Effect of Optimized Alarm Parameters on Frequency of Alarm Signal, Clinically Significant Events and Cardiac Arrests

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Introduction

In cardiac care units (CCU), monitors measure physiological changes such as heart rate and blood pressure, but often, alarms sound and no medical action is required. Physiological monitors produce high percentages (86%-99.4%) of false-positive alarms (Graham, 2010).

Frequent false alarms have many adverse effects. Commonly, alarm fatigue is experienced by nurses and as a result, when a true adverse event occurs and the respective alarm sounds, nurses may be slow to react, deem the alert non-actionable, or miss the alarm all together (Cvach, 2015).

In 2015, a pilot randomized controlled trial at John Hopkins was done to determine the effects of altered alarm settings on alarm frequency and the number of patient adverse events was published. The study showed a decrease in alarm frequency with no difference in the number of adverse events, including cardiac arrests and mortality (Cvach, 2015).

Expanding alarm parameters in the CCU could reduce false and non-actionable alarms, reduce alarm fatigue , and increase patient safety. If effective, the adjusted alarm parameter protocol could be expanded to other units that experience a high frequency of alarms.

Objectives

To determine the effect of optimized alarm parameters on cardiac arrests, frequency of CSE's and frequency of ETI's.

Materials and Methods

- Alarm parameters in the Queen's Medical Center CCU have been adjusted in accordance with research done at John Hopkins (Maria Cvach).
- Patient beds were given either optimized alarm parameters or standard alarm parameters using Quasi-Randomization.
- Patients and nurses are informed of the study, not of the randomization scheme.
- Consent from patients are waived due to infeasibility.
- Alarm parameters optimized: Bradycardia, Trigeminy, Heart Rate, Pulse Oximetry, and Non-Sustained Ventricular Tachycardia.
- Data collection occurs on all patients admitted into the CCU for the duration of one year (July 2018-June 2019).
- Alarm data is retrieved by Biomed staff from the Philips cardiac monitors and analyzed by a data analyst.
- Patient demographic data is retrieved from Carelink Database. Code-blue and cardiac data is retrieved from the Code Blue Database.
- Clinically significant event (CSE) and event triggered intervention (ETI) data is collected approximately three times a week from nurse interviews using a data collection sheet.
- Using SAS, a chi-square test will be done to evaluate differences in proportions and a t-test will be done to evaluate differences in means.

Setting	Study Protocol	Standard Protocol
Bradycardia	<50	<60
Trigeminy	On	Off
Hypoxia	<88%	<90%
Non-sustained V-Tach	On	Off

Table 1: Alarm setting protocol for adjusted and standard beds

Clinically Significant Event (CSE)
1. Hypotension
2. Hypertension
3. Apnea
4. Cyanosis
5. Hypoxia
6. Unintended Extubation
7. Arrhythmia
8. Combative Patient
9. Change in LOC/ Altered Mental Status
10. Seizure
11. Pain Crisis
12. Cardiac Arrest
13. Hypoglycemia
14. Other
15. Non-Applicable/Unknown

Table 2: List of CSE's used by research assistant to interview nurses on CSE's and ETI's

Clinically Significant Event Triggered Intervention
a. Notified prescriber
b. Stimulated patient
c. Suctioned patient
d. Repositioned patient
e. Ambu-bagged patient
f. Administered oxygen or increased levels
g. Called a code/RRT
h. Administered a new medication/changed dose
i. Patient intubated
j. Implemented new protocol
k. Changed patient diet
l. Other

Table 3: List of ETI's used by research assistant to interview nurses on CSE's and ETI's

Results

- 137 unique patients enrolled in the study
- 4 code blues (2 altered alarm settings, 2 standard alarm settings)
- 38 clinically significant events (CSE) occurred in 612 hours of monitoring
- On average, nurse interviews took less than a minute per patient

Discussion

- After the first 4 weeks of data collection, the feasibility to continue the study is clear.
- Numbers show adjusted alarm settings don't correlate to an increased frequency of adverse events. Therefore, patient safety isn't at risk.
- The majority of CSE's were identified by nurse observation, which can mean nurses are capable of independently identifying if a patient needs help nearly fifty percent of the time.
- Because more nurses customized the alarms for odd profiles, it is possible that the optimized settings are helping the nurses efficiently care for patients.
- The significance of the future findings would be proving that alarm parameters can be widened without negative impacts on patient care.
- New alarm setting protocols may possibly be implemented permanently.

	Standard Alarm Settings (odd bed number)	Optimized Alarm Settings (even bed number)
Total Possible CSE times	325	287
Number of Code Blues	2	2
Number of CSE's/hr of observation	.00646	.0592
Alerted via-		
Visual Alarm	7	3
Audible Alarm	3	1
Observation	11	13
Type of CSE-		
• Hypotension	3	0
• Hypertension	3	1
• Apnea	2	0
• Cyanosis	0	0
• Hypoxia	2	2
• Unintended Extubation	0	0
• Arrhythmia	7	3
• Combative Patient	1	0
• Change in LOC/ Altered Mental Status	0	3
• Seizure	0	3
• Pain Crisis	0	1
• Cardiac Arrest	0	0
• Hypoglycemia	0	0
• Other	3	4

Table 4: CSE data collected by nurse interviews over a 4 week period

Type of ETI	Number of Occurrences
• Notified prescriber	8
• Stimulated patient	1
• Suctioned patient	1
• Repositioned patient	0
• Ambu-bagged patient	0
• Administered oxygen or increased levels	7
•Called a code	1
•Administered a new medication/changed dose	15
• Patient intubated	2
• Implemented new protocol	0
• Changed patient diet	0
• Other	10

Table 4: ETI data collected by nurse interviews over a 4 week period

Limitations

Limitations of the research include the nurses' ability to personalize the alarms outside of the designated parameters which can make it more difficult to determine what caused the results. Also, data is collected exclusively from the Queen's Cardiac CCU which combines a medical and surgical ICU as well as a telemetry unit. Results could vary for other medical units, but expanding the study to other major hospitals in the U.S. and replicating the study in other units will add to the validity of the findings.

Conclusions

- The results show a decrease in the frequency of CSE's when adjusted to optimized. This agrees with the hypothesis that there is an effect of adjusted alarms on alarm signals and adverse events.
- The frequency of cardiac arrests were equal for the optimized and standard alarm setting beds which implies that adjusting alarm settings would be a safe way to reduce frequency of alarms and alarm fatigue.
- The data agrees with previously published studies that have done research on a smaller scale and together, hospitals can benefit by creating a plan to maximize efficiency in the cardiac critical care units as well as expand to other units.

Literature cited

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For further information

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