Electronic Integrated Monitoring of Medical Emergency Team Calls to a Step Down Unit

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BACKGROUND

Early discharge from intensive care units (ICUs) to lower acuity monitoring units (step-down units or SDUs) is increasing, placing sicker patients in less well staffed units. The hope is that this will improve throughput of care.

However, the ability of minimally invasive monitoring via electronic integrated monitoring systems (IMS) in SDUs to identify cardio-respiratory instability in order to activate Medical Emergency Treatment (MET) team response is unknown.

HYPOTHESIS

Non-invasive monitoring when coupled to an IMS to derive an illness index will detect clinically significant cardiorespiratory events requiring MET team activation earlier than presently occurs

METHODS

Following approval by the Patient Safety Committee, data were collected in a blinded fashion for 8 weeks from all patients in a 24 bed surgical-trauma SDU

De-identified physiologic monitoring data were transmitted from each bedside monitor to an accompanying BioSign™ monitor

Data were collected from BioSign™ monitors, an IMS which uses 4 parameters (heart rate [HR], respiratory rate [RR], blood pressure [BP], and peripheral oxygen saturation [SpO_2]), to develop a single neural networked signal, the BioStatus Index (BSI)

Data were also collected from Condition C (MET activation) records

Data were analyzed (descriptive) for patient deterioration according to both the BSI trigger value and local MET activation criteria

METHODS

Example of the BioSign™ screen (blinded in this phase) developing a single physiologic index value

RESULTS

333 patient admissions were evaluated

Reflecting 18,692 hours of continuous monitoring

SpO_2 monitoring data were absent in 38.5% of monitored hours, despite SpO_2 monitoring being mandatory

Most patients were stable throughout their SDU stay

MET activations occurred on 10 occasions:

7 Cardiorespiratory Cause

- **4 respiratory cause (2 SpO_2, 2 SpO_2 + RR)**
- **2 cardiac cause (2 BP)**
- **1 mixed cardiorespiratory**

3 Other Cause

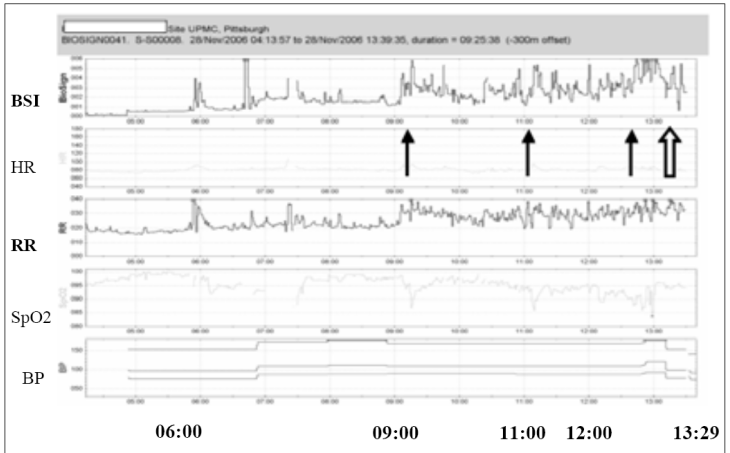
- **1 chest pain, 2 acute mental status change**

RESULTS

All 7 MET activation events of respiratory and/or cardiac cause were detected by BSI in advance of MET activation

Mean advanced detection time prior to MET activation was 6.33 hours

Cardio-respiratory deterioration was generally characterized by progressive increases in BSI over time rather than step increases



Example of physiologic data trends of patient who had Condition C called at 13:29

CONCLUSION

Continuous monitoring of physiologic variables on an SDU is less than mandated. Efforts need to be taken to create conditions wherein defined quality practices are done.

In those monitored, cardiorespiratory deterioration requiring MET activation was uncommon but was preceded by integrated monitoring system index values in danger range prior to activation of METS activation.

Use of integrated physiological variable monitoring may improve nursing staff performance at identification of unstable patients in non-ICU environments.

UPMC Presbyterian CRITERIA FOR INITIATING "CONDITION C" (CRISIS) Medical Emergency Treatment*

RESPIRATORY:
- Rate <8 or >36
- New Onset Difficulty Breathing
- New Pulse Oximeter Reading < 85% for > 5 minutes (unless patient known to have chronic hypoxemia).
- New requirement for >50% supplemental oxygen to keep SpO2 > 85%

HEART RATE:
- <40 or >140 with new symptoms; or any rate >160

BLOOD PRESSURE:
- <80 OR >200 systolic or 110 diastolic with symptoms (neurologic change, chest pain, difficulty breathing)

ACUTE NEUROLOGIC CHANGE:
- Acute loss of consciousness
- New onset lethargy or difficulty wakening
- Sudden collapse
- Seizure (outside of seizure monitoring unit)
- Sudden loss of movement (or weakness) of face, arm or leg

OTHER:
- >1 STAT page required to assemble team needed to respond to a crisis
- Patient complaint of (cardiac) chest pain (unresponsive to nitroglycerine, or MD unavailable)
- Color change (of patient or extremity): Pale, dusky, gray or blue
- Unexplained agitation of > 10 minutes
- Suicide attempt
- Uncontrolled bleeding
- Bleeding into airway
- Narcan use without immediate response
- Large acute blood loss
- Crash cart must be used for rapid delivery of meds

DeVita et al. *Qual Saf Health Care* 2004; 13: 251-4

Simplistic Explanation

- **An early warning system that is weighted and automated through neural networking, data fusion algorithmic processes. Able to recognize changes from normality (defined by a training set).**
- **Alerts for a single parameter deviating by + 3 SD from "normal" value in the training set, or 2-3 parameters moving away from normality by a smaller amount.**
- **Filtered for noise; requirement for temporal persistence (i.e. 4 out of previous 5 minutes)**

Tarassenko L. Hann A. Young D. Integrated monitoring and analysis for early warning of patient deterioration. *British Journal of Anaesthesia*. 2006; 97(1):64-8.

"Artificial neural networks are computational tools comprised of a number of highly interconnected elementary processors or cells. Most of their utilization is pattern recognition, prediction, optimization, and classification. Their main property is the ability to learn by experience. Each cell is in fact characterized by a transfer function which processes its input information, and its output is directed to other connected cells after bring weighted. Neural networks build their own representation of the problem they face."