Contact-Free Under-the-Mattress Monitoring for Early Recognition of and Response to Clinical Deterioration in Medical/Surgical Units

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Objectives

To determine the effects of continuous patient monitoring using the EarlySense contact-free monitor in a medical-surgical unit on RRT calls and code blue activations for patients initially admitted to non-ICU units.

Introduction

- Delayed or suboptimal intervention for inpatients with unexpected clinical deterioration is associated with increased morbidity and mortality.
- It has been established that patients frequently demonstrate clinical signs of deterioration **hours before** cardiac/respiratory arrest or urgent transfers to intensive care units (ICU).
- The EarlySense™ system is a **contact-free** piezoelectric sensor placed under the mattress that provides validated accurate **continuous** measurement of heart rate, respiration rate, and movement.

Methods

- The study was a double-controlled group study conducted on the medical-surgical service of a 316 bed urban acute care community hospital.
- EarlySense monitors were implemented in a 33-bed medical-surgical unit including bed side monitors, central nurse station display and pagers for nurses.
- A 9-month prospective intervention period (Nov 09'-July 10') and a 9-month retrospective baseline period (Jan 09'-Sep 09') were compared for primary and secondary outcomes. Monitoring was performed in one unit (study unit) while a similar "sister" unit served as a control unit for the two time periods.
- Patient charts were reviewed by research nurses for co-morbidity, acuity level and study outcomes. Other study variables were collected through the hospital's administrative systems.
- In addition, since code blue activations were scarce, and in order to enhance power of statistics – data regarding code blue events, was collected for whole 3 years 2009-2011 (inclusive).

Table 1:

Demographics and baseline acuity and co-morbidity for the four patient groups. (* acuity level – based on a hospital acuity score, range 1-4)

Demographics	Control Unit (CU)			Study Unit (SU)			CU Vs. SU (post)
	Baseline (pre)	Control (post)	p Value	Baseline (pre)	Intervention (post)	p Value	p Value
Patients(N)	1535	2361		1433	2314		
Age (SD)	49.8 (19.6)	49.6 (20.3)	0.76	49.5 (19.6)	49.3(19.9)	0.73	0.50
% Males	46.2	45.0	0.57	44.5	48.9	0.04	0.08
Acuity level*	2.87	2.86	0.36	2.82	2.83	0.70	0.14
Charlson score	1.81	1.85	0.62	1.84	1.80	0.61	0.50

Results

- Overall, 7,643 patients participated in the study, 2,314 of them were monitored using the EarlySense monitor. Demographics and baseline clinical information is presented in Table 1.
- In the study unit, **RRT calls** per 1000 patients, decreased significantly after intervention from **10.5** → **5.6**. Relative risk of RRT call was 0.54 compared to baseline p=0.07, *see Table 2*.
- Number of code blue events did not change significantly, however the outcomes improved with intervention. Percentage of patients that stayed in the unit, after coding, increased from 18.8% → 55.6% (p=0.08 Fisher's exact test). Transfers to ICU and death decreased during intervention by a factor of 3.38 and 1.31 respectively. *See Table 3*.

Table 2:

Summary of RRT calls and outcomes Control unit Vs. Study Unit before and after EarlySense systems installation. There was a significant decrease in RRT calls before and after intervention p=0.07 (Fisher's exact test).

RRT Calls	Control Unit (CU)			Study Unit (SU)			CU Vs. SU (post)
	Baseline (pre)	Control (post)	p Value	Baseline (pre)	Intervention (post)	p Value	p Value
Calls/1000pt (N)	7.2 (11)	6.8 (16)	0.52	10.5 (15)	5.6 (13)	0.07	0.38
Stayed in unit	5 (45.5%)	6 (37.5%)		4 (26.7%)	3 (23.1%)		
Relative risk (CI)	0.95 (0.44, 2.03)			0.54 (0.26, 1.12)			0.83 (0.40, 1.72)

Conclusion

- **Contact-free under-the-mattress** sensors allow **continuous** monitoring of patients without intervening with normal proceedings on medical and surgical units.
- We hypothesized that **continuous** monitoring might result in earlier recognition of patient deterioration and earlier intervention of RRTs and code-blue teams.
- A reduction in number of RRT calls, as well as higher survival rate in code-blue events, were associated with the use of continuous monitoring.
- Continuous monitoring of heart, respiratory and movement rates can provide early warning signs of deterioration allowing early intervention by Rapid Response or Code Blue Teams resulting in improved patient outcomes

Table 3:

Summary of code blue activations and outcomes for the years 2009-2011. The distribution of outcomes is significantly different at the level p=0.08 (Fisher's exact test).

Code Blue	Reference	Intervention	Relative Risk
No. of events	16	9	
Expired	6 (37.5%)	1 (11.1%)	0.30 (p=0.17)
Transferred to ICU	7 (43.8%)	3 (33.3%)	0.76 (p=0.47)
Stayed in unit	3 (18.8%)	5 (55.6%)	2.96 (p = 0.08)