Mandatory early warning scoring—implementation evaluated with a mixed-methods approach ☆

Gitte Bunkenborg, ICRN, PhD [a,b,*], Ingrid Poulsen, RN, PhD [c], Karin Samuelson, RNANIC, PhD [d], Steen Ladelund [e], Jonas Åkeson, MD, PhD [b]

[a] Department of Anaesthesiology, Copenhagen University Hospital, Hvidovre, Denmark
[b] Department of Clinical Sciences Malmö, Anaesthesiology and Intensive Care Medicine, Lund University, Skåne University Hospital, Malmö, Sweden
[c] Department of Neurorehabilitation, TBI Unit, Copenhagen University Hospital, Glostrup, Denmark
[d] Department of Health Sciences, Lund University, and the Intensive Care Unit, Skåne University Hospital, Lund, Sweden
[e] Clinical Science Centre, Copenhagen University Hospital, Hvidovre, Denmark

ARTICLE INFO

ABSTRACT

Aim: The aim of this study was to evaluate adherence to an intervention optimizing in-hospital monitoring practice, by introducing early warning scoring (EWS) of vital parameters.
Background: Interventions comprising EWS systems reduce in-hospital mortality, but evaluation of adherence to such interventions is required to correctly interpret interventional outcome.
Method: Adherence was evaluated with a mixed-methods approach. Quantitative data, obtained pre-interventionally (2009) and postinterventionally (2010 and 2011), were used to calculate and compare time intervals between scorings of vital parameters. Semi-structured interviews were used to evaluate the implementation process.
Results: We found significant reductions in time intervals between measurements of vital parameters in 2011 compared to 2009. Scorings of vital parameters were repeated within 8 hours in 71–77% of patients scoring total modified EWS levels of 0, 2 or 4. The theme *Motivation by clinical relevance and meaningfulness* was identified as crucial to the implementation process.
Conclusion: High adherence to an intervention may be strongly related to nurses' perceived clinical relevance of the intervention.

1. Introduction

Unrecognized clinical deterioration among in-hospital patients is a serious patient safety issue and may result in prolonged in-hospital stay or unexpected death (Hillman et al., 2001; Jones, DeVita, & Bellomo, 2011). For more than a decade it has been known that values of vital parameters, e.g. respiratory rate, heart rate, blood pressure, cerebral awareness or oxygen saturation, may deviate several hours ahead of many serious adverse events (Hillman et al., 2001). In response to reports of suboptimal in-hospital care preceding serious adverse events (McQuillan et al., 1998), hospital organizations have introduced Early Warning Scoring (EWS) and Medical Emergency Teams (MET) to improve in-hospital patient safety by earlier identifying deviating vital parameters and more appropriately managing clinical deterioration (Hillman et al., 2005; McGaughey et al., 2007).

Regular monitoring and scoring of bedside-measureable vital parameters (respiratory rate, heart rate, blood pressure, body temperature and cerebral awareness) in general ward patients followed by appropriate interpretation of deviations in these parameters may enable hospital staff to optimize clinical management of patients at risk of further deterioration and death. This improvement of clinical practice has been associated with lower numbers of unexpected death, cardiac arrest, and admission for intensive care (Bunkenborg, Samuelson, Poulsen, Ladelund, & Åkeson, 2014; Mitchell et al., 2010).

The outcome of any clinical intervention, like the systematic use of EWS, is believed to depend on implementation efforts (Fixsen, Naoom, Blase, Friedman, & Wallace, 2005). The term implementation refers to those specific plans and actions undertaken to make an intervention become part of clinical practice, and the clinical intervention is the new evidence-based practice that an organization seeks to take into use (Damschroder et al., 2009; Fixsen et al., 2005). Nevertheless, studies evaluating EWS systems and their effects on patient outcome do not report in detail to what extent these systems were actually implemented (Mitchell et al., 2010), although this information, underpinned by information about the context, organizational support, and characteristics of

Table 1
Clinical monitoring practice before and as part of the study intervention, implemented at a four-ward medical and surgical study setting in an urban Danish university hospital.

	Clinical practice	
	Before the intervention	As part of the study intervention
Bedside assessment of vital parameters	Values of single or few vital parameters (heart rate, systolic blood pressure, body temperature) obtained once or twice a day in patients, as considered appropriate by individual nursing staff members.	Values of complete sets of vital parameters (respiratory rate, heart rate, systolic blood pressure, body temperature, cerebral activity, and oxygen saturation) obtained by nursing staff at least every 8th hour in all patients not under terminal care.
Scoring of severity of illness	No corresponding scoring.	Immediate corresponding modified early warning scoring by nursing staff in all patients.
Documentation	Delayed recording in patient charts of values of vital parameters obtained.	Immediate recording in patient charts of all values of vital parameters and corresponding Modified Early Warning Scores.
Initial bedside nursing actions	Actions towards observed deviations in vital parameters taken as considered individually appropriate by nurses.	Actions towards observed deviations in vital parameters, and corresponding Modified Early Warning Scores, taken according to an algorithm for immediate bedside action.
Interprofessional communication and collaboration	Values of vital parameters reported to physicians as considered appropriate by individual nurses.	Values of vital parameters, and of corresponding Modified Early Warning Scores, discussed between physicians and nurses at least once a day.

participants, may facilitate appropriate interpretation of the achieved clinical outcome (Damschroder et al., 2009; Fixsen et al., 2005). Studies report considerable variation in day- and night time recordings of vital parameters and EWS, partial adherence to the hospital monitoring protocol (Hands et al., 2013), and low adherence to voluntary use of EWS (Ludikhuize, de Jonge, & Goossens, 2011).

The purpose of this study was to evaluate the adherence of nursing staff to a clinical in-hospital intervention comprising optimization of bedside monitoring practice including EWS, and to explore possible explanations for the achieved levels of adherence to this intervention.

2. Methods

2.1. Study design

A mixed-methods approach (Zhang & Creswell, 2013) was used to evaluate adherence to a clinical intervention and the process of implementation in this interventional study, which is part of a more extensive non-randomized, prospective study. Priority was given to the quantitative method, evaluating adherence by calculating time intervals between consecutive bedside measurements of vital parameters, and evaluating corresponding patient management. Qualitative semi-structured individual interviews (Kvale & Brinkmann, 2008) of nurse ward managers were undertaken to evaluate the process of implementation and explore underlying explanations for implementation outcome according to a sequential embedding strategy (Zhang & Creswell, 2013).

2.2. Intervention

The clinical multi-component intervention (Table 1 and Appendix A) was a modified in-hospital monitoring practice based on mandatory and structured bedside measurements and assessments of vital parameters according to the Modified Early Warning Score (MEWS) system (Subbe, Kruger, Rutherford, & Gemmel, 2001) in all in-hospital patients not under terminal care in the study setting.

Vital parameters were to be measured and assessed every eighth hour in patients scoring 0 and 1 and more frequently in those scoring higher. Nursing staff was to react to increased MEWS levels according to an algorithm for bedside action and to call the MET in patients scoring 5 or more (Gardner-Thorpe, Love, Wrightson, Walsh, & Keeling, 2006; Subbe et al., 2001). Electronic equipment was used to measure blood pressure, heart rate, oxygen saturation, and rectal temperature. Nursing staff counted the respiratory rate over 60 seconds and assessed the cerebral awareness according to the alert–voice–pain–unresponsive (AVPU) score. Values of each parameter were recorded in a paper-based observation chart, and corresponding individual MEWS levels and the total MEWS level were calculated and recorded manually together with the exact time and date of each completed set of bedside measurements and assessments (Appendix A).

2.3. Implementation

Various activities targeting core aspects of implementation (Damschroder et al., 2009) were undertaken over a 5-month period

Table 2
Activities used to implement a clinical intervention of systematic in-hospital patient bedside monitoring practice at a four-ward medical and surgical study setting in an urban Danish university hospital.

Implementation activity extent and main purpose	
Interprofessional program of teaching and training for medical and nursing staff members in the study setting	Four-hour teaching session of theory, addressing early warning signs, sepsis, monitoring practice and ABCDE principles of emergency management, for optimization of basic professional knowledge
	Four-hour session of full-scale simulation training, addressing detection and interprofessional emergency management of deteriorated patients, for optimization of professional collaborative and clinical skills
Interprofessional programme of knowledge-sharing sessions for medical and senior nursing staff members	Three 1-hour sessions for promotion of interprofessional communication and collaboration on deteriorated patients
Nurse ward managers and ward nurses as opinion leaders for staff members in each ward of the study setting	Continuous promotion of individual participation in the intervention for optimization of monitoring practice and patient safety, and for continuous bridging of gaps between research knowledge and clinical bedside application
Visits by main investigator in each ward of the study setting	Weekly 1 hour feedback sessions addressing educational, interprofessional, organizational and clinical issues aiming at optimizing staff's understanding of the intervention