



# Student nurses' recognition of early signs of abnormal vital sign recordings



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## SUMMARY

**Background:** There is increasing urgency for nurses to recognize early signs of deterioration in patients and to take appropriate action to prevent serious adverse effects.

**Objectives:** To assess respondents' ability to identify abnormal recordings for respiratory and heart rate, oxygen saturation level, systolic blood pressure, level of consciousness, urinary output and normal temperature.

**Design:** A descriptive observational survey.

**Setting:** A nursing college in Cape Town, South Africa.

**Participants:** A sample of 77/212 (36.3%) fourth year students.

**Methods:** A self-administered adapted questionnaire was employed to collect demographic data and respondents' selections of recorded physiological values for the purpose of deciding when to call for more skilled help. **Results:** The median age for 62/77 (80.5%) of the respondents was 25 years; 3/76 (3.9%) had a previous certificate in nursing. Most respondents were female (66/76, 85.7%). Afrikaans was the first language preference of 33 (42.9%) respondents, followed by isiXhosa (31/77, 40.3%) and English (10/77, 13.0%). Most respondents (48/77, 62.3%) recognized a normal temperature reading (35–38.4 °C). However, overall there would have been delays in calling for more skilled assistance in 288/416 (69.2%) instances of critical illness for a high-score MEWS of 3 and in 226/639 (35.4%) instances at a medium-score MEWS of 2 for physiological parameters. In 96/562 (17.1%) instances, respondents would have called for assistance for a low-score MEWS of 1.

**Conclusions:** Non-recognition of deterioration in patients' clinical status and delayed intervention by nurses has implications for the development of serious adverse events. The MEWS is recommended as a track-and-trigger system for nursing curricula in South Africa and for implementation in practice.

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## Introduction

In the health care environment nurses are often in frontline positions and are challenged by complex clinical situations requiring skilful application of knowledge for decision-making (Benner and Wrubel, 1989) and recognition of signs of patient deterioration. Appropriate action limits serious adverse events (SAEs) (Ludikhuijze et al., 2012). Final year student nurses' poor performance of basic assessment despite evidence of satisfactory academic preparation is of concern (Cooper et al., 2010). The aim of this paper is to fill a gap in the published literature on final year student nurses' ability to analyse vital sign recordings in a classroom setting for the purpose of detecting patients at risk of developing a critical illness.

Effective observation of ward patients is the first step in identifying the deteriorating patient and effectively managing their care (Odell et al., 2009). Early recognition of deterioration in patients requires accurate and timely documentation of vital signs, interpretation of findings and acting quickly and appropriately (Hammond et al., 2013). Prospective observational studies from the developed and developing countries report that the most common antecedents to cardiac arrest, death and unanticipated admission to intensive care are hypotension (Kause et al., 2004; Rylance et al., 2009), decreased level of consciousness (Kause et al., 2004; Nurmi et al., 2005), respiratory distress and decreased oxygen saturation (Nurmi et al., 2005). A study undertaken in an emergency department in Cape Town, South Africa reported a significant increase in admissions and in-hospital mortality with an increasing number of abnormal parameters (Burch et al., 2008).

Early warning score (EWS) systems known as 'track-and-trigger systems' (TTS) aimed at directing or guiding patient care (Smith et al., 2008) were first developed in the United Kingdom (UK) and described in the literature in 1997 (Morgan et al., 1997). EWS and modified EWS (MEWS) track one or more physiological signs with predetermined ranges, the 'trigger' or response criteria (Gao et al., 2007), guided by a

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call-out algorithm in response to abnormal readings. Scores are derived from simple patient observations such as systolic blood pressure (BP), pulse and respiratory rate, temperature, level of consciousness, and urine output (Rylance et al., 2009). Single-, multiple-parameter and combination track-and-trigger systems are in use (Gao et al., 2007; Kyriacos et al., 2011a) based on the deviation of single and multiple parameters from normality respectively and the calculation of a score (Ludikhuize et al., 2012). TTS are increasingly utilised on general wards in the UK (Royal College of Physicians, 2012) and Australasia (Green and Williams, 2006; Robb and Seddon, 2010).

Published literature on the accuracy of nurses' recordings of patients' vital signs on EWS charts (Mohammed et al., 2009) and their ability to recognize deterioration with the use of MEWS (De Meester et al., 2013) is from developed health care systems. Increasingly, such data are from resource-poor countries (Carter, 2008; Kyriacos et al., 2014; Rylance et al., 2009) but there is a paucity of published work on student nurses' interpretations of vital sign recordings.

### Observation Practice

The National Patient Safety Agency (NPSA, 2007) reported that serious patient safety incidents can be attributed to: no observations made for a prolonged period and therefore non-recognition of changes in a patient's vital signs or of the importance of the deterioration and/or no action taken other than recording of observations or delayed action (Robb and Seddon, 2010). Concerns about poor monitoring (Hogan, 2006; Kyriacos et al., 2014; Nurmi et al., 2005) are ascribed to over-reliance on electronic monitoring technology, specifically pulse oximetry to measure ventilation (Wheatley, 2006) and nurses' lack of knowledge regarding the functional limitations of these machines. Health care assistants are most frequently given the task of taking patient observations (Hogan, 2006; Wheatley, 2006) and may overlook important cues.

Patient survival often depends on nurses' decisions based on their interpretation of a patient's vital sign recordings (Goldhill and McNarry, 2004; Burch et al., 2008; Jacques et al., 2006). To achieve a positive outcome for patient care and to prevent SAEs the observation practice of nurses in complex ward situations should be understood (Odell et al., 2009). Factors in the context in which nurses work that predict patient mortality include nursing and physician characteristics, professional role support and environment, patient characteristics, teaching hospital status and hospital location (Aiken et al., 2011; Tourangeau et al., 2002).

### Aim and Objectives

The aim of the study was to determine whether final year nursing students can recognize abnormal physiological vital sign recordings for the purpose of summoning more skilled help for clinical deterioration in hypothetical patients who require assessment. The specific objectives were to assess respondents' ability to identify abnormal recordings for respiratory and heart rate, oxygen saturation level, systolic blood pressure, level of consciousness, urinary output and normal temperature.

## Methods

### Research Design

A descriptive, observational design using a survey at one time-point was employed (Grimes and Schulz, 2002).

The study was conducted in a classroom setting in May 2013. The public sector college offers a 4-year Diploma programme for registration with the South African Nursing Council as a nurse (general, psychiatric, community) and midwife (R425, 1978). English is the language of instruction. The curriculum did not include EWS systems for early recognition of deterioration in patient status.

### Sampling

The study population comprised final year nursing students ( $N = 212$ ) who would have had at least 4000 h of clinical experience. On a particular day all the students were invited to participate in the study.

StatCalc (Epi Info version 7) was used to calculate the sample size. In the absence of available published data, the determination of sample size was based on the estimation that 75% of the population ( $N = 212$ ) would have the ability to recognize abnormal physiology with a 95% confidence interval (CI) and 1.0% margin of error. A sample size of 177 was calculated.

### Data Collection

A self-administered English survey questionnaire (Appendix 1) was adapted from Kyriacos (2011b) with permission to obtain respondents' demographic data (age, previous nursing qualifications and language) and ability to recognize early signs of deterioration in a patient from recorded cut points (thresholds) for seven physiological variables. Scores were not displayed on the questionnaire but used for interpreting responses during data analysis.

Respondents were required to circle one low and one high (upper) range of abnormal recordings (Fig. 1) for respiratory and heart rate, systolic BP and urine output. For oxygen saturation respondents were required to identify one range of abnormal readings and to identify normal temperature range.

Responses were evaluated for single (Fig. 2) rather than aggregated physiological parameters (a total score of a number of parameters for one observation time-point). For interpretation of respondents' concern about a single physiological parameter that triggered at a MEWS of 1 to 3 in the absence of published clinical risk levels for single parameters, we were guided by the National Institute for Health and Clinical Excellence Clinical Guideline 50 (NICE CG 50, 2007). We regarded a MEWS of 1 as a low-score, 2 as a medium-score and 3 as a high-score.

However, clinical risk has been established for aggregate MEWS scores (Royal College of Physicians, 2012) but also any single red score (3). The National Early Warning Score Development and Implementation Group (NEWSDIG) recommended that an extreme score (3) in any one physiological parameter, should trigger a medium-level alert (Royal College of Physicians, 2012).

### Instrument Validation

A Master's-prepared nurse and one Registered Professional Nurse with more than 5 years' experience in managing a ward used a checklist adapted from Kyriacos (2011b) with permission to establish the Index of Content Validity (CVI) (Schilling et al., 2007) and face validity of the questionnaire. Content validity was preset at  $\geq 70\%$  (Guttman et al., 2006) for rating of items at a 3 (relevant but needs minor alteration) or 4 (extremely relevant). For Section 1, 3 of 4 (75%) items relating to demographic data were rated at 4; 1 item was rated at 3 and adjusted to include the category 'other' than nursing qualifications. Section 2 was rated 4 by both reviewers and all items remained unchanged.

Face validity relating to quality of printing, length of questionnaire, response scale, if visually easy to read and comprehend and clarity of instructions achieved a rating of 4 ('very skilful') by both experts (100%). To enhance the quality of the layout and format of the questionnaire which were rated 4 by one expert and 3 ('satisfactory') by the other, recommended changes were made.

### Ethical Considerations

Approval to conduct the study was granted by the University of Cape Town, Faculty of Health Sciences' Human Research Ethics Committee (HREC 660/2012) and authorities at the research setting in terms of

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