

## RESEARCH IN BRIEF

**Nursing assessment of continuous vital sign surveillance to improve patient safety on the medical/surgical unit**

Terri Watkins, Lynn Whisman and Pamela Booker

**Aims and objectives.** Evaluate continuous vital sign surveillance as a tool to improve patient safety in the medical/surgical unit.

**Background.** Failure-to-rescue is an important measure of hospital quality. Patient deterioration is often preceded by changes in vital signs. However, continuous multi-parameter vital sign monitoring may decrease patient safety with an abundance of unnecessary alarms.

**Design.** Prospective observational study at two geographically disperse hospitals in a single hospital system.

**Methods.** A multi-parameter vital sign monitoring system was installed in a medical/surgical unit in Utah and one in Alabama providing continuous display of SpO<sub>2</sub>, heart rate, blood pressure and respiration rate on a central station. Alarm thresholds and time to alert annunciations were set based on prior analysis of the distribution of each vital sign. At the end of 4 weeks, nurses completed a survey on their experience. An average alert per patient, per day was determined retrospectively from the saved vital signs data and knowledge of the alarm settings.

**Results.** Ninety-two per cent of the nurses agreed that the number of alarms and alerts were appropriate; 54% strongly agreed. On average, both units experienced 10.8 alarms per patient, per day. One hundred per cent agreed the monitor provided valuable patient data that increased patient safety; 79% strongly agreed.

**Conclusions.** Continuous, multi-parameter patient monitoring could be performed on medical/surgical units with a small and appropriate level of alarms. Continuous vital sign assessment may have initiated nursing interventions that prevented failure-to-rescue events. Nurses surveyed unanimously agreed that continuous vital sign surveillance will help enhance patient safety.

**Relevance to clinical practice.** Nursing response to abnormal vital signs is one of the most important levers in patient safety, by providing timely recognition of early clinical deterioration. This occurs through diligent nursing surveillance, involving assessment, interpretation of data, recognition of a problem and meaningful response.

**What does this paper contribute to the wider global clinical community?**

- Provides examples of nursing interventions in response to continuous vital sign monitoring that may improve patient safety.
- Demonstrates that multi-parameter vital sign surveillance can be accomplished in a medical/surgical unit with an alarm rate acceptable to nurses.

**Authors:** Terri Watkins, MSN, Castleview Hospital (LifePoint Health), Price, UT; Lynn Whisman, BSN, MBA, FACHE, Vaughan Regional Medical Center (LifePoint Health), Selma, AL; Pamela Booker, MSN, CNOR, LifePoint Health, Brentwood, TN, USA

**Correspondence:** Pamela Booker, MSN, CNOR, LifePoint Health, 330 Seven Springs Way, Brentwood, TN 37027, USA. Telephone: +1 615 920 7557.

**E-mail:** Pam.Booker@lpnt.net

This is an open access article under the terms of the Creative Commons Attribution-NonCommercial-NoDerivs License, which permits use and distribution in any medium, provided the original work is properly cited, the use is non-commercial and no modifications or adaptations are made.

**Key words:** alarm fatigue, failure-to-rescue, nursing interventions, patient monitoring, patient safety, vital signs

Accepted for publication: 27 September 2015

## Aims

Improving patient safety is an important focus of nursing leadership. The aim of this study was to assess nursing experience with continuous vital sign monitoring as a method for improving patient safety in the medical/surgical unit.

## Background

Failure-to-rescue (FTR) is defined as the number of deaths in patients who develop postoperative complications and is one of the metrics recommended by the National Quality Forum as a measure of hospital quality ([www.qualityforum.org/QPS](http://www.qualityforum.org/QPS)). High FTR rates and delayed escalation of care are influenced by the recognition of patient deterioration followed by communication of patient deterioration to implement appropriate care (Johnston *et al.* 2015). It has been demonstrated that there are clear signs of patient deterioration hours before events such as cardiopulmonary arrest (Schein *et al.* 1990). Regular assessment of multi-parameter vital signs has been shown to be important in identifying patients at risk for serious adverse events, allowing time for nursing interventions to prevent FTR (Storm-Versloot *et al.* 2014). One of the concerns of implementing continuous, simultaneous monitoring of multiple vital signs is an abundance of unnecessary audible alerts which interrupt nursing work flow and decrease, rather than improve patient safety (Graham & Cvach 2010). The purpose of this study was to investigate the impact of continuous, noninvasive, multi-parameter vital sign monitoring on nurses' assessment of patient safety.

## Design

This was a prospective, observational study at two geographically dispersed hospitals in a single hospital system.

## Methods

A continuous vital sign monitoring system (Sotera Wireless Inc., San Diego, CA) was installed in a med/surg unit in a 49-bed acute care facility in Utah (Unit 1) and a med/surg unit in a 175-bed full-service hospital in Alabama (Unit 2). The monitoring system provided continuous display of SpO<sub>2</sub>, heart rate (HR), systolic and diastolic blood pressure

(BP) and respiration rate (RR) on a central station. Measurements and waveforms were sent wirelessly to a central server for retrospective analysis of alarm rates. Nurses received formal training in the use of the system for continuous monitoring of their patients' vital signs prior to initiation of this study. Alarm thresholds and time to alert annunciations were set based on prior analysis of the distribution of each vital sign.

Nurses in each unit kept a log of interventions performed in response to alerts issued by the monitoring system. At the end of 4 weeks, nurses were asked to complete a survey on their experience using the monitor. The nurses were asked if they strongly agreed, agreed, were neutral, disagreed or strongly disagreed with 12 statements. Three of the statements focused on patient safety (Table 1).

Responses to the patient safety survey were tabulated in aggregate for both hospitals. Nursing leadership reviewed the intervention logs and identified interventions that may have prevented serious complications. An average alert per patient, per day was determined retrospectively from the vital signs data saved on the server and knowledge of the alarm settings.

## Results

In Unit 1, monitors were installed at 16 beds, and 123 patients were monitored. In Unit 2, monitors were installed

**Table 1** Survey statements related to patient safety

The number of alarms/alerts was appropriate.
Being able to view my patient's posture from the central station increased his/her safety.
I am satisfied with the performance of the monitor and believe it provides valuable data that will enhance patient safety.

**Table 2** Average number of alarms/patient/day for multi-parameter monitoring

	Unit 1	Unit 2
Blood Pressure	1.5	4.1
Heart Rate	4.6	3.4
Respiration Rate	0.5	1.1
SpO <sub>2</sub>	3.0	3.2
Total	9.7	11.8

**Table 3** Examples of alert-initiated interventions

	Intervention
Blood Pressure	The nurse received a low BP alert after the first dose of a new drug was given. The physician was notified, additional testing done and the drug was discontinued.
Heart Rate	The nurse was alerted with a high HR alarm and the physician was notified. The patient was diagnosed with new atrial fibrillation and medically treated.
Respiration Rate	The nurse received a RR alert for a patient requiring CPAP. On visiting the patient's room it was discovered that the CPAP equipment had failed, resulting in a call to repair the equipment.
SpO <sub>2</sub>	The nurse was alerted to a low SpO <sub>2</sub> (69%). On examination it was determined that the patient had removed the O <sub>2</sub> cannula to go to the bathroom and did not replace it. The patient and family were educated on the importance of keeping the O <sub>2</sub> on and an extension tube was provided to allow the patient to reach the bathroom without removing the cannula.

at 24 beds, and 113 patients were monitored. Each patient was monitored for an average of 3 days. A total of 24 nurses completed the survey, 16 in Unit 1 and eight in Unit 2.

Ninety-two per cent (92%) of the nurses agreed that the number of alarms and alerts were appropriate; 54% strongly agreed. The actual numbers of alarms for both units are shown in Table 2. On average, both units experienced 10.8 alarms per patient, per day.

One hundred per cent of surveyed nurses agreed that posture information helped increase patient safety; 75% strongly agreed. One hundred per cent agreed the monitor provided valuable patient data that increased patient safety; 79% strongly agreed.

Table 3 shows examples of interventions resulting from system alerts that the nursing team identified as having a significant impact on patient safety.

## Conclusions

This study demonstrated that continuous, multi-parameter patient monitoring could be performed on medical/surgical units with a small and appropriate level of audible alerts.

Continuous vital sign assessment may, in some cases, have initiated nursing interventions that prevented failure-to-rescue events. Nurses surveyed unanimously agreed that continuous vital sign surveillance will help enhance patient safety.

## Relevance to clinical practice

Nursing response to abnormal vital signs is one of the most important levers in patient safety, by providing timely recognition of early clinical deterioration. This occurs through diligent nursing surveillance, a process involving assessment, interpretation of data, recognition of a problem and meaningful response (DeVita *et al.* 2011). Continuous noninvasive vital sign monitoring combined with meaningful alarm notification, enables nurses to move beyond intuitive judgment to evidence-based practice, using physiological trended data for timely intervention, at the earliest signs of deterioration. Analysis of nursing intervention to alarms and abnormal vital signs will generate new knowledge on how best to identify and respond to early signs of deterioration. This will, in turn, improve safety and advance nursing practice.

## Acknowledgements

We would like to thank Kerry Blakely and Tara Garcia for providing the training on the monitoring system and their assistance in developing the Nurse Survey questions. We are grateful to Brooke Skora for her assistance in determining the alarm rates.

## Funding

Sotera Wireless provided assistance in the development of the nursing survey and determination of the alarm rates.

## Contributions

Study design: PB, TW, LW; Data collection and analysis: PB, TW, LW; Manuscript preparation: PB, TW, LW.

## Conflict of interest

The authors have no conflicts to disclose.

## References

- DeVita MA, Hillman R & Bellomo K (2011) *Textbook of Rapid Response Systems, Concepts and Implementation*. Springer, New York.
- Graham KC & Cvach M (2010) Monitor alarm fatigue: standardizing use of physiological monitors and decreasing nuisance alarms. *American Journal of Critical Care* **19**, 28–34.
- Johnston MJ, Arora S, King D, Bouras G, Almoudaris AM, Davis R & Darzi A (2015) A systematic review to identify the factors that affect failure to rescue and escalation of care in surgery. *Surgery* **157**, 752–763.
- Schein RMH, Hazday N, Pena M, Ruben BH & Sprung CL (1990) Clinical antecedents to in-hospital cardiopulmonary arrest. *Chest* **98**, 1388–1392.
- Storm-Versloot MN, Verweij L, Lucas C, Ludikhuize J, Goslings JC, Legemate DA & Vermeulen H (2014) Clinical relevance of routinely measured vital signs in hospitalized patients: a systematic review. *Journal of Nursing Scholarship* **46**, 39–49.