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Alarm Fatigue Prevention Benchmark Project

Lauren James
ljames13@patriots.uttyler.edu

Alarm Fatigue Prevention Benchmark Project

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Lauren James

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Executive Summary

Healthcare technology is constantly evolving to find ways to help provide better outcomes for patients. Clinical monitoring is technology that helps healthcare staff recognize deterioration of the patient which allows them to intervene earlier, which increases the patient's chance for survival. The monitors are connected to the patients to monitor vital signs such as heart rate, oxygen saturation, respirations, and blood pressures. They allow staff to get real time feedback of the patient's condition and determine if the patient is getting better or any interventions need to be done due to clinical deterioration.

However, all technology has setbacks and downfalls. Clinical monitoring is no exception. Staff that are around clinical monitoring can experience alarm fatigue due to the excessive noise and high frequency of false alarms. The fatigue can cause them to miss important alarms as they become conditioned to believe that the alarm is false. This can be very dangerous to patients as it can cause poor outcomes such as injury or death due to the lack of interventions.

1. Rationale for the Project

Alarm fatigue is an overexposure to the sounds created by monitoring system that eventually leads to desensitization from the noise and leads to missed alarms (Lewandowska et al,. 2020). Alarm fatigue can be dangerous to patients as staff may delay or miss responding to high priority alarms, which could cause the patient to experience adverse and/or sentinel events. Due to so many patient harm events being reported, the Joint Commission has made one of the patient safety goals to be "Reduce patient harm associated with clinical alarm systems" (TJC, 2021).

According to Lewandowska et al. (2020), the average number of alarms that are generated by one patient can be anywhere from 150-400. This means 35% of a nurse's time at work can be spent responding to alarms. Alarm fatigue is a safety issue for both staff and patients. Staff can become burnt out overtime due to the repeated stimulus and patient safety is compromised. Texas Children's Hospital has many different patients of all age with a variety of diseases. Many of them require clinical monitoring for staff to closely watch any changes. With patients of different ages with different disease processes, this can make monitoring difficult. Clinical monitors and order sets have a set of baseline parameters for different age groups. However, those parameters may not be appropriate for many patients as their baseline is not the same as what is programmed into the monitor/orders. There is also no standard on how to ensure that the placement of electrodes for the monitors will be the most effective and whether or not they need frequent changing to ensure effectiveness.

The current policy on alarm management is very vague. It states that physicians will set alarm parameters, while the primary caregiver of that patient is responsible for ensuring those parameters are inputted in the monitor and responding to all alarms. There are no guidelines on

what patients requiring monitoring and which ones do not. With the limited guidelines in the current policy, anyone admitted to the hospital could be put on clinical monitoring for however long the physicians see fit. There is also no specific training or education discussed in the policy. The only thing mentioned is s learn how to manage these monitors “on-the-job”. Therefore, they receive no formal education on how to manage monitors and alarms. Essentially, staff have to use “trial and error” to determine the most effective way to place electrodes. This shows that alarm management education is limited and vague as well.

Lewandowska et al. (2020) stated that many staff who are in charge of monitoring patients on clinical monitors feel that the lack of training they received contributes to false alarms and alarm fatigue. Due to this statement and the previous discussion of vague policy and education on clinical monitoring, it is recommended that staff receive more formal training and that the protocol is redone. The protocol needs to have guidelines to help staff determine who needs monitoring and how to monitor them.

2. Literature Synthesis.

Alarm fatigue is a widely known concept, but there is not a lot of data to help show what alarm fatigue actually looks like and how it effect patients and staff. To help researchers understand what alarm fatigue physically looks like, Bonafide et al. (2015) performed an observational study to help researchers gain understanding on alarm fatigue by measuring the response time of nurses exposed to high rates of non-actionable alarms. Paine et al. (2016) also conducted a systematic review that showed evidence of staff having decreased response time by due to increased alarm exposure. Winters et al. (2018) showed that alarm fatigue affected both patients and staff by staff having decreased response times and patients stated that they felt their monitoring was not accurate due to the number of false alarms. These studies were able to show

the effects of staff experiencing alarm fatigue and patients' perceptions of alarm fatigue due to a high frequency of nonactionable alarms.

To understand how staff personally perceive alarm fatigue, Petersen & Costanzo (2017) performed a qualitative survey. They were able to identify the staff felt that majority of clinical alarms were nonactionable and admitted to responding slowly to them, as well as sometimes turning them off. Similarly, in a systematic review conducted by Lewandowska et al. (2020) was able to establish that staff feel overwhelmed by the number of nonactionable alarms that go off and state that it interferes with patient care.

Many staff feel that their education is lacking when it comes to understanding alarm management. Alarm management is described as "interventions that help decrease alarm fatigue by decreasing the number of false alarms" (Bi et al., 2020). Through an integrative literature review Nyarko et al. (2022) was able to establish that many of nurses feel that they are not proficient in alarm management and that continuous education programs throughout employment were successful in decreasing alarm fatigue. Bi et al. (2020) performed a randomized clinical trial to show that a 12-week alarm management training based on the theory of planned behavior was effective in reducing staff alarm fatigue when compared to staff who did not receive training. Yousefinya et al. (2021) implemented both an education course and a manual for staff to refer to for alarm management instructions.

There is also the discussion of what are the most effective interventions for decreasing alarm fatigue. Paine et al. (2016) and Gul et al. (2023) performed a systematic review which focused on a combination of interventions to help decrease alarm fatigue. Both articles found that widening alarm parameters, implementing alarm delays, and using disposable electrocardiographic lead wires were most effective in decreasing alarm fatigue. Oster & Lewis (2019) established a quality improvement project called the CEASE bundle, which stands for

Communication, Electrodes (daily changes), Appropriateness (evaluation), Setup alarm parameters (patient customization), and Education (ongoing). They stated that the combination of all these interventions was effective in decreasing alarm fatigue by improving alarm accuracy.

Other articles focused on individual interventions to determine if they would be effective on their own. Yeh et al. (2020) was able to introduce an interdisciplinary team-based intervention to help decrease alarm fatigue where they were responsible for customizing patient parameters. for Chromik et al. (2022) placed the responsibility on technology performing the interventions rather than staff. They stated that IT-based solutions were effective in alleviating alarm fatigue.

3. Project Stakeholders

Stakeholders are vital when implementing projects. By determining who the stakeholders are, it will help determine the project's success. For this benchmark project, the stakeholders that will be directly involved in the success of it are healthcare staff (nurses, physicians), nurse educators, and management/administration. Firstly, management and administration are needed for approval and buy-in of the project. Educators will also need to be involved in buy in as they will be responsible to educating staff on alarm management. Physicians are responsible for putting in the orders for clinical monitoring and determining the parameters. Nurses would be responsible attending education sessions, putting patients on the monitors, and having discussions with physicians about the appropriateness of the monitoring.

Patient and their families are also considered stakeholders as they will be affected by the benchmark project. The purpose of this project is to increase patient safety. In a pediatric hospital, many families/patients have complained about the noises and/or delayed responses. Parents want their children to receive the best care possible but also rest at the same

time. Patients and their families will influence the success of the project through their perception of patient care on satisfaction surveys.

4. Plan for Implementation

The purpose of the project is to help eliminate alarm fatigue by increasing the accuracy of clinical monitors through decreasing false alarms. Research has shown that education on alarm management helps decrease alarm fatigue (Nyarko et al., 2022). Nurses who work in clinical care involving patient monitoring will be required to attend an educational course on clinical monitors. The course objectives will be based on Lewis & Oster's (2019) CEASE bundle. It will be required that all nurses will attend an in-person, education course within a month of being assigned. The course will be over the clinical monitors that will be used on the units and it will last approximately two hours. The course will include the following information:

a. Setting up clinical monitors for the ordered parameters

b. Prepping the patient

    i. Electrocardiogram (ECG)

        1. Change ECG electrodes daily or more often if needed – unless contraindicated due to skin breakdown

        2. Provide proper skin preparation

            a. Excessive hair should be clipped

            b. Clean skin with soap and water; dry with a towel before electrode application

ii. Pulse Oximeter

1. Change sensor as needed

2. Monitor for skin breakdown

c. At the start of every shift, discuss the appropriateness of clinical monitoring with the interdisciplinary team,

i. Does this patient require continued monitoring or can it be discontinued?

ii. Do the parameters need to be changed based on the patient's condition?

d. Make parameters above and below 10% of the patient baseline.

e. Pause alarms when performing care that would cause non-actionable alarms.

f. Documentation within the chart (*based on Lewis & Oster, 2019)*

i. Communication

1. Electrodes

a. Did RN change ECG electrodes and place correctly? Is excessive hair clipped; skin cleaned and dried with a towel before electrode application?

b. Did RN check the skin under the pulse oximetry sensor and change as needed?

2. Appropriate

   a. Did RN screen the patient for monitoring appropriateness?

   b. Did RN discontinue monitoring parameters when no longer needed?

3. Setup

   a. Did RN customize alarm parameters 10% of the patient's baseline based on physician orders.

Staff will also be encouraged to volunteer to be "super-users" and they will help troubleshoot the clinical monitoring systems. There will also be a tip sheet available on each unit for nurses to review and refresh their knowledge on what was learned in the course.

At the end of the course, there will be a survey to get feedback from the staff about the class. It will ask about things they considered helpful, unhelpful, information that could be eliminated from the course and information that could be expanded on. By taking this course, the goal is that false alarms will be decreased which will help increase alarm accuracy. This will help eliminate alarm fatigue. The course will also give staff the tools to initiate conversations of whether it is appropriate to continue to monitor the patient and if the parameters of the patient need to be changed depending on their condition.

Documentation will also be implemented into the chart. The staff will be responsible for charting at the beginning of the shift and with any changes made to the patient's clinical monitoring. After all required staff have gone through the education course, these interventions will be implemented in the clinical setting by these staff. After three months a survey will be sent

out to all clinical staff to determine if they felt these interventions were helpful or if they made any difference.

5. Timetable/Flowchart

At this time, the project is unable to be implemented within the hospital. However, the plan includes a timeline to help guide those who are able to implement the project. It would be best to implement this project at the time of yearly critical competencies. This would be during the month of July for Texas Children's. As previously stated, all employees will have one month from the date of when the education was assigned. The entire month of July is dedicated to critical competencies, so staff would need to complete the education by the end of July.

Three months after the deadline of the course, which would be September, a survey will be sent out for feedback on the interventions when being used in the clinical setting. Based on the results of the survey, policies will be created and implemented. The policy will include required documentation (as previously discussed) and it will be audited to determine whether staff are adhering to the interventions or not.

6. Data Collection Methods

As of right now, there is not a statistical way to measure alarm fatigue due to it being subjective (Claudio et al, 2021). Instead, we will have to measure the nurses/staff perception by using a qualitative survey of how they felt the interventions performed and whether or not they feel that their alarm fatigue decreased. The steps to evaluate this change's effectiveness will be:

a. Presurvey at the start of the education course to determine staff perceptions of alarm fatigue.
b. Three months after all staff have completed their education course, a survey will be sent out to determine if there are any changes in their perceptions.

c. Collect data between the two surveys to calculate the change in staff perception.

The two surveys that are sent out will be the same. They will be sent to employee's emails and they will require a mandatory response. The responses for the first part of the survey will be nine questions and will use a Likert scale. This will have the options for the person to choose strongly disagree, disagree, neutral, agree, and strongly agree. From there we will calculate the percentage of answers for each question, grouping strongly disagree and disagree together, and agree and strongly agree together. Neutral will be its own category. The second part of the survey will include a ranking choice question for staff to list the interventions that they feel were most effective. They will be rated on a scale from 1-5, with one being the most effective and five being the least.

7. Cost/Benefit Discussion

The cost of this project would be paying staff to attend the course. Every floor at Texas Children's has their own educator and they are on salary. Part of their jobs are to teach education courses and create, so there would be no additional cost to have them teach/create an alarm management course. All floors have the ability to care for patients on clinical monitors, so it is a matter of choosing who would be in charge of teaching. Staff pay is hourly and ranges, on average, anywhere from $30-$40 an hour. The hospital employes over 3,500 nurses and the course would last approximately two hours. This would mean the hospital would have to pay about $140,000 to compensate staff for attending the class. However, this would just be at the implementation of the education course. For new hires, it could be implemented into in-person orientation courses that they are already required to attend.

Although the cost seems steep starting out, the benefit will outweigh the risk. As alarm fatigue affects both patients and nurses, this is a necessary cost to the organization. Patient injury

that is found to be caused by the hospital requires the hospital to pay for care. Depending on how serious the injury is, the care could easily cost upward of what it would cost to have nurses attend the course. Decreased alarm fatigue will also help with staff retention, so the hospital will not have to spend money on hiring new staff to replace the ones that have left (Lewis & Oster, 2019).

8. Discussion of Results

To determine if the project was successful in decrease alarm fatigue, the results of the surveys will be looked at. After both surveys are completed, data will be collected and compared to see the difference in results before and after implementation. If there is an increase in staff response time and a decrease in alarm frequency according to staff perception, the project will be considered a success. The second part of the survey helps determine which interventions staff perceived to be the most effective. Through learning which interventions were most effective, future education courses can focus on those and emphasize the importance of them.

Conclusions/Recommendations

Clinical monitoring is an important tool that is needed in healthcare. Without it, patient clinical deterioration can be missed which is why it is important to decrease alarm fatigue among staff. Ultimately, these interventions are helpful in decreasing alarm frequency by making the clinical monitors more accurate. The alarm management interventions discussed are a great way to be proactive to ensure patient safety and making sure that nurses have the tools to be successful when caring for their patients. The results of the benchmark project should eventually lead to a more in-depth policy being created on alarm management.

Nurses become more confident and competent when given the tools to succeed. According to Nyarko et al. (2022) perceptions of alarm fatigue and clinical practice improved

greatly when nurses received training and education on alarm management. Both new hires and current employees need to receive specific, precise education on alarm management rather than learning it on the job through trial and error. Because of this, it is recommended that an alarm management course is developed and implemented.

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Appendix A

Synthesis Table

PICOT Question: In units where patient monitors (monitor oxygen saturations, heart rate/rhythm) are used (P) how does customizing parameters to meet the patients' needs and changing electrodes as needed (I) compared to using the preset parameters and/or not changing electrodes (C) affect the number of alarms being triggered and the staff's response time (O) during a 12-hour shift (T).

Evidence Synthesis Table

Studies	Design	Sample	Intervention	Outcome
A	Single Blind RCT	Experimental group (n = 47) Control group (n = 46)	12-week EC that included AM strategies (i.e., AC)	EG RAF and NA when compared to CG
B	Observational study that uses video	N= 36	HP AC EC	AF decreased
C	Literature review	N= 69	Using IT systems	RAF
D	Systematic and Meta-analysis	N=389	AC AM DAC ITBA Skin preparation	Combined results showed Weak effect on RAF

E	Systematic Review	N = 7	EC that included AM strategies	No changes in AF
F	Quasi-experimental study	N=74	CEASE	RAF and nurse perception of AF
G	Integrative review	N=13	EC	RAF and NA
H	Systematic Review	N = 12	RAF - Widening alarm parameters, implementing alarm delays, and using disposable electrocardiographic lead wires and changing electrodes daily	RAF and NA.
I	Observational Qualitative Study	n = 26	EC that included AM strategies	Decreased AF and increased PS
J	Systematic Review	N=62	EC AC DAC	RAF and NA
K	Cohort Study	n=24	ITBA AC	RAF
L	Quasi-experimental study	N= 60	EC that included AM strategies	RAF and increased RT

Legend: A = Bi et al, 2020., B = Bonafide et al., 2015, C = Chromik et al., 2022, D = Gul et al., 2023 E = Lewandowska et al., 2020, F = Lewis & Oster, 2019, G = Nyarko et al., 2023, H = Paine et al., 2016, I = Petersen & Costanzo, 2017, J = Winters et al., 2018, K= Yeh et al., 2020, L = Yousefinya et al., 2021; AC = alarm customization, AE = alarm exposure, AM = alarm management, AF = alarm fatigue, CEASE = Communication, Electrodes (daily changes), Appropriateness (evaluation), Setup alarm parameters (patient customization), and Education (ongoing), CA = computational approach, CG = control group, DAC = daily electrode changes, EC = education course, EG = experimental group, HP = hospital policy, ITBA = interprofessional team-based approach, NA = nonactionable alarms, PS = patient safety, RAF = reducing alarm frequency, RT = response time,

Outcomes Table: Effect of Interventions on Alarm Frequency

	A♦	B	C	D♦	E♦	F	G	H♦	I	J	K	L
AF	↓	UTE	↓	↓	NC	↓	UTE	NR	↓	UTE	↓	NC
NA	↓	↓	↓	↓	NE	↓	↓	↓	NE	↓	↓	↓
PS	↑	↑	NE	NE	↑	↑	NE	NC	↑	NC	NC	NR
RAF	↓	↓	↓	↓	NE	↓	↓	↓	NE	↓	↓	↓
RT	NR	↓	NE	NE	NE	NR	NE	NE	↑	↓	NE	↓

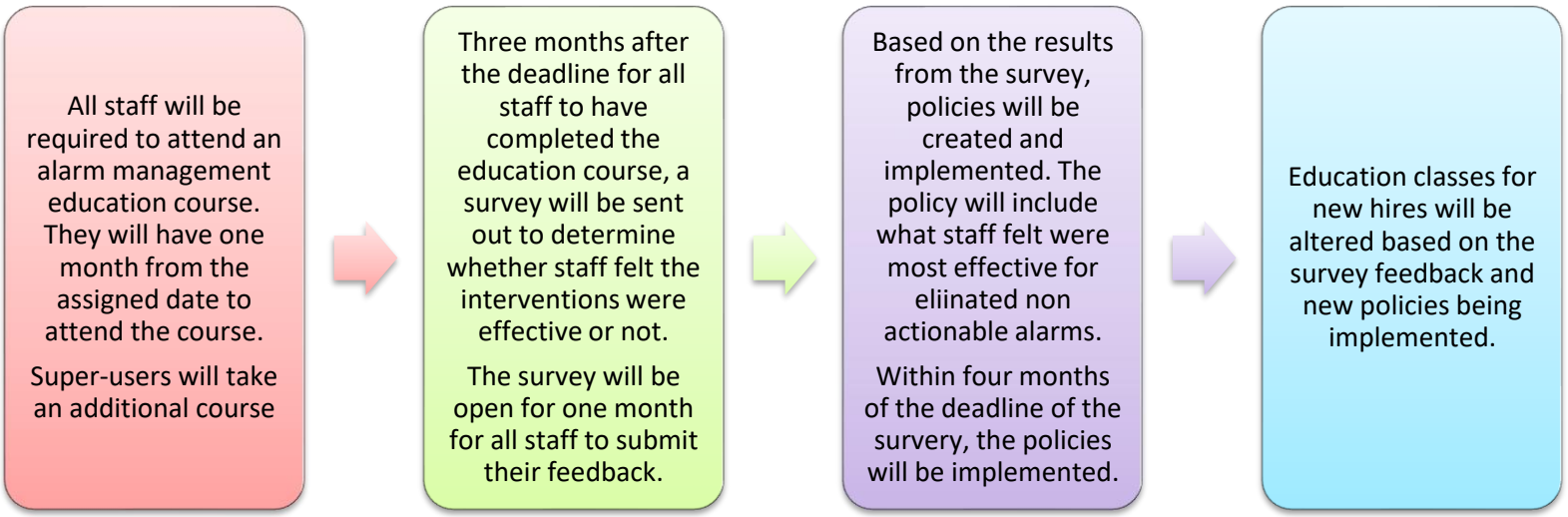
Legend: A = Bi et al, 2020., B = Bonafide et al., 2015, C = Chromik et al., 2022, D = Gul et al., 2023 E = Lewandowska et al., 2020, F = Lewis & Oster, 2019, G = Nyarko et al., 2023, H = Paine et al., 2016, I = Petersen & Costanzo, 2017, J = Winters et al., 2018, K= Yeh et al., 2020, L = Yousefinya et al., 2021; AF = alarm fatigue, NA = nonactionable alarms, NC = no significant change, NE = not evaluated, NR = no results provided, PS = patient safety, RAF = reducing alarm frequency, RT = response time, UTE – unable to evaluate

* = statistically significant findings

♦ = higher level evidence

Appendix B

Flowchart



Appendix C

Evaluation Tool

Alarms are important for patient safety.

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

When alarms frequently go off, I become indifferent to them.

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

When an alarm goes off, I respond promptly.

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

I feel that some patients on clinical monitors are being monitored unnecessarily.

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

Patient alarms occur frequently.

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

The majority of the alarms that go off are false or nonactionable.

- Strongly disagree
- Disagree
- Neutral

- Agree
- Strongly agree

Alarms interrupt patient care.

- Strongly disagree
- Disagree
- Neutral,
- Agree
- Strongly agree

Staff respond to alarms quickly.

- Strongly disagree
- Disagree
- Neutral,
- Agree
- Strongly agree

Rate items on a scale of 1-5, with 1 being most effective

1. Change ECG electrodes and/or pulse oximeter sensor daily or more often if needed – unless contraindicated due to skin breakdown

2. Provide proper skin preparation

3. Customize alarm parameters 10% of the patient's baseline based on physician orders

4. Communicating with the team does this patient require continued monitoring, or can it be discontinued?

5. Communicating if the parameters need to be changed based on the patient's condition.