unit staff and Clinical Champions and maintained the purpose of the project. This was communicated directly to staff by the project leader, night Clinical Champion, and the CSR at morning huddles. The remainder of the project showed integration of this change without difficulty and further concerns were not expressed for the remainder of the 6-week implementation period.

Discussion

The findings of this QI project support the feasibility of implementing and evaluating structured hourly rounding on a cardiovascular unit with an observed reduction in alarm fatigue. However, a measured reduction in patient call light use was not demonstrated. The reduction in perceived or felt alarm fatigue, a qualitative measure, without a quantitative decline in the number of call lights, indicates an improvement in the perception despite reality. This may

indicate that when staff were accountable for a quality improvement issue, were proactive about it, and owned the change to address a concern, that they perceived less of a burden from the triggering events (i.e., alarms) despite no actual reduction in their counted number. This placebo effect of sorts, from purposeful hourly rounding, may have contributed to the reduced alarm fatigue as a qualitative measure. The improvement in felt alarm fatigue as reported by staff is the more significant and meaningful finding of the two measured outcomes, as this is the final indication, regardless of the actual number of alarms, of the experience of staff. Fatigue is experienced and thus achieving a reduction in this outcome, despite not decreasing the number of call lights that contribute to said fatigue, is the more compelling finding and support the overall success of this DNP project. Furthermore, as anecdotal evidence, staff reported that they heard fewer number of call lights during their shift. The lack of change, and actual slight increase in the number of call lights, may have also been influenced by the patient's increased confidence in its use, knowing that staff are more responsive and thus patients are not as hesitant to summon them. In sum, the quantity of call lights did not change but quality of their experienced effect on bedside staff did improve, and this is considered to be the primary most indicative finding.

This project did not achieve fewer number of alarms as seen in similar published initiatives (Krepper et al., 2014; Mitchell et al., 2014; Olrich et al., 2012). This may be due to the presence of competing priorities on the unit, relatively infrequent reinforcement by the project leader, a high-paced unit, patient acuity, and the perception among staff in outcome achievement. Conversely, project facilitators included the support of unit leadership and nursing staff and the added presence of nursing students on select weekdays. Weekly onsite project promotion by the project leader, with both day and night staff, was a key facilitator. Recording hourly rounds after completion rather than before completing the task was reiterated in the fourth week by the DNP

student and CSR; this issue appeared to resolve. Unexpected benefits or costs of the implementation were not identified.

The strengths of this project include support from unit and department leadership during the development and implementation of this project. Additionally, several staff nurses noted previous positive experiences with a similar initiative which fostered engagement among unit staff. Participation of nursing students three days each week provided additional human resources and allowed hourly rounding to be further divided among unit staff and students. The biomedicine department was genuinely interested in the project and collaborated in obtaining alarm reports, measuring results, and contributing personnel time. Two clinical champions consistently reinforced the initiative and communicated regularly with the DNP project leader, providing for both prompt feedback and timely dissemination of any project changes. Finally, this was conducted at a teaching hospital which values evidence-base practice and fosters a continual learning environment.

Project limitations include the information technology platform for obtaining call light reports. This yielded what appeared to be a falsely low baseline measurement and was initially resolved by collaborating with the biomedicine director, who in turn contacted the database vendor directly. The biomedicine staff were then able to correct the method of querying call light reports and this yielded an accurate and complete baseline call light report. However, the post-implementation measure also appeared to be problematic due to its low count and thus, while this measure demonstrates good reliability, its validity is not established. It is valid to the extent that it measured all call lights generated on the project unit over 24 hours. The alarms reporting system was unable to be improved upon during the implementation of this project. Internal validity was threatened by staff participation bias due to the tracking form. Completion of hourly

rounds could have been influenced by this awareness of the audit tool, either increasing compliance or reducing if viewed as a performance measure. This was met by informing staff in the morning huddles that the form is anonymous and nonpunitive. There was potential bias in the use of call lights by patients due to their awareness of the initiative, resulting in either less likely or more likely to press the call light. Compliance with hourly rounding by float staff, due to lack of an awareness, also limited results; efforts to brief these staff on hourly rounding was reiterated midway through the project. Findings from this QI project may not be generalized outside of this setting and population.

Plans for sustainability consisted of obtaining feedback from nursing staff post-implementation and presenting the project findings with practice recommendations to stakeholders and senior leaders. The organization agreed to consider the continuation of hourly rounding with clinical champions and consider writing an organizational nursing policy and procedure on hourly nurse rounding.

Conclusion

The results of this project can be used to support purposeful hourly rounding as a method for reducing alarm fatigue in nursing staff. The sustainability mechanisms of this practice change include attaining the project's long-term goals, demonstrated by organizational measures on patient satisfaction, safety, and nursing satisfaction. This will be assessed by the CSR and positive results in any of these domains bolsters the support for future initiatives. Feedback was obtained from nursing staff and clinical champions, and these findings were shared with nursing leadership who were engaged in the efforts. Support was generated for a subsequent purposeful hourly rounding project, as it was perceived by stakeholders that it was a needed, feasible, successful, and evidence-based initiative. An established documentation method in the electronic

health record would provide ease of recording rounds in future projects. Lastly, writing an organizational nursing policy would solidify this practice as part of the standard of care for existing and orienting staff. The hourly rounding initiative was considered by leadership at the organization and would utilize similar measures and methods, and extend the initiative to other adult units, over a six-month period of time, as a component of maintaining Magnet status. Use of the same measurement instrument (i.e., alarms reporting system) would generate the data needed to compare pre- and post-implementation effectiveness.

Recommendations for future projects include dividing the unit with half participating in the initiative and the other half not, so as to compare call lights and fewer tracking form data from the two sections. Staff training sessions should consist of informal seminar format, as well as reinforcing these through morning staff huddles and clinical champions for a successful implementation. An adherence rate greater than 41.6%, as seen in this project, should be an aim as increased participation may have a reciprocal reduction in call lights. To improve compliance among float staff, it is recommended to send an email to all nursing staff in the institution who may float to the project unit with key information on expectations when assigned to the unit. Additionally, conducting leadership rounds with the unit manager, clinical champion, and project leaders more than once weekly would increase participation. In practice, structured hourly rounds are a feasible practice to continue at the discretion of the nursing staff and unit leadership. The tracking process will provide an audit of staff compliance in future implementations. Recommended next steps include a continued integration of purposeful hourly rounding as a means to mitigate call light use, guided by the patient care delivery model, and observing for long-term outcomes on a unit level (Figure 1).

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Table 1

Alarm Fatigue Assessment Results of Nursing Staff Pre-Implementation

Registered Nurses: Question 1	**0-6 Months**	**6-12 Months**	**1-3 years**	**4-6 years**	**> 6 years**	
1. How long have you worked on the HVU?	15.4% (2)	7.7% (1)	46.2% (6)	23% (3)	7.7% (1)	
Questions 2-10	**Never**	**Rarely**	**Occasionally**	**Usually**	**Always**	**Weighted Average**
2. Generally, I hear a certain amount of noise on the unit.	0	0	15.4% (2)	53.9% (7)	30.8% (4)	4.15
3. I believe much of the noise on the unit is from the alerts of the call lights, bed alarms, and chair alarms.	0	0	0	79.9% (10)	23% (3)	4.23
4. When alarms go off repeatedly, I become indifferent to them.	0	23% (3)	53.9% (7)	23% (3)	0	3.00
5. On some shifts the heavy workload on the unit prevents my quick response to alarms.	0	7.7% (1)	30.8% (4)	53.9% (7)	7.7% (1)	3.62
6. When I'm upset or nervous, I'm more responsive to alarm sounds.	15.4% (2)	38.5% (5)	23% (3)	15.4% (2)	7.7% (1)	2.62
7. Alarm sounds prevent me from focusing on my professional duties.	0	0	69.2% (9)	30.8% (4)	0	3.31
8. I pay more attention to the alarms on certain shifts.	30.8% (4)	23% (3)	30.8% (4)	15.4% (2)	0	2.31
9. When alarms go off repeatedly and continuously, I lose my patience.	0	23% (3)	46.2% (6)	30.8% (4)	0	3.08

10. At change of shift, I pay less attention to the alarms from patients.	15.4% (2)	38.7% (5)	30.8% (4)	15.4% (2)	0	2.46
Patient Care Technicians: Question 1	**0-6 Months**	**6-12 Months**	**1-3 years**	**4-6 years**	**> 6 years**	
1. How long have you worked on the HVU?	50% (3)	16.7% (1)	33.3% (2)	0	0	
Questions 2-10	**Never**	**Rarely**	**Occasionally**	**Usually**	**Always**	**Weighted Average**
2. Generally, I hear a certain amount of noise on the unit.	0	0	16.7% (1)	66.7% (4)	16.7% (1)	4.00
3. I believe much of the noise on the unit is from the alerts of the call lights, bed alarms, and chair alarms.	0	0	16.7% (1)	50% (3)	33.3% (2)	4.17
4. When alarms go off repeatedly, I become indifferent to them.	0	33.3% (2)	50% (3)	16.7% (1)	0	2.83
5. On some shifts the heavy workload on the unit prevents my quick response to alarms.	0	0	16.7% (1)	50% (3)	33.3% (2)	4.17
6. When I'm upset or nervous, I'm more responsive to alarm sounds.	16.7% (1)	16.7% (1)	33.3% (2)	33.3% (2)	0	2.83
7. Alarm sounds prevent me from focusing on my professional duties.	50% (3)	0	50% (3)	0	0	2.00
8. I pay more attention to the alarms on certain shifts.	33.3% (2)	50% (3)	16.7% (1)	0	0	1.83
9. When alarms go off repeatedly and continuously, I lose my patience.	16.7% (1)	50% (3)	33.3% (2)	0	0	2.17

10. At change of shift, I pay less attention to the alarms from patients.	0	50% (3)	33.3% (2)	16.7% (1)	0	2.67

Note: HVU = Heart Vascular Unit.

Table 2

Alarm Fatigue Assessment Results of Nursing Staff Post-implementation

Registered Nurses: Question 1	**0-6 Months**	**6-12 Months**	**1-3 years**	**4-6 years**	**> 6 years**	
1. How long have you worked on the HVU?	29.4% (5)	11.8% (2)	23.5% (4)	11.8% (2)	23.5% (4)	
Questions 2-10	**Never**	**Rarely**	**Occasionally**	**Usually**	**Always**	**Weighted Average (Pre-Implementation)**
2. Generally, I hear a certain amount of noise on the unit.	0	0	17.7% (3)	76.5% (13)	5.9% (1)	3.88 (4.15)
3. I believe much of the noise on the unit is from the alerts of the call lights, bed alarms, and chair alarms.	0	5.9% (1)	29.4% (5)	58.8% (10)	5.9% (1)	3.65 (4.23)
4. When alarms go off repeatedly, I become indifferent to them.	5.9% (1)	17.7% (3)	70.6% (12)	5.9% (1)	0	2.76 (3.00)
5. On some shifts the heavy workload on the unit prevents my quick response to alarms.	0	11.8% (2)	41.2% (7)	47.1% (8)	0	3.35 (3.62)
6. When I'm upset or nervous, I'm more responsive to alarm sounds.	11.8% (2)	41.2% (7)	35.3% (6)	11.8% (2)	0	2.47 (2.62)
7. Alarm sounds prevent me from focusing on my professional duties.	5.9% (1)	29.4% (5)	47.1% (8)	11.8% (2)	5.9% (1)	2.82 (3.31)
8. I pay more attention to the alarms on certain shifts.	23.5% (4)	41.2% (7)	23.5% (4)	11.8% (2)	0	2.24 (2.31)
9. When alarms go off repeatedly and continuously, I lose my patience.	5.9% (1)	47.1% (8)	41.2% (7)	0	5.9% (1)	2.53 (3.08)

10. At change of shift, I pay less attention to the alarms from patients.	5.9% (1)	47.1% (8)	35.3% (6)	11.8% (2)	0	2.53 (2.46)
Patient Care Technicians: Question 1	**0-6 Months**	**6-12 Months**	**1-3 years**	**4-6 years**	**> 6 years**	
1. How long have you worked on the HVU?	50% (5)	10% (1)	40% (4)	0	0	
Questions 2-10	**Never**	**Rarely**	**Occasionally**	**Usually**	**Always**	**Weighted Average (Pre-Implementation)**
2. Generally, I hear a certain amount of noise on the unit.	0	10% (1)	20% (2)	50% (5)	20% (2)	3.80 (4.00)
3. I believe much of the noise on the unit is from the alerts of the call lights, bed alarms, and chair alarms.	0	10% (1)	20% (2)	30% (3)	40% (4)	4.00 (4.17)
4. When alarms go off repeatedly, I become indifferent to them.	10% (1)	40% (4)	40% (4)	10% (1)	0	2.50 (2.83)
5. On some shifts the heavy workload on the unit prevents my quick response to alarms.	0	0	20% (2)	50% (5)	30% (3)	4.10 (4.17)
6. When I'm upset or nervous, I'm more responsive to alarm sounds.	10% (1)	50% (5)	20% (2)	10% (1)	10% (1)	2.60 (2.83)
7. Alarm sounds prevent me from focusing on my professional duties.	10% (1)	40% (4)	40% (4)	10% (1)	0	2.50 (2.00)
8. I pay more attention to the alarms on certain shifts.	30% (3)	40% (4)	20% (2)	10% (1)	0	2.10 (1.83)
9. When alarms go off repeatedly and continuously, I lose my patience.	10% (1)	30% (3)	40% (4)	20% (2)	0	2.70 (2.17)

10. At change of shift, I pay less attention to the alarms from patients.	40% (4)	40% (4)	10% (1)	10% (1)	0	1.90 (2.67)

Note: HVU = Heart Vascular Unit.

Table 3

Call Light Quantity Results on a Cardiovascular Unit

Time of Measurement	Call Light Count (*n*)
Pre-Implementation	53
Post-Implementation	54
Change	1.9% increase

Table 4

Documented Rate of Completed Hourly Rounds by Nursing Staff

Week of Project	N of Documented Hourly Rounds	Rate of Completion
Week 1	5,037	50%
Week 2	4,294	42/6%
Week 3	4,301	42.7%
Week 4	4,035	40%
Week 5	3,946	39.1%
Week 6	3,540	35.1%
Mean per Week	4,192	41.6%

Figure 1: Patient Care Delivery Model

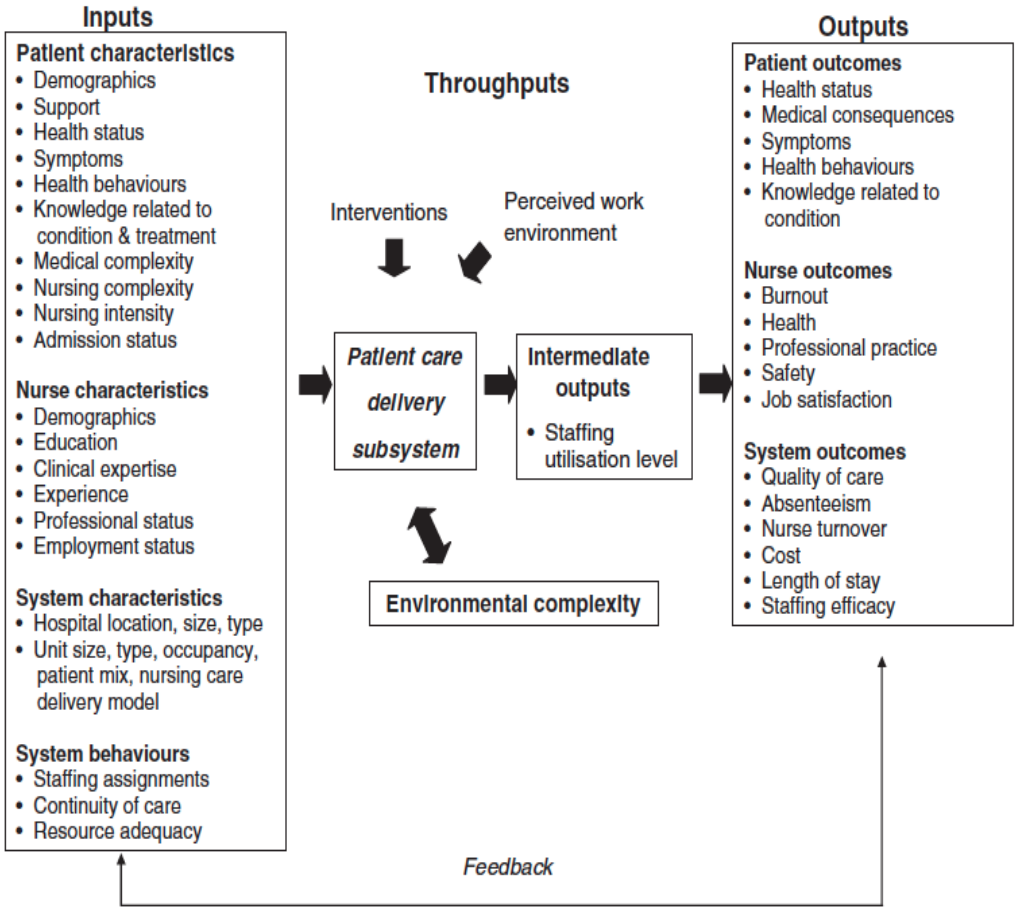

Figure 1: Patient Care Delivery Model (O'Brien-Pallas et al., 2010) utilized as the guiding theoretical framework for an alarm fatigue project.

Figure 2: Nursing Experience Among Pre-Implementation Assessment Respondents

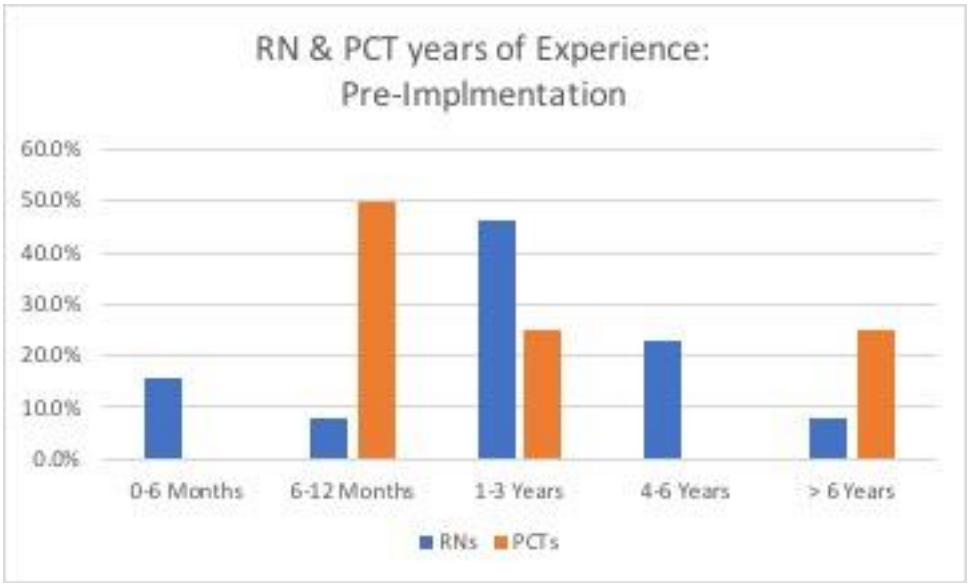

Figure 2: Years of professional experience reported by unit nurses and patient care technicians at baseline.

Figure 3: Nursing Experience Among Post-Implementation Assessment Respondents

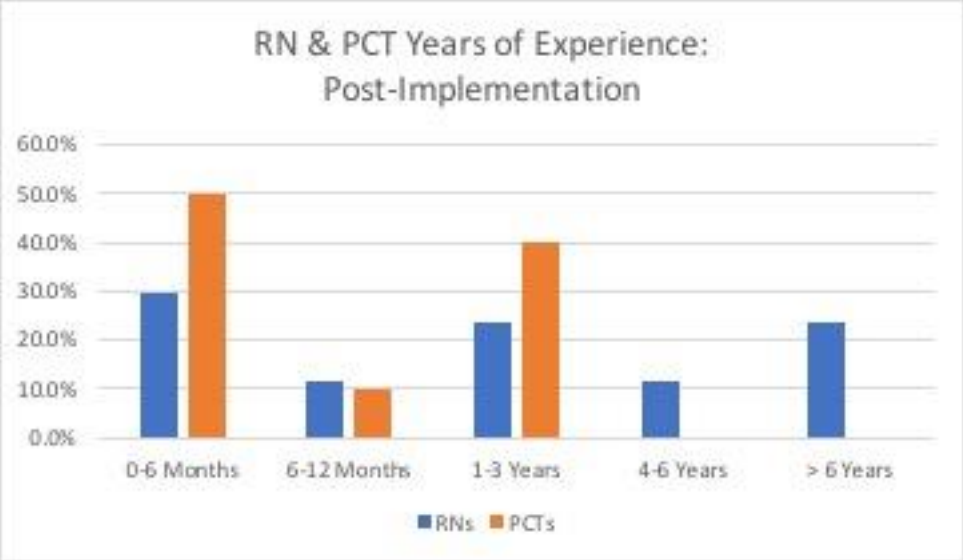

Figure 3: Years of professional experience reported by unit nurses and patient care technicians following implementation.

Appendix A

Alarm Fatigue Assessment

1. How long have you worked as a(n) RN/PCT on the Heart Vascular Unit?

0-6 months 6-12 months 1-3 years 4-6 years > 6 years

Please respond to the following questions on a scale of 1-5:

1 = Never 2 = Rarely 3 = Occasionally 4 = Usually 5 = Always

2. Generally, I hear a certain amount of noise on the unit.

3. I believe much of the noise on the unit is from the alerts of the call lights, bed alarms, and chair alarms.

4. When alarms go off repeatedly, I become indifferent to them.

5. On some shifts the heavy workload on the unit prevents my quick response to alarms.

6. When I'm upset or nervous, I'm more responsive to alarm sounds.

7. Alarm sounds prevent me from focusing on my professional duties.

8. I pay more attention to the alarms on certain shifts.

9. When alarms go off repeatedly and continuously, I lose my patience.

10. At change of shift, I pay less attention to the alarms from patients.

Adapted from "A nurses' alarm fatigue questionnaire: Development and psychometric properties," by C. Torabizadeh, A. Yousefinya, F. Zand, M. Rakhshan, & M. Fararooei, 2017, *Journal of Clinical Monitoring and Computing, 31*(6), pp. 1305-1312. The expressed written permission was obtained from its author Dr. Camellia Torabizadeh via email correspondence on March 29, 2018.

Appendix B

Hourly Rounding Tracking Form

Date: _____

Please place an "X" in the appropriate column after completing patient hourly rounds.

Hour	RN	PCT
0700		
0800		
0900		
1000		
1100		
1200		
1300		
1400		
1500		
1600		
1700		
1800		
1900		
2000		
2100		
2200		
2300		
2400		
0100		
0200		
0300		
0400		
0500		
0600		

Evidence Review Table

Author, year	Study objective/intervention or exposures compared	Design	Sample (N)	Outcomes studied (how measured)	Results	Level[a] and Quality[b] Rating
Krepper et al. (2014)	Determine whether using an educational program to implement the Standard Hourly Rounding Process (SHaRP) would increase quality and safety, patient satisfaction, and workflow productivity compared to compared to unregimented implementation process.	Quasi-experimental	Two cardiovascular units with 32 beds each Average day shift nurses *n* = 21 Average night shift nurses *n* = 17.	Efficiency of care delivery was measured as the number of call lights daily, number of steps taken by nurses, and nurses' subjective rating of adequate time with patients. Quality and Safety was measured by readmission rates and patient falls. Patient Satisfaction was measured via discharge phone calls which included two specific questions on hourly rounding, and the unit's monthly HCAHPS survey data.	Post-intervention, there were statistically significant fewer call lights on the intervention unit compared to the control unit ($p<.001$); however, an increase was seen in the overall quantity of call lights in both units during the 6-month study. There was no significant difference seen between units in overall steps taken ($p=.05$) or perceived quantity of patient contact time ($p=.06$). There was no significant difference in quality measures between the two units. No significant difference was seen in safety Overall, face validity was demonstrated for hourly rounding, with further research needed to identify best practices for such programs and its impact on outcomes.	II, A

Mitchell, M. D., Lavenberg, J. G., Trotta, R. L., & Umscheid, C. A. (2014)	Explore the frequency of call lights, patient satisfaction, and how this relates to nurses' clinical response, and evaluate the efficacy of current interventions to reduce false alarms.	Systematic Review Followed PRISMA guidelines.	16 published studies (Pre-post design n = 14; quasi-experimental n = 2)	The primary outcomes explored were patient satisfaction, frequency of call lights, falls, and nursing satisfaction. Varying methods of measurements were used among the studies appraised.	There was a significant reduction (by 23%-70%, median 54%) in the number of call light alarms across the 10 studies that measured this outcome. Overall moderate strength for this outcome. Patient satisfaction increased in nine of the 11 studies, with four of these higher rates being statistically significant; none of the studies found a reduction. Falls were reduced in nine studies, by 24% to 80 % (median 57%), with statistical significance in two studies. Overall moderate strength for this outcome. Greater positive outcomes were found when the rate was more frequent. in studies with more Studies found the more frequent intervals of hourly rounding had a proportional reduction in call lights.	I, B
Olrich, T., Kalman, M., & Nigolian, C. (2012)	Evaluate the effects of hourly nurse rounding on the use of call lights, fall rates, and patient satisfaction	Quasi-experimental study	All patients discharged from two medical-	Data on quantity of call lights measured pulled via	The quantity of call lights was initially statistically significant (p<.05), and the rate was	II, C

			surgical units (over one year) *n* = 4,418	information technology. Patient falls and satisfaction data per institutional reports and surveys.	increased at the 2-week point due to a confounding factor; when this is accounted for, the use of call lights at 2 and 4 weeks was significantly reduced. No significant change was detected at its conclusion, owing to its small sample size, as the power for conclusive statistical significance was challenging. Fall rate was lowered by 23% (*p*>.0672) Patient satisfaction was not statistically significant based on survey data (*p*=.383); however, anecdotal data from staff found improved satisfaction.	
Petras, D. M., Dudjak, L. A., & Bender, C. M. (2013)	Pilot protocol for nurse 2-hour rounding program, with an aim to reduce call lights, patient falls, and increase patient satisfaction.	Quality improvement project	Days of data collection: *n* = 23 Long term acute care hospital: *n* = 87	The practicality of implementing a program was a primary outcome that was achieved as efficacy was demonstrated (no explicit measurement). Call lights measured as totals per 12-hour day and night shift.	Increase frequency of rounding, every 2 hours, reduced the number of patient call lights from baseline by a small degree (average of 11.2 calls/24 period); also, when staff rounded more frequently, the improvement was incremental. There were four patient falls, which was a slight increase (by 1 episode),	III, B

				Falls were measured as number per month. Patient satisfaction was quantified per number of formal grievances filed, as tracked by the patient advocate.	compared to the average number before the study; however, the fall rate did not change significantly. and authors note an increase in unit census during this time. There was one patient grievance filed which was a reduction by four episodes from pre-intervention. A systematic hourly rounding method developed, with opportunities for further improvement and dissemination.	

Note: HCAHPS = Hospital Consumer Assessment of Providers and Systems

[a]Rating system classifies evidence in a hierarchy of strength in one of seven levels: Level I, Level II, Level III, Level IV, Level V, Level VI, or Level VII. [d]Johns Hopkins Nursing Evidence-based Practice Rating Scale classifies the quality of evidence in one of three levels: A, B, or C.