The Effect of Optimized Alarm Parameters on Frequency of Alarm Signals, Clinically Significant Events, Cardiac Arrests and Mortality

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Introduction

- Cardiac telemetry devices monitor a patient's physiology and alert healthcare providers of any deviations from their standard health parameters (Cvach et al. 2015)
- **~80-90% of clinical alarms are false or non-actionable** (Bach et al., 2018).
- The plethora of false alarms generates a "cry wolf" effect known as **alarm fatigue** (Drew et al., 2014)
- A proposed standard method of reducing false alarms is enhancing alarm parameters with more optimal margins. This could potentially be used to reduce preventative deaths based on observed health conditions per population.
- **This study will investigate the effects of modified alarm settings on the frequency of actionable clinically significant events (CSEs) and cardiac arrests.**

Results

- Data was collected for a monitoring period of 1,840 hours among 444 patients.
- There were a greater number of ODD profile standard alarm settings patients compared to EVEN profile modified alarm settings patients enrolled in the study.
- **The most common types of CSEs were hypotension, hypoxia and arrhythmia.**
- **The most common ETIs were "notified prescriber", "administered oxygen or increased levels" or "administered a new medication/changed dose".**
- **5 code blues occurred among ODD standard settings and 3 code blues occurred among EVEN modified settings.**

Discussion

- **The results show a greater percentage of CSEs per hour among EVEN modified settings (4.30%) compared to ODD standard settings (3.55%).**
- **A p-value of 0.407 was generated, showing no significant difference between the frequencies of CSEs among standard settings and modified settings.** Therefore, the number of CSEs were not necessarily more frequent in one alarm setting over the other. In addition, many of the CSEs were observed by the nurses rather than diagnosed by visual or audible monitor alerts. These observed events do not necessarily indicate the effectiveness of the modified alarm settings

	Standard Alarm Settings (ODD Profile)	Modified Alarm Settings (EVEN Profile)
Total Possible CSE Times (hours)	957	883
Total Number of CSEs	34	38
Number of Code Blues	5	3
Number of CSEs/hr of observation	0.0355	0.0430
	p-value= 0.407 (not significant p>0.05)	
Type of Alert:		
Visual	9	11
Audible	10	13
Observation	16	25

Table 4: Number of possible CSEs,, total number of CSEs and types of alerts that occurred between standard and modified alarm settings

- There is reason to continue collecting data since the modified alarm settings do not endanger patient safety. There were a fewer number of adverse events among the modified alarm settings rather than the standard alarm settings. In addition, throughout the study nurses were still able to individualize alarm settings to their patients. However, fewer modified alarm settings were customized compared to standard alarm settings. This suggests that the modified alarm settings are potentially more representative of the patient population

Methodology

- Randomized- control study of 50 beds in Queen Emma Tower 6 Diamond Head and Ewa wings, Tower 3 Cardiac Comprehensive Care Units (CCU).
- The population of patients studied were cardiac and surgical recovery patients on telemetry monitors.
- The study uses data collected from July 3- August 3, 2018 and June 12- July 16, 2019 (10-weeks) for 4-hours, 3-days a week for the duration of the study.
- Odd beds contained standard Queen's Hospital parameters, and even beds contained modified alarm settings from the Cvach et al protocol.
- To retain randomity each patient's consent was waived under IRB approval
- Each hour the nurse assigned to each patient[s] was asked if any Clinically Significant Events (CSE) had occurred (Table 2).
- If a CSE occurred the nurse reported how his/her event triggered intervention (ETI) response (Table 3).
- The nurse also reported whether a visual, audible or observed alarm initiated his/her response, and the type of alarm that alerted the event (i.e. BP, Tachy, Brady, SpO2, etc.).
- A statistical calculator was used to compare the significance in frequency of CSEs between the two settings. A p-value was generated from the data to illustrate this significance based on correlation.

	Modified Setting (EVEN Profile)	Standard Setting (ODD Profile)
Bradycardia	50	60
Non-sustained V- Tach	Off	On
V. Trigeminy	Off	On
Hypoxia	88%	100%

Table 1: Differences between EVEN modified alarm settings developed by Cvach et al. study and ODD Queen's Medical Center standard alarm settings.

Clinically Significant Events (CSEs)
1. Hypotension (requiring call to a prescriber)
2. Hypertension (requiring call to a prescriber)
3. Apnea
4. Cyanosis
5. Hypoxia (requiring supplemental/ change in O_2)
6. Unintended Extubation
7. Arrhythmia
8. Seizure
9. Change in LOC/ Altered Mental Status
10. Combative Patient
11. Pain Crisis
12. Cardiac Arrest (Code)
13. Hypoglycemia
14. Other
15. Not Applicable/ Unknown

Table 2: Classified clinically significant events (CSEs) used during data collection

Clinically Significant Event Triggered Interventions (ETIs)
A. Notified prescriber
B. Stimulated patient
C. Suctioned patient
D. Repositioned patient
E. Ambu-bagged patient
F. Administered oxygen or increased level of oxygen
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: Event triggered interventions (ETIs) made by nurses in response to CSEs

Conclusion

The results show a greater frequency of CSEs among the modified alarm settings compared to the standard alarm settings. However due to little significance in correlation, no definitive conclusions can be drawn surrounding the difference in effectiveness of the alarm settings. In addition, due to the relatively low number of CSEs and adverse events further data collection must be performed in order to attain greater certainty in the study. The results were similar to Cvach et al. study and reinforces the feasibility of the protocol in measuring the effectiveness of the modified settings. The reduction of alarm customizations among modified alarms settings could indicate a more practical set of parameters for monitoring patients. With further data collection, these modified settings could potentially reduce the prevalence of non-actionable alarms and alarm fatigue.

Acknowledgements/More Information

For more information contact: katriel@hawaii.edu or scan the QR code for the full report

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