A DESCRIPTION OF FINALYEAR NURSING STUDENTS' ABILITY TO RECOGNIZE ABNORMAL VITAL SIGNSRECORDINGS AND CLINICAL DECISION-MAKING PROCESSES

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DECLARATION

I, Martha Maria Leonard, hereby declare that the work on which this dissertation/thesis is based is my original work (except where acknowledgements indicate otherwise) and have used the Harvard UCT system of referencing. I declare that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university.

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DEDICATION

I dedicate this dissertation first and foremost to Almighty God who granted me the strength to complete this project. Secondly I wish to extend much gratitude to my family and partner for accepting and respecting the times when I could not avail myself because of my academic responsibility.

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ABSTRACT

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. Effective observation of ward patients is the first step in identifying the deteriorating patient and effectively managing their care. It is important to understand nurses' observation practice and how they employ their ways of knowing in making clinical decisions.

Aim: The aim of this study was to determine whether final year nursing students can recognize and respond to abnormal vital sign recordings, and to analyse their clinical decision-making processes.

Methods

Design: This wasa descriptive observational study using a survey at one time point anda reflective interview with ten randomly selected participants.

Participants: Of a population of 212 final year nursing students on a 4-year training programme at a nursing college, in Cape Town, South Africa, 77(36.3%)participated in this study.

Data instruments: Section 1: Demographic survey; Section 2: Selection of a range of recorded values for seven vital signs (respiratory rate, heart rate, systolic blood pressure, temperature, oxygen saturation, level of consciousness and urine output) for the purpose of deciding when to call for help; Section 3: Structuredinterview for a description of decision-making in Section 2.

Results: The median age for 62/77 (80.5%) of the respondents was 25 years, and 3/76 (3.9%) had a previous nursing qualification (enrolled nursing). Most respondents were female (66/76,85.7%) and Afrikaans was the first language preference of33 (42.9%) respondents, followed by isiXhosa for 31 (40.3%) and English for 10 (13.0%).Using hypothetical patients, respondents' selections of low and high values for seven physiological parameters for the purpose of calling for more skilled assistance showed that overall there would have been delays in 288/416 (69.2%) critically ill patients at a high-risk modified early warning score (MEWS) level of 3 and in 226/639 (35.4%) at a medium risk MEWS level of 2. There were 96/562 (17.1%) intended responses in those at a low-risk MEWS level of 1. Most respondents (48/77, 62.3%) recognized a normal temperature reading(35-38.4^{o} C).Interview data from 10 randomly selected participants indicated limited cue acquisition, hypothesis generation,cueinterpretation, and no evidence of hypothesis evaluation.

Conclusion: This descriptive study examined final year nursing students' ability to recognize abnormal vital signs recordings and analysed clinical decision-making processes adopted by participants when deciding to call for more skilled assistance. The study found that respondents will delay calling for more skilled assistance at high-risk MEWS levels of3 and 2 for respiratory rate, oxygen saturation, heart rate, systolic blood pressure, level of consciousness and urine output – all indicators of critical illness. This has implications for serious adverse events being experienced by patients. The MEWS is recommended as the first-line trackandtrigger system for implementation in nursing schools and health care institutions in South Africa.

Keywords: Early warning scoring (EWS) system, patient safety, thinking skills, clinical decision-making.

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ABBREVIATIONS

APA	American Philosophical Association
BP	Blood pressure
CI	Confidence interval
CVI	Content validity index
EWS	Early warning scoring
GCS	Glasgow Coma Scale
MET	Medical emergency team
MEWS	Modified early warning score
OR	Odds ratio
SAE	Serious adverse event
SANC	South African Nursing Council
TTS	Track and trigger systems
UK	United Kingdom
USA	United States of America

CONCEPTUAL DEFINITIONS

Appropriate response: Means interpretation of nurses' self-reported actions according to Kyriacos' (2011) call-out algorithm on the Cape Town modified early warning scoring (MEWS) observations chart (Appendix 1).

Clinical decision-making: Clinical decision-making is a complex process involving observation, information processing, critical thinking, evaluating evidence, applying relevant knowledge, problem-solving skills, reflection and clinical judgement to select the best course of action which optimises a patient's health and minimises any potential harm. The role of the clinical decision-maker in nursing is, therefore, to be professionally accountable for accurately assessing patients' needs using appropriate sources of information, and planning nursing interventions that address problems and which they are competent toperform (Standing, 2005:34).

Clinical reasoning: A complex cognitive process that uses formal and informal thinking strategies to gather and analyse patient information, evaluate the significance of this information and weigh alternative actions (Simmons, 2010:1155).

Early warning scoring system: Early warning scores are 'track and trigger systems' that aim to aid the timely recognition of patients with potential or established critical illness. Deterioration in heterogeneous groups of patients is quantified on a numerical scale and, via predefined escalation protocols, facilitates objective decision-making to ensure a suitable clinical response (Smith, Prytherch, Schmidt & Featherstone, 2007:171).

Thinking skills: The American Philosophical Association defines critical thinking as purposeful, self-regulatory judgement which results in interpretation, analysis, evaluation, inference, and explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations on which judgement is based (Facione, 1990:2).

CHAPTER ONE

INTRODUCTION

In hospital ward settings nurses are often the first point of contact with patients, and they are at the bedside more frequently than other health care professionals. The shift towards community-based care and away from acute hospital-driven care in the United Kingdom (UK) has resulted in fewer acute beds in National Health Service (NHS) Trust medical and surgical wards (Johnstone,Rattray & Myers, 2007). Increasingly, in the UK,Israel (Zimlichman*et al*., 2009) and Greece (Georgaka, Mparmparousi & Vitos, 2012),sicker and more dependent patients are admitted to general wards without an accompanying increase in staff resources. In the health care environment nurses at various stages of training and varying levels of expertise are challenged by complex clinical situations that demand judgement and skilled decision-makingwhich involve the skilful application of clinical knowledge (Benner & Wrubel, 1989).Consequently,sound clinical decision-making is a core competence required by all nurses as frontline workers to detect early warning signs of patient deterioration and to implement appropriate action to avoid serious adverse events (SAEs).

To aid clinical decision-making and enhance patient safety various measures have been put in place; one example is the classic first reported earlywarning scoring (EWS) system (Morgan, Williams & Wright, 1997:100) for a rapid response to clinical deterioration. According to Reeves (2008:74) many states in the United States of America (USA) have provided decision-making models to help nurses make sound decisions related to their practice.

1.1 Background

There is increasing concern that nurses should recognize early signs of clinical and physiological deterioration in patients and take appropriate action to prevent SAEs.Effective observation of ward patients is the first step in identifying the deteriorating patient and effectively managing their care (Odell, Victor & Oliver, 2009:1993).The National Patient Safety Agency (2007:9)stated in the fifth Patient Safety Observatory report in which “deterioration” was the key theme, that serious patient safety incidents can be attributed to: no observations made for a prolonged period and therefore changes in a patient’s vitalsigns not detected; no recognition of the importance of the deterioration and/or no action taken other thanrecording of observations; delay in the patient receiving medical

attention, even when deterioration has beendetected and recognized.A comparative study of antecedents to cardiac arrests, deaths and emergency intensive care admissions in Australia and New Zealand (ANZ) and the UK; were documented for 168 deaths, 112cardiac arrests and 103 unanticipated ICU admissions (Kause,*et al.*, 2004).
It is also important to understand how nurses perceive and understand the practice of recording, interpreting and reporting vital signs within the broader context of clinical decision-making in nursing,described in Carper's landmark work (1978:23) as ways of knowing in nursing .The published literature about nurses' accuracy in recording patients' vital signs on EWS charts (Mohammed*et al*., 2009) is from developed countries.

EWSsystems also known as 'track and trigger systems' (TTS) are designed to monitor or track one or more physiological signs with predetermined ranges referred to as the 'trigger' or response criteria(Gao*et al.*,2007:667). Triggers are for calling for more experienced assistance to manage deteriorating patients (Morgan, Williams & Wright, 1997:100).Jacques*et al*.(2005:176)assert that these triggers usually consist of predefined abnormal conditionsor changes in physiological variables that aredeemed to be associated with a number of SAEs. Two types of EWS that are in use are single-parameter and multiple-parameter systems based on the deviation of a single parameter and multiple parameters from normality respectively(Ludikhuize*et al*., 2012:423). Single-parameter systems focus on a single-parameter score and the multiple TTS rely on the calculation of a score based on a multitude of parameters (Ludikhuize*et al.*, 2012:423). The further the deviation from the physiological norm,the higher the EWS score will be and the sicker the patient (Sharpley & Holden, 2004:99).

These systems for identifying patients with potential or established critical illness are increasingly utilised in general wards in the United Kingdom (UK) and Australasia, and rely on the detection and interpretation of early physiological derangement and a call-out algorithm in response to abnormal readings. According to Gao *et al.* (2007:668) TTS have predominantly evolved as a means to alert critical care outreach services in the UK and medical emergency teams in Australia.EWS used for this purpose is derived from simple patient observations and may include blood pressure (BP), pulse rate, respiratory rate, temperature, consciousness level, urine output and other parameters (Rylance*et al*.,2009:791). It is also aimed at directing or guiding patient care (Smith*et a*l., 2008:171).

Appropriate clinical responses to abnormal vital signs are dependent on nurses' ability to use their knowledge and their clinical decision-making ability to avoid treatment delays and subsequent SAEs. Many decision-making theories have been employed to explore decision-making in nursing (Buckingham & Adams, 2000:981).According to Botti and Reeve (2003:41) "the most comprehensive examination of clinical problem-solving and expert novice differences was undertaken by Elstein, Shulman and Sprafka (1978)." This classic model, which will guide data analysis for the interviews (Section 3 of the questionnaire (Appendix 2)), is based on Newel and Simon's (1972) information-processing view of diagnostic reasoning. Elstein *et al.*(1978) described four major components of the reasoning process, reported by Dowie and Elstein (1988:111-115) as cue acquisition, generating initial hypotheses, cue interpretation and hypothesis evaluation.

1.2 The South African situation

In South Africa the 4-year training programme of the South African Nursing Council (SANC) Regulation (R425 of 1978) for the preparation of a nurse (general, psychiatric and community) and midwife is offered at diploma and degree level. The focus of the present study is the diploma programme. On completion of this course the nurse must be "skilled in the diagnosing of individual, family, group and community health problems and in planning and implementing of therapeutic action and nursing care" (sub-section 6(2) R425). To aid in the successful completion of this programme objective, first-year student nurses receive instruction in the monitoring of vital signs, which continues over the 4-year period of training.

However, there is little published literature that deals with nurses' interpretation of vital signs recordings or their responses to abnormal readings (Kyriacos, 2011). More particularly, there is no South African published literature dealing with student nurses' ability to recognize and respond to signs of physiological deterioration in patients. EWS systems are designed to assist nurses in general wards to detect early deterioration. This study examined the decision-making processes of final year nursing students, guided by Elstein *et al.*'s (1978) conceptual framework.

1.3 Problem statement

In the first year of the 4-year training programme of SANC Regulation R425(1978) student nurses are assessed on their competence to measure and record patients' vital signs and to interpret abnormal

vital sign recordings – but there is no published literature that these skills have been retained by the final year. This means that patient safety is potentially at stake.

1.4 Aim

The primary 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 secondary aim was to analyse participants' clinical decision-making processes.

1.5 Research questions

The research questions were derived from an analysis of the relevant literature:

- Can final year diploma-prepared nursing students identify patients' abnormal vital sign recordings?
- At what level of physiological deterioration will final year diploma-prepared nursing students decide to call for more skilled help?

1.6 Specific objectives

The **primary objective** of this study was to assess the participants' ability to identify the following:

- abnormal respiratory rate, oxygen saturation levels (SAT/SpO_2), heart rate (pulse), systolic BP, level of consciousness and urinary output volume from recordings (Appendix 2, Section 2, questions 1-4, 6-7); and
- a normal temperature range (question 5).

A **sub-objective** was to describe the participants' demographic characteristics (Appendix 2, Section 1).

A **secondary objective** was to describe the clinical reasoning process adopted by randomly selected participants when deciding at what level of physiological deterioration to call for more skilled assistance (Appendix 2, Section 3).

1.7 Relevance of the study

No such study appears to have been undertaken to establish and describe student nurses' ability to recognizephysiological deterioration and the clinical decision-making processes involved when deciding at what level of physiological deterioration to call for more skilled assistance. This study will attempt to contribute new knowledge in this field of nursing and patient safety.If nurses do not recognize abnormal recordings, this implies that they would not call for more skilled help when it is needed, resulting in the potential for increased inpatient morbidity and mortality.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The objectives for this study were to assess the participants' ability to identifyabnormal respiratory rate, oxygen saturation levels (SAT/SpO_2), heart rate (pulse), systolic BP, level of consciousness and urinary output volume from recordings (Appendix 2, Section 2,questions 1-4, 6-7);a normal temperature range (Question 5); to describe the participants' demographic characteristics (Appendix 2, Section 1); andto describe the clinical reasoning process adopted by participants when deciding to call for more skilled assistance (Appendix 2, Section 3).The published literature reviewed for this study relates to the selected keywords: early warningscoring (EWS) systems, patient safety, thinking skills and clinical decision-making.

2.2 Search strategy

A search strategy for published literature on the keywords from 1997 to 2012 was conducted using databases as outlined in Table 2.1.It is not conventional for a literature search to include dated references (earlier than the previous ten years) but the study refers to classic works that were used to guide the interpretation of the qualitative data such as the Elstein *et al.* (1978) conceptual framework and Carper's (1978) ways of knowing in nursing. Furthermore, the year 1997 is important as in this year Morgan,Williams and Wright,published the first EWS system.Classic sources dating to the late 1980's and early 1990's relating to clinical and physiological antecedents to in-hospital cardiac arrests, deaths and unexpected admission to intensive care units are still cited today. The search strategy was limited to publications in English where possible. Additional studies were identified from reference lists of articles that were found to be useful.

Table 2-1: Search strategy for keywords

Database	Keywords	Results	No. of relevant papers
EBSCOHOST	Clinical decision-making	18	2
	EWS/patient safety	11	8
	Critical thinking	179	5
Pubmed	Clinical decision-making	45	7
	EWS/patient safety	5	2
	Critical thinking	429	3
Total		**687**	**27**

Cited references found in these publications and used in the report are not included in Table 2.1; some of these datedback to 1964.

The main themes extracted from the published literature on the selected keywords were as follows, and are each described further below:

- Observation practice
- Vital signs monitoring
- Vital signs documentation and reporting of abnormal vital signs
- EWS systems
- Factors affecting clinical decision-making
- Types of decision-making theories
- Clinical reasoning
- Critical thinking
- Significance of level of academic attainment and experience
- The context in which nursing occurs and the culture of the nursing unit
- Conceptual framework for information processing in diagnostic reasoning.

2.3 Observation practice

Odell, Victor and Oliver(2009:1993)assert that the first key step to identifying patient deterioration is effective recording of observations in patients, which is then followed by appropriate and effective management. Assessing a patients' needs is the first step in providing holistic patient care [find a recent edition of a nursing textbook that says something like this], and understanding the significance of patient observations is deemed a professional responsibility(South African Nursing Council, 2003-

2012; Hogan, 2006:490; Kisiel & Perkins, 2006:1052).Appropriate recognition of early deterioration of patients requires key skills such as accurate and timely documentation of vital signs, and the ability to interpret these vital signs and to act quickly and appropriately on trends of deterioration (Hammond*et al*., 2013:19). Often this means calling for more skilled health care practitioners toassess the patients' condition.

2.3.1 Vital signs monitoring

A serious concern has been expressed in several studies regarding the infrequent or lack of monitoring of any of the inclusive parameters to assess EWS (Hogan, 2006:489;Wheatley, 2006:120;Nurmi*et a*l., 2005:702;Kyriacos *et al.*, 2011). In qualitative studies it was found that health care assistants are most frequently given the responsibility of taking patient observations (Hogan, 2006:490;Wheatley, 2006:119).Hogan (2006:491)asserts thatwhen observations are seen as a task to be done nurses sometimes overlook important cues and are therefore unable to experience the whole situation.Similarly, in a study conducted by Sharpley and Holden (2004:102)it was reported that although health care workers diligently monitored and recorded vital signs, some of them displayed a lack of understanding of the importance of their findings and the implications of abnormal vital signs.

Poor or lack of monitoring of observations has also been ascribed to over-reliance on electronicmonitoring technology, specifically on pulse oximetryto measure ventilation(Wheatley, 2006:120 citing Kenward,Hodgetts &Castle*,* 2001).Of 20 observational periods, 18 (90.0%) patientshad their observations taken with the use of electronic equipment, an indication that observation practice was dominated by machines(Wheatley, 2006:118).The fact that nursing staff are not actively taking patient observations or assessing the patient may compromise decision-making regarding patient care, as a deficit in assimilation of information may occur (Wheatley, 2006:120). Further concerns regarding the use of electronic equipment was the lack of nurses'knowledge regarding the functional limitations of these machines: for example, nurses did not know that a non-invasive BP pressure machinewill record a patient's pulse rate but is unable torecognize an irregular heart rate and the pulsevolume (Hogan, 2006:491).

2.3.2 Vital signs documentation and reporting abnormal vital signs

The most common abnormal vital signs preceding cardiac arrestare reported to be respiratory rate and changes in heart rate (Hogan, 2006:489)and, in addition torespiratory distress, decreased oxygen saturation and a decreased level of consciousness (Nurmi*et al.*, 2005:703).Despite thepublished evidence of changes in specific vital signs preceding cardiac arrest,thegeneral paucity of assessment (Cooper*et al.,* 2010:2316),monitoring and recording (particularly of respiratory rate of patients)is well documented(Chen*et al*.,2009:35**;** Hogan, 2006:490;Nurmi *et al.*, 2005:703;Wheatley 2006:120). Nurmi *et al.* (2005:703) reported that in four Finnish hospitals 1 (0.91%) of 110 patient documents studied retrospectively revealed thatrespiratory rate had beenrecorded; this findingis consistent with those from other countries.Conversely, Santiano*et al.* (2009:46)reported that in their study changes in the breathing status of patients (reported as 'worried') accounted for the largest proportion (35.2%)of calls for emergency assistance.The call criterion "worried"waslisted under 'other criteria' intended for patients not fitting the normal/objective criteria forthe medical emergency team (MET):airway –threatened; breathing–all respiratory arrest, respiratory rate <5 and respiratory rate >35; circulation– all cardiac arrest, pulse rate <40, pulse rate >140 and systolic BP<90; neurology– sudden fall in level of consciousness (fall in the Glasgow Coma Scale (GCS) of 0.2 points) and repeated or prolonged seizures.

The adequacy of documentation of vital signs is another aspect ofconcern in the observation practice of nurses located in published studies(Jonsson*et al.*, 2011:164; Chen *et al.*, 2009:35). Patients at risk of SAEs are referred to and managed by aMET system which is part of a rapid response team consisting of doctors and /or nurses. This system is activated when abnormal vital signs reach predetermined values.

A cluster randomised controlled study conducted in 23 Australian hospitals that tested the introduction of a MET system found that close to 77%of patients suffering adverse events had at least one missing recorded vital sign immediately before the event in the control hospitals(Chen *et al.*, 2009:37). However, their study indicated that the MET hospitals had a significant reduction in the proportion of missing vital signs over time.A retrospective observational study by Ludikhuize*et al.* (2012:423) reported that pulse rate and BP were recorded most often, whereasurine production and level of consciousness were seldomrecorded and respiratory rate was documented in only 23% ofthe

cases. Furthermore,Ludikhuize*et al.*(2012:424) asserted that the lack of documentation of vital signs impedes the recognition of patients at risk of deterioration.

The Joint Commission on National PatientSafety (2009) recommended that hospitals shouldimplement measures to improve early recognition of changes in the patient's condition, as a significant number of critical inpatient events are preceded by warning signs.Evidently, a study conducted by Ludikhuize, deJonge & Goossens (2011:1432)reported that nurses trained in using the track and trigger systemcould identify patients with antecedent signs of deterioration more frequently than non-trained nurses and the trained nursesresponded by notifying the physician on call more frequently than non-trained nurses.

It is therefore important that the observation practice of nurses in complex ward situations is understood if a positive outcome for patient care is to be expected and to prevent SAEs(Odell*et al.*, 2009:1993). Patient survival depends a great deal on the decisions that nurses makebased on their interpretation of a patient's vital sign recordings, as several studies indicate an association between easily recordable physiological derangement and mortality(Goldhill & McNarry, 2004:92;Burch, Tarr& Marroni, 2008:677; Jacques*et al*.,2006:179).

Appropriate clinical responses by nurses topatients' abnormal vital signs are dependent on the nurses' ability to use their knowledge to recognize clinical deterioration,and their clinical decision-making skillsto call for assistance timeously to avoid treatment delays and subsequent SAEs.Kyriacos' (2011:243) research established that while training resulted in a statistically significant difference (p=0.01) between post-intervention knowledge test scores of nurses in the intervention wards who had training (19.5, SD 25.6)and those in the control arm who had no training (4.0, SD 13.2), nurses in both trial arms failed to respond appropriately to recorded disturbed physiological parameter recordings(Kyriacos, 2011:252-253).

2.4 EWS systems

The primary purpose of observations charts for recording patients' vital signs is to alert health care practitioners to a deteriorating condition in a patient. However, performance of these charts is under-reported (Chatterjee*et al*., 2005) and is not standardised.

EWS systems are recommended by a large number of patient safety organisations, because “audits have demonstrated that standard systems of care failed to identify sick patients at an early stage and that this leads to excess mortality” (Cuthbertson, 2008:153). Conversely, a number of studies identified a concern that nearly all the various forms of EWS lack data to suggest that they have acceptable accuracy for use in the roles for which they are proposed (Cuthbertson, 2008:154; Rylance*et al.,* 2009:792). Cuthbertson (2008:153) reported that accuracy relates to the sensitivity and specificity of the test, a test with the ability to identify deteriorating patients who require assessment and to avoid inappropriate responses in relation to patients who are not deteriorating. A study conducted by Smith*et al.*(2008:170) observed 33 similar aggregate-weighted scoring systems and tested their accuracy on a large, high-quality prospective database of medical patients. They found that only 12 scores discriminated well between survivors and non-survivors, and the best scores incorporated age. Jansen and Cuthbertson (2010:2) reported that existing TTS often failed to identify patients who required additional care and had not been shown to improve outcomes.

Although Morgan *et al.* (1997) did not intend the EWS to be used to predict deterioration, the modified early warning score (MEWS) has been found to be useful for predicting SAEs. DeMeester*et al*. (2013) reported that the MEWS had a predictive value for SAEs (sensitivity of 61%, specificity of 74% and AUC 0.703). Kyriacos (2011) reported sensitivity and specificity of the local experimental MEWS for predicting death: for heart rate, a MEWS of 2 was 45.5% sensitive (95% CI 16.8–76.6) and 81.4% specific(66.6-91.6); for systolic BPa MEWS of 1 showed 72.7%sensitivity (95% CI 39.0–94.0) and 77.3%specificity (62.2-88.5).

There is published evidence that the implementation of a MEWS system markedly improved documentation of vital signs. Jonsson *et al.*(2011:166) reported that in their retrospective study of 65 patient records, no record includedrecordings of all six parameters listed on a MEWS chart. Hammond*et al*.(2013:18) reported a statistically significant increase (210%) in overall frequency of the full vital sign set of documentation during the first 24 hoursafterdischarge from intensive care unit (95% CI 148-288, p<0.001)after the implementation of MEWS. In this study the frequency of individual and the full set of vital signs documentation increased. In particular, temperature recordings increased by 26% (95% CI 8-46, p=0.003).

In a doctoral thesis Kyriacos (2011) found that implementation of a local consensus-derived MEWS observations chart on surgical wards resulted in significant differences in relation to the number of

patients with recordings of postoperative respiratory rate between the intervention (27/57, 47.4%) and control arms (2/57, 3.5%) (χ^2 28.9, df 1, OR 24.75, 5.5-111.3). There were significantly more recordings of all seven parameters(respiratory and heart rate, oxygen saturation, systolic BP, temperature, level of consciousness and urine output) in intervention wards (5/57 patients) than control wards (0/57) (risk estimate 1.10, 1.01-1.2). More patients with the MEWS chart in the intervention arm had recordings of respiratory rate, oxygen saturation, level of consciousness and of all parameters than patients in the control arm with the existing observation chart(χ^2 8.37, df 1, OR 20.08 (Haldane's estimator), 1.08-375.09) that did not incorporate a scoring system.

Despite concern about the validity of MEWS expressed in several studies, the general opinion is that it is useful but more work is required to determine whether this instrument measures what it is supposed to measure (Cuthbertson, 2008:153; Jansen & Cuthbertson, 2010:1; Kyriacos*et al.*, 2011:315; Subbe*et al.,* 2001:841). Kyriacos' (2011) local MEWS forms the basis for the questionnaire used in this study. Despite the implementation of EWS/MEWS to facilitate clinical decision-making with regard to nurses' observation practice, various factors impact on clinical decision-making.

2.5 Factors affecting clinical decision-making

Although decision-making is central to the discipline of nursing, there is limited understanding of the processes used by nurses in clinical decisionmaking (Botti & Reeve, 2003:39). However, what is known is that nurses' clinical decisionmaking occursin the dynamic context of increasinglycomplex patient situations within clinical practice in health care settings (Gillespie & Paterson, 2009:164), and that decisions are informed by multiple sources of knowledge (Gillespie, 2010:334). Furthermore,decision-making is influenced by all that the nurse brings to the situation, such as knowledge, skills and experience (Tanner, 2006:205), and clinical decision-making is supported by a range of thinking processes (Gillespie, 2010:338).

2.5.1 Types of decision-making theories

Botti and Reeve (2003:39) assert that limited understanding of the acquisition of decision-making skills by novice nurses exists due to several interrelated reasons, one of which is that the few studies that did investigate this problem used diverse methodologies to measure decision-making, resulting in difficulty to compare findings across studies. Manias, Aitkenand Dunning(2004:271) reported that three decision-making models are commonly used to reflect graduate nurses' decision-making

activities: hypothetical deductive, pattern recognition and intuition models. Bjørk and Hamilton (2011:1) assert that the analytical clinical decision-making theory and information-processing model appear to dominate in nursing research. Thevarious theoretical models describe different reasoning patterns that are used during clinical decision-making. According to Tanner (2006:207) nurses use these patterns of reasoning alone or in combination,and the most common patterns found in experienced nurses areanalytical, intuitive and narrative thinking.

The analytical reasoning process is described by Hammond (1996:60) as logical and mathematical, forming the basis of rationality and signifying a step-by-step, defensible process.Tanner (2006:207) referred to the primary characteristic of analytical reasoning as the generation of alternatives, where alternatives are weighed against clinical data in a systematic and rational way to reach an outcome. This process of reasoning (Tanner, 2006:207) is applied in particular situations where one lacks essential knowledge; for example, the beginner nurse who is faced with a comprehensive assessment compares assessment data to textbook information of all possible signs and symptoms.

Intuitive reasoning in turn is the opposite of analytical and involves cognitive processing that produces an answer without the use of a conscious, logical, defensible, step-by-step process (Hammond, 1996:60). Thompson and Dowding (2009:11) report that the intuitive approach has as its main tenet the differentiation between expert and novice, where the expert no longer relies on analytical principles to make a judgement of a situation. Tanner (2006:207) reported that substantial research reported this characteristic and described it as, theimmediate apprehension of a clinical situation and is a function of experience with similar situations(Benner,1984:4, Benner & Tanner, 1987:129,).

The cognitive continuum approachmakes no distinction between analytical and intuitive reasoning;instead, cognition occurs on a continuum with intuition and analytical reasoning at each endpoint (Thompson & Dowding, 2009:12). When explaining the cognitive continuum a decision that is taken that is seen as neither analytical or intuitive is referred to as quasi-rational, indicating that it has properties of both analysis and intuition (Bjørk & Hamilton, 2011:2).

2.5.2 Clinical reasoning

In the published literature there is evidence that the term ‘clinical reasoning’ has been used synonymously with problem solving, clinical judgment, diagnostic reasoning and decision-making

(Simmons, 2010:1152) and information processing (Farel & Brammat, 1990:153).According to Simmons (2010:1152), problem solving, clinical judgment and decision-making refer to elements of both process and outcome, whilediagnostic reasoning and clinical reasoning refer to thinking strategies used by nurses. Tanner (2006:204) referred to clinical reasoning as a process that nurses and clinicians use to make judgments. Furthermore, it is described as a deliberate process that involves generating alternatives, weighing these up against the evidence to find the most appropriate solution and by using patterns characterized as practical reasoning (Tanner, 2006:204).

Although Simmons (2010) and Banning (2008) both focused on analysis of the concept of clinical reasoning, Banning provides a similar but more comprehensive description of various reasoning strategies used by nurses. Simmons (2010:1155) provided the following definition:clinical reasoning in nursing is "a complex cognitive process that uses formal and informal thinking strategies to gather and analyse patient information, evaluate the significance of this information and weigh alternative actions".The clinical reasoningprocess is recursive with multiple entrance points; during this cycle of reasoning the nurse employs both formal and informal thinking strategies. Formal strategies include decision analysis and information processing, while informal strategies are characterized by heuristics(thinking strategies/methods of processing large amounts of data to reduce cognitive strain). The use of these strategies depends on the situation and the experience of the nurse. Formal and informalthinking strategies enable the nurse to gatherand analyzepatient information, evaluate its significance and weigh the evidence to determine action. Multiple factors can impact the clinical reasoning process, such as cognitive ability, life experience, maturity and skill level within practice.

Simmons*et al.* (2003:713)conducted a descriptive exploratory study on full-time employed registered nurses with 2-10 years' experience working in medical and surgical wards, with the aim of determining the thinking strategies they employ in patient assessment. Their study revealed that these nurses mostly employed heuristic thinking strategies. The results indicated that 11 heuristics were used to speed up their reasoning process andto consolidate patient information; concurrentlynurses also used their knowledge gained from work experience and education. The five main forms of heuristics used most frequently were pattern recognition, judging the value, providing explanations, forming relationships and drawing conclusions.

2.5.3 Critical thinking

Clinical reasoning pertinent to nursing depends on the development of cognition (or critical thinking) and metacognition (or thinking about thinking) (Kuiper & Pesut, 2004:382).Similarly, Simmons (2010:1154) reported that in the analysis of clinical reasoning as a concept, critical thinking is related to clinical reasoning. Consequently, critical reasoning skills are deemed an essential antecedent to sound clinical reasoning when making clinical judgements to provide appropriate nursing care (Rhodes & Curran, 2005:257).Popil(2011:204)describes the significance of critical thinking in nursing as purpose-driven, outcome-directed thinking which is determined by the patients' needs and guided by professional standards.

Despite the lack of a clear definition of critical thinking, research indicates that the most comprehensive one is that ofthe American Philosophical Association (APA), which defines critical thinking as purposeful, self-regulatory judgement which results in interpretation, analysis, evaluation, inference, and explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations on which judgement is based (Facione, 1990:2). This definition of critical thinking, Kuiper and Pesut (2004:382) assert, has evolved through time, and the prevailing definitions are based on the Greek philosophies and premises of Socrates.

With the move of nurse education into institutes of higher education nationally,Girot (2000:288) conducted a study to evaluate the difference in development of critical thinking across four groups of nurses at different stages of the academic process and their perception of their decision-making ability in practice. It was found thatthere was no significant difference in the critical thinking skills across all groups studied, supporting the findings of other studies in the USA which examined the cognitive skills ofstudents undertaking graduate programmes.

According to Kuiper and Pesut (2004:282) critical thinking was established as an important outcome for nursing education and used as a key criterion for evaluation when accrediting nursing education programmes.To meet the learning needs of undergraduate student nurses, Ko*et al*.,(2005:1038)developed and evaluated a vital signs e-book for undergraduate student nurses and recommended this approach for nurse educators. Everett and Wright (2011:16) described a more holistic, integrated teaching approach for undergraduate student nurses to learn how to measure vital signs; this incorporated simulation using real-time demonstrations and blended learning that included e-learning, tutorials and skills laboratories.

2.5.4 Types of knowledge

According to,Benner, Tanner andChesla, (1996:194) clinical judgement requires various types of knowledge such as clinical and caring knowledge that are socially embedded in nursing practice. These types include explicit and tacit knowledge which is inherent in nurses' ways of knowing (Zander, 2007:8). Explicit knowledgeis formal information derived from science and theory which is abstract, generalizable and applicable in many situations. Tacit knowledge is acquired through experience where scientific abstractions are filled out in practice, and aids instant recognition of clinical states; and highly localised and individualised knowledge which is drawn from knowing the individual patient and shared human understanding (Benner, 1984:43).Zander (2007:8) concurs that tacit knowledge is gained through repeated experience and that reflections on those experiences make the knower less reliant on facts and rules or the particular situation and more on the whole of the situation.

Cioffi (2000:108) reported that knowledge of the patient and past experience were involved in the recognition of patient deterioration bynurses in herstudy, based on their feeling that something was wrong, but that they could not "put their finger on it". This study revealed six subcategories of nurses' subjective observations prior to abnormal physiological observations:a gut feeling and a sixth sense, something you cannot put your finger on, something isgoing to happen, 'knowing' the specific patient, pastexperiences with similar patients, and patterns built up.In the situated clinical framework of Gillespie (2010:334) she refers to foundational knowledge that is key to informing nurses' decision-making, which, she asserts, arises from multiple dimensions: the nursing profession, the nurse herself and general and specific aspects of the patient situation.The second factor that influences clinical decision-making is academic attainment and experience.

2.5.5 Significance of level of academic attainment and experience

Research has highlighted the difference in clinical decision-making approaches and ability between the experienced and the novice nurse, and that a distinction between levels of education and experience is essential for conducting meaningful discussions about their decision-making skills (Bakr *et al*., 2013:75). Tanner (2006:206) reported that the novice nurse must reason things through analytically or learn how to recognize a situation to which a particular aspect of theoretical knowledge applies, and begin to develop practical knowledge that allows refinement, extensions and adjustment of textbook knowledge.Novice nurses are in the process of acquiring domain-specific

knowledge, and because of their limited experience they are more reliant on problem-solving skills when clinical judgements have to be made(Botti & Reeve, 2003:40).The experienced nurse's decision-making skills are identified as subjective probability judgement, especially when faced with uncertain decision-making,when they reflect and draw on knowledge of previous situations (Cioffi, 2001:597). Three specific qualitative attributes were described by Radwin (1998:590) regardinga nurses' experience: a focus on the patient, confidence in practice, and knowledge of antecedents and consequences of similar patient situations.

Twycross and Powls (2006:1325) explored the decision -making skills of children's nurses with different levels of experience and academic attainment, graduate and non-graduate. They found that all nurses used hypothetical deductive reasoning, more specifically backward reasoning which is a characteristic of non-expert decision-making. Graduate and non-graduate nurses collected similar additional information before planning nursing interventions.

2.5.6 The context in which nurses work

Understanding and identifying factors which may facilitate or inhibit clinical decision-making is of paramount importance, as the outcome or results of decisions in healthcare have a direct bearing on the quality of patient care (Smith, Higgs & Ellis, 2008:89;Hoffman, Donoghue & Duffield, 2004:53). Factors in the context in which nurses work that predict patient mortality have been identified as: nursing staff ratios, nursing skill mix, professional role support and nurse characteristics(experience and capacity to work), the nursing practice environment,continuity of care by registered nurses, nurse burnout, nurse satisfaction, patient characteristics, physician expertise,teaching hospital status and hospital location(Aiken*et al.*,2011; Tourangeau*et al*., 2002).

Studies conducted on acute care environments indicate the profound influence of contextual factors on decision-making (Tanner, 2006:206). In addition to textbook knowledge, nursing judgement in the actual care setting is influenced by knowledge of the unit, routine workflow and specific patient information that assists in prioritising tasks (Ebright*et al*., 2003:635). Gillespie and Paterson (2009:164) assert that the novice nurse frequently responds to complex and unfamiliar clinical situations by drawing on theoretical knowledge and psychomotor skills rather than enacting decision-making that addresses the complex and multidimensional nature of the situation.

A qualitative study investigating factors that impact on clinical functioning and clinical decision-making in Iran reported that competence and self-confidence were implied as the most important personal factors (Hagbaghery, Salsali & Ahmadi, 2004:1).Other personal factors that were found to influence clinical decision-making through the increased use of the interpretive-intuitive model was associated with years of experience in the present job, further education, male gender, higher age and working predominantly in a surgical ward (Bjørk & Hamilton, 2011:6).A study conducted by Hoffman, Donoghue andDuffield (2004:53) found that personal factors such as education and experience were not significantly associated with clinical decision-making. Their study (Hoffman*et al.*, 2004:53) examined Australian nurses' decision-making and found that the "greatest variability to decision-making was holding a professional occupational orientation, followed by level of appointment, area of clinical speciality and age, in that order".

According to Twycross and Powls (2006:1325), who investigated clinical decision-making of children's nurses in six wards of a Scottish children's hospital, several factors have been suggested as affecting nurses' clinical decision-making, although the research evidence remains contradictory.Additionally, Bucknall (2003:310) indicates the importance of the need to measure the impact of contextual variables on nurses' decision-making in order to improve health care outcomes.

2.6 Conceptual framework for information processing in diagnostic reasoning

Currently many decision-making theories have been employed to explore decision-making in nursing (Buckingham & Adams, 2000:981).According to Botti and Reeves (2003:41) "the most comprehensive examination of clinical problem-solving and expert novice differences was undertaken by Elstein, Shulman and Sprafka (1978)." This model is based on Newel and Simon's (1972) information-processing view of diagnostic reasoning. Elstein *et al.*(1978) described four major components of the clinical decision-making/reasoning process, reported by Dowie and Elstein (1988:111-115) as follows:

- Cue acquisition, which comprises a process of obtaining information through initial history taking, physical examination and a variety of tests, e.g. laboratory or psychological data.
- Generating initial hypotheses, when alternative problem formulations are retrieved from memory using cues to link up to the long-term memory. The number of hypotheses is normally limited and rarely exceeds six or seven. A number of strategies is used to generate a

hypothesis, e.g. two related strategies are used to generate most hypotheses, which is association from a cue to a cluster of cues to a set of competing formulations to additional competing formulations.

- Cue interpretation occurs when data interpretation follows in light of the alternative hypotheses under consideration. These cues are interpreted on a three-point scale to confirm or disconfirm hypotheses or to assess them as non-contributory.
- For hypothesis evaluation data are weighted and combined to determine if one of the hypotheses generated is confirmed.

Botti and Reeve (2003:41) proposed thatfindings on the application of Elstein*et al.*'s model suggest that a small number of hypotheses are generated early in problem-solving tasks, and these hypotheses differ in levels of complexity according to the nurses' level of experience.Significantly more cues are collected by more experienced nurses than less experienced nurses, and more experienced nurses have greater diagnostic accuracy. Hypothesis generation uses two inference types, forward reasoning and backward reasoning, often referred to as data-driven and hypothesis-driven reasoning respectively (Arocha, Patel & Patel, 1993). Forward reasoning occurs when data trigger a hypothesis and different cues are linked to separate hypotheses. Backward reasoning represents a pattern of reasoning where a hypothesis serves to generate or evaluate data; therefore, the hypothesis constrains the data type searched for.The present study examined the decision-making processes of final year nursing students, guided by Elstein *et al.*'s (1978) conceptual framework that incorporates hypothetical-deductive reasoning in the decision-making model.

2.7 Summary

In thischapter the main themes that were extracted from the published literature on EWS systems, patient safety, thinking skills and clinical decision-makingwerepresented to illuminate the pivotal role of effective nurse observation practice in the prevention of SAEs in patient care on general hospital wards. Nursing research reported on various factors within the healthcare environment and personal factors of both experienced and novice nursesthat impact positively or negatively on nurses' observation practice.

Most importantly, the contribution of research towards initiatives that were implemented to enhance effective nurse observation practice, such as the EWS, was highlighted.

CHAPTER THREE

METHODS

3.1 Introduction

This chapter deals with the aim and objectives of this study of limited scope, the study design, how the study was conducted, who the participants were, and how the data were collected and analysed. To ensure scientific rigour, aspects of validity and reliabilityof data collection tools were established. To ensure ethical practice, the principles of the Helsinki Declaration (World Medical Association, 2008) were upheld.

A two-phase study was designed. Phase one consisted of a pen-and-paper questionnaire survey administered to final year diploma nursing students at a nursing college in the Western Cape, South Africa. Phase Two consisted of a reflective interview conducted with 10 randomly selected participants from the sample of final year students who volunteered to participate in the study, to examine and describe their information processing, diagnostic reasoning and clinical decision-making processes related to their responses

3.2 Aim

The primary 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 secondary aim was to analyseparticipants' clinical decision-making processes. The following objectives were identified to achieve the aim of the study.

3.3 Specific objectives

The **primary objective** of this study was to assess the participants' ability to identify the following:

- abnormal respiratory rate, oxygen saturation levels (SAT/SpO_2), heart rate (pulse), systolic BP, level of consciousness and urinary output volume from recordings (Appendix 2, Section 2, questions 1-4, 6-7); and
- a normal temperature range (question 5).

A **sub-objective** was to describe the participants' demographic characteristics (Appendix 2, Section 1).

A **secondary objective** was to describe the clinical reasoning process adopted by participants when deciding to call for more skilled assistance (Appendix 2, Section 3).

The primary objectivewas to assess the participants' ability to identify:

A. Abnormal respiratory rate, oxygen saturation levels (SAT/SpO_2), heart rate (pulse), systolic BP, level of consciousness and urinary output volume from recordings (Appendix 2, Section 2,questions 1-4, 6-7); and
B. Normal temperature range (question 5).

Sub-objective: To describe the participants' demographic characteristics (Appendix 2, Section 1).

Secondary objective: To describe the clinical reasoning process adopted by 10 randomly selected participants when deciding at what level of physiological deterioration to call for more skilled assistance (Appendix 2, Section 3).

3.4 Research design

A descriptive, observational design using a survey at one time-point was employed to achieve the study aim.Grimes and Schulz' (2002a) algorithm for classification of types of clinical research justifies this study as having an observational design and specifically a descriptive observational design. According to Grimes and Schulz (2002b:145) a descriptive study is designed and only concerned with the description of the existing distribution of variables, without regard to causal or other hypotheses. In addition, good descriptive reporting answers five basic 'W' questions:Who, what, why, when

andwhere, plus and a sixth question: So what? The study aim answers both the ‘what’ and ‘why’ questions and the research design answers the ‘what’ question. The information that follows provides more explicit information to answer the aforementioned five basic questions.

3.5 Research site

The study was conducted in a classroom settingat the Western Cape College of Nursing in Cape Town, South Africa, when the fourth-year nursing students were in their final block for theoretical instruction in May 2013. This is a public sector institution offering the 4-year R425 Diploma programme for registration as a nurse (general, psychiatric, community) and midwife. This answers the ‘where’ and ‘when’ questions.

3.6 Study population

The study population included all the final year nursing students (N=212) on the 4-year R425 Diploma programme for registration as a nurse (general, psychiatric, community) and midwife.

3.6.1 Eligibility criteria

The eligibility criteria answer the ‘who’ question of this descriptive study.

3.6.1.1 Inclusion criteria

The entire fourth (final)-year student group at the Western Cape College of Nursing was invited to participate in the study.

3.6.1.2 Exclusion criteria

There were no exclusion criteria. English is the medium of instruction at the College, so even if participants were English second- or third-language speakers, language was not an exclusion criterion as all of the students would have had basic English language competence.

3.6.2 Sampling method

Non-probability convenience sampling was employed for Phase One:All of the fourth-year nursing students present in class on a particular day were invited to participate in the study.These students were considered to possess the characteristics relevant for this study, that is, domain-specific knowledge and recognition of early warning signs of physiological deterioration. In addition, these students would have had at least 4000 hours of clinical experience. The choice of non-probability

sampling for this study was based on its pragmatic advantages (De Vos*et al*., 2011:231): the availability of an already existing population group, time and financial constraints. The disadvantages were reduced by having a sample that was as large as possible (De Vos*et al.*, 2011:231).

3.6.3 Estimation of sample size

The sample size needed for this study was calculated from a population (N=212) using StatCalc (Epi Info version 7) based on the following information:

In the absence of available published data, it was estimated that:

75% of the population (N=212) would have the ability to recognize abnormal physiology;
95% confidence interval (CI);
1.0% margin of error.

A sample size of n=177 was calculated to be needed for Phase One (Sections 1 and 2).

For Phase Two(Section 3), 10participants for the interview were randomly selected using the Microsoft Excel software program (2010) for simple random sampling. Names of students were listed in Microsoft Excel and random numbers were allocated to each participant.

3.7 Data collection: Instrumentation

The construction (section 3.7.1) of a three-part, self-administered survey questionnaire (Appendix 2) is described, followed by a description of the validation of the questionnaire (section 3.7.2) by experts for content and face validity (content validity index (CVI), Appendix 3). A pilot study was conducted for test-retest reliability of the survey questionnaire (Appendix 2). Thereafter the procedure for data collection and the method of data management and analysis are described.

3.7.1 Instrument design

3.7.1.1 Phase One

The use of questionnaires for data collection in healthcare research has increased (Rattray & Jones, 2007). The survey questionnaire (Appendix 2) was adapted from Kyriacos' thesis (2011) with permission and consists of two parts – Section 1: Demographic data; and Section 2: A knowledge

questionnaire about respondents' ability to recognizeearly warning signs of deterioration in a patient. The questionnaire was in English as this is the medium of instruction at the college.

Sections 1 and 2 of the self-administered survey questionnaire (Appendix 2) consisted of a pen-and-paper exercise.

Section 1: Required respondents' demographic data (age, previous nursing qualifications and language), which is an addition to Kyriacos's questionnaire.

Section 2: Consists of seven physiological variables requiring respondents to apply knowledge of the biosciences for the purpose of interpreting recordings of the seven physiological vital signs and deciding when to call for more skilled assistance for **early** signs of deterioration. The values for each of the seven vital signs were arranged in clusters guided byKyriacos' (2011: 413) final study results and recommended MEWS ward observations chart (Appendix 1), but the MEWS was not displayed on the questionnaire. The MEWS range of thresholds (cut-points) for physiological parameters is depicted as weighted trigger points and expressed as 0 (normal), 'upper' and 'lower' 1 to 3; for example,respiratory rate lower 2 = 9 or less.

Respondents were required to circle one range of abnormal low recordingsand one range of abnormal high recordings respectively for respiratory rate, heart rate, systolic BP and urine output. For oxygen saturation respondents were required to identify one range of abnormal readings and for temperature respondents were required to identify the normal range.An example of a student's selection is provided in Box 1.

Box 1

Circle two blocks to indicate the respiratory rate readings (breaths/min) in the list below that would be of concern to you as early signs of deterioration in a patient and for which you will summon more skilled help:

9 or less	9-14	15-20	21-29	30 or more

Respondents' selections indicating their ability to recognize physiological deterioration would then be converted to a MEWS, as shown in Box 2.

Box 2				
RESPIRATORY RATE MEWS				
2 (medium risk)	0 (normal)	1 (low risk)	2 (medium risk)	3 (high risk)
9 or less	9-14	15-20	21-29	30 or more

3.7.1.2 Phase Two

Phase Two consists ofSection 3of theself-administered survey questionnaire (Appendix 2)**,** a reflective interview conducted with 10 randomly selected participants from the sample of respondents to examine and describe their information-processing, diagnostic reasoning and clinical decision-making processes related to their responses on the survey questionnaire. This section is an addition to Kyriacos' questionnaire. Questions were aimed at establishing how participants identified the abnormal readings for the purpose of calling for more skilled assistance.

3.7.2 Instrument validation

3.7.2.1 Validity of research instrument

A checklist for the CVI (Appendix 3), adapted from Kyriacos (2011) with permission, was used to quantify content and face validity of the research instrument (self-administered survey questionnaire(Appendix 2)). Content validity of each question on the survey questionnaire (Appendix 2) was established by one Master's-prepared nurse and one Registered Professional Nurse with at least 5 years' experience in managing a ward.

Content validity of items on the questionnaire was assessed, and the results for each question on the self-administered survey questionnaire are presented in Table 3-1.

Table 3-1: Expert opinion on the CVI of the survey questions (Appendix 3)

Index of content validity (CVI)				
Section/question	**1 = Irrelevant**	**2 = Unable to assess relevance without item revision or item is in need of such revision that it would no longer be relevant**	**3 = Relevant but needs minor alteration**	**4 = Extremely relevant**
Section1 Q1				2 (100%)
Q2			1 (50%)	1(50%)
Q3				2(100%)
Q4				2(100%)
Section 2 Q1				2(100%)
Q2				2(100%)
Q3				2(100%)
Q4				2(100%)
Q5				2(100%)
Q6				2(100%)
Q7				2(100%)
Section 3 Q1				2(100%)
Q2				2(100%)
Q3				2(100%)
Q4				2(100%)
Q5				2(100%)
Q6				2(100%)
Q7				2(100%)

For Section 1, 3 of 4 items relating to demographic data were considered to be extremely relevant and rated a 4. One reviewer rated question 2 of this section (previous qualifications) as “relevant but needs minor alteration”. In discussion with the supervisor it was decided to adjust this item to include a category ‘other’ in order to accommodate the participants who did not have any previous nursing qualifications. It was felt that the respondents’ previous nursing qualifications were relevant and could contribute to their knowledge and experience, which might influence their response.

Sections 2 and 3 were rated extremely relevant by both reviewers and therefore all items remained unchanged.

Facevalidity of items on the questionnaire was established by one Master's-prepared nurse and one Registered Professional Nurse with at least 5 years' experience in managing a ward to ensure that the layout, organisation, ease and comprehension were adequate and that the questions were realistic.

Table 3-2: Expert opinion on the facevalidity of items on the questionnaire

	Very skilful	Satisfactory	Needs improvement	Unacceptable
Layout	1 (50%)		1(50%)	
Format	1 (50%)		1(50%)	
Quality of printing	2(100%)			
Length of the questionnaire	2(100%)			
Response scale of 1-4	2(100%)			
Visually easy to read	2(100%)			
Visually easy to comprehend	2(100%)			
Instructions at the beginning of the questionnaire are clear and easy to understand	2(100%)			

Generally the unquantified ranking for face validity was established as 'Very skilful'. One expert indicated that "'Layout' and 'Format'needs improvement". The recommended changes regarding Format, which referred to punctuation in Section 1, question 4 and Section 2, questions 1,2,3 and 4, were made.In terms of layout: in Section 2, spacing between questions 2-7 was increased; in question 6 'one response' was formatted to bold; and in question 7 'two values' was formatted to bold. The aforementioned recommendations were accepted to enhance consistency in the Layout and Format.

3.7.2.2 Reliability

To ensure that the measurement processes and instrument have acceptable levels of reliability, that is,repeatability,stability or internal consistency (Jack &Clarke, 1998), a pilot study was conducted.

Sections 1 and 2 of the self-administered survey questionnaire (Appendix 2) were administered to two third-year students on two separate occasions within 72 hours to establish test-retest reliability of the questionnaire:"Test-retest reliability is more relevant in the setting of clinical medicine because the constructs we attempt to measure are heterogeneous" (Marx*et al*.,2003:730). The 7 physiological parameters were heterogeneous variables. The 72-hour period between the test-retest is acceptable, as Marx *et al.*(2003:733) found no difference in results for a 2-day or 2-week time-frame.

Thereafter an interview (Section 3 of questionnaire) was conducted with each pilot participant. These students did not participate in the final study, but were deemed appropriate for testing the research instrument, both with three years (about 3000 hours) of clinical experience. These students would have successfully completed bioscience courses in the first and second year of training. Results from the pilot study were incorporated into the final instrument.

In Section 1 demographic data were checked for consistency only between time-point 1 and 2,and were found to be consistent. In Section 2 data were analysed for pilot study participants' intra-rater and inter-rater percentage agreement on perceptions of early warning trigger values for six physiological variables for calling for more skilled assistance, and what they considered to be a normal temperature range over two timepoints. Results for time 1 were compared with those for time 2 (72 hours later) for each respondent and then between raters.

Reliability refers to the degree to which repeated measurements with theresearch instrument will deliver the same results. Inter-rater reliability determines whether there is significant variability (Twomey, Wallis & Myers, 2007) between the two participants rating the same phenomenon, and intra-rater reliability assesses the variability within one participant re-rating the same phenomenon. Reliability only illustrates consistency with repetition and not validity.Measurement of agreement/disagreement is appropriate for ordinal level data (Rattray & Jones, 2007:235). Measuring only the percentage agreement does not take into account agreement expected on chance alone(Karanicolas *et al.,* 2009). The data are presented in Table 3-3.

Table3-3: Pilot study participants' (N=2) selection of appropriate responses to MEWS trigger points for six physiological variables and the identification of normal temperature range over two time points

	Participant A						Participant B					
Physiological variable	Time point 1 **MEWS lower**	Time point 2 **MEWS lower**	**Agree Yes/No** (%)	Time point 1 **MEWS upper**	Time point 2 **MEWS upper**	**Agree Yes/No** (%)	Time point 1 **MEWS lower**	Time point 2 **MEWS lower**	**Agree Yes/No** (%)	Time point 1 **MEWS upper**	Time point 2 **MEWS upper**	**Agree Yes/No** (%)
Respiratory rate	2	2	Yes	2	3	No	2	2	Yes	3	3	Yes
Heart rate	2	2	Yes	3	3	Yes	2	1	No	3	2	No
Systolic BP	0	3	No	2	2	Yes	0	0	Yes	2	2	Yes
Urine output	3	3	Yes	2	2	Yes	3	3	Yes	2	2	Yes
Oxygen saturation¥	3	3	Yes				3	3	Yes			
Conscious level¥	3	3	Yes				3	3	Yes			
Temperature (normal)* 35-38.4^{0}C	0	0	Yes				missing	2	No			
	TOTAL		Yes=6 (85.7) No=1 (14.3)			Yes=3 (75.0) No=1 (25.0)			Yes=5 (71.4) No=2 (28.6)			Yes=3 (75.0) No=1 (25.0)

Note on table:
MEWS 0 = normal
MEWS 1 = upper or lower (low risk)
MEWS 2 = upper or lower (medium risk)
MEWS 3 = upper or lower (high risk)
¥ One response required
*Normal temperature required
Proportion agreement does not account for chance.

Inter-rater agreement for Time 1 = 9/11 (81.8%); for Time 2 = 7/11 (63.6%).

Data in Table 3-3indicate that for Participant A there was **intra-rater** agreement between Time 1 and Time 2 for the following:

- heart rate lower MEWS 2 (medium risk) and upper MEWS 3 (high risk);
- urine output lower MEWS 3 (high risk) and upper MEWS 2 (medium risk);
- oxygen saturation MEWS 3 (high risk;) and
- level of consciousness MEWS 3 (high risk).

There was intra-rater agreement for respiratory rate lower MEWS 2 (medium risk), but not for respiratory rate upper MEWS 2 (medium risk) and 3 (high risk). There was agreement for systolic BP upper MEWS 2 (medium risk) but not for normal values (MEWS of 0) or systolic BP lower MEWS 3 (high risk). On both occasions there was agreement relating to the normal temperature range MEWS of 0.Agreement indicated that Participant A would not respond to a low-risk MEWS trigger of 1 for any vital sign parameter, but would respond to a medium-risk MEWS trigger of 2.However, Participant A would delay a response until a high-risk MEWS trigger of 3 was reached for a fast heart rate, low urine output, low oxygen saturation, fast respiratory rate and low systolic BP. For time 1 Participant A would trigger a call-out for a normal range (MEWS of 0) for systolic BP.

For Participant B there was **intra-rater** agreement between Time 1 and Time 2 for the following:

- respiratory rate lower MEWS 2 (medium risk) and upper MEWS 3 (high risk);
- systolic BP MEWS 0 (normal values) and upper MEWS 2 (medium risk);
- urine output lower MEWS 3 (high risk) and upper MEWS 2 (medium risk);
- oxygen saturation MEWS 3 (high risk); and
- level of consciousness MEWS 3 (high risk).

For heart rate, there was no agreement for both lower MEWS 2 (medium risk) and 1 (low risk) or for upper MEWS 3 (high risk) and 2 (medium risk) between Time 1 and 2. For temperaturethere were missing data for time point 1 and a normal temperature was considered to be a lower MEWS 2 (medium risk) for time point 2.Participant B indicated a consistent response to a mediumrisk (lower 2) MEWS trigger for respiratory rate. There was no consistency in response to heart rate. This participant would call for help for a normal systolic BP, which was considered to be low, and would respond to a medium risk for a high Systolic BP (upper MEWS of 2). Participant B would only respondto a high-risk MEWS trigger of 3for a fast respiratory rate,fast heart rate on one occasion,low urine output,oxygen saturation and level of consciousness.

There was 100% **inter-rater** agreement between the two sets of results forParticipant A and Participant Bfor respiratory rate Time 1, systolic BP Time 2, as well as urinary output, oxygen saturation, and consciousness level at both Times 1 and 2. There was noagreementforrespiratory rate upper, systolic BPlowerand for heart rate and temperature.

In summary, for a lower MEWS for seven physiological parameters, Participant A scored 85.7% (6/7) agreement between Time 1 and 2 and this was 71.4% (5/7) for Participant B. For upper MEWS, both Participant A and B scored 75.0% (3/4) agreement between Time 1 and 2. The agreement at Time 1 over all lower and upper MEWS was 9/11 between Participant A and B. The discrepancies at Time 2 were greater, with only 7/11 agreement. The potential for variation in clinical responses to trigger EWS(Prytherchet *al.*,2006) may account for lack of intra-rater agreement.

The following changes were made to the final self-administered survey questionnaire:

- As a result of important aspects of the instructions for Section 2 being overlooked by participants, such as 'circle' and the words 'one or two', these words as well as the vital signs were indicated in bold.
- Questions 1, 2, 3, 4, 6 and 7 were adjusted to include the words **"as an early sign of deterioration",** because it appeared that participants focused on late/critical signs.

In terms of Section 3, the interview data, audiotaped recordings of the interviews with the two pilot participants were transcribed and analysed for a quantitative description of frequency of categories of cognitive processes used by them in deciding when to call for more skilled assistance, guided by the conceptual framework of Elstein *et al.*(1978) (Section 2.5).The data are presented in Table 3-4.

Table 3-4: Checklist for analysing transcribed interviews for frequency of occurrence of four aspects of information processing

Evidence found or not

Checklist for evidence of information processing Elstein *et al.*(1978)	**Participant code No.**	**Yes**	**No**	**Other Describe**	**Frequency of occurrence**
1. Cue acquisition which comprises a process of obtaining information	A B	√ √		The questionnaire survey did not contain a scenario/patient problem from which cue acquisition could be made. Although the pilot participants were shown their completed surveys, for both participants there was limited cue acquisition for a hypothetical patient.Both participantsmade a superficial attempt at seeking cues from their selected physiological values for a hypothetical patient they were worried about.	2
2. Generating initial hypotheses, when alternative problem formulations are retrieved from memory using cues to link up to the long-term memory	A B	√ √		Participant A indicated that he first checked the normal valuesand then deduced the abnormal values of the vital signs from these. Participant B also indicated that she would first check the normal values and thendeduced the abnormal.Participant B interpreted her information by recalling a patient who had a "low urinary output"	For6 questions this was repeated For 5 questions For 1 question
3. Cue interpretation occurs when data interpretation follows in light of the alternative hypotheses under consideration	B	√		Participant B made the connection between low urinary output and the "dehydrated patient" as a justification for the decision to call for help	For 1 question
4. Hypothesis evaluation			√		
Total		3	1		

For the two pilot participants (A and B), there were two occurrences of generating initial hypotheses, when alternative problem formulations were retrieved from memory using cues to link up to the long-term memory, and one occurrence (Participant B) of cue interpretation when data interpretation followed in light of the alternative hypotheses under consideration. There was no occurrence of hypothesis evaluation.Frequencies of cognitive processes were disappointingly low, but no further analysis was done for the pilot study.

3.8 Data collection procedure

3.8.1 Gaining access

Written permission to conduct the study was obtained from the Western Cape College of Nursing Interim Research Committee (Appendix 5A). There were two groups of fourth-year students.

3.8.2 Recruitment for participation

The researcher had arranged to have one hour with each class during a self-study period to recruit final year students for voluntary participation. During recruitment each student was given a copy of the Information Sheet (Appendix 6) describing the study and a Consent Form (Appendix 6). With a show of hands students indicated willingness to participate in the study.

On another scheduled self-study day the researcher arranged to return to conduct the study in a venue large enough to accommodate all students willing to participate. Those students not willing to participate continuedwith class work in their scheduled venue. Participants recruited into the study were given the Consent Form (Appendix6) to sign and a copy to keep. They then completed Sections 1 and 2 of the questionnaire (Appendix 2). The researcher was present to clarify any queries and to collect the completed questionnaires.

After random selection of 10 respondents from the students who volunteered to participate in the study, these respondents were invited to participate in the interviews one day after completion of the questionnaire. An arrangement was made to conduct the interviews in a quiet room within the college and at a time convenient for the participants. Arrangements were made with lecturers to make up lost self-study time.

3.9 Data management and analysis

Descriptive and limited inferential statistical analysis of the data wasconducted. Raw data were entered onto a password-protected Excel© spread sheet (Microsoft Office 2010). Data were copied onto a CD for safekeeping in a secure environment for 3 years. Data wereanalysed using Microsoft® Office Excel® 2010, IBM SPSS Statistics version 19 and DAG-Stat.

3.9.1 Data analysis: Section 1 Demographic data

Descriptive and univariate statistical analyses were undertaken (Table 3-5). Inferential statistical tests were employed for the limited interval level data (age).

Table 3-5: Demographic variables

Interval variable: Age in years	Statistical tests: Measures of dispersion: number, proportion and percentage, minimum-maximum, 95% CI Measures of central tendency: mean for normally distributed data, median for data not normally distributed
Categorical variables: Previous qualifications Gender Language	Number, proportion, percentage Measures of association: Chi-square Degrees of freedom (df), p-value, CIs

3.9.2 Data analysis: Section 2 Clinical decision-making

For Section 2 data were analysed for the number of respondents who identified a MEWS level 1, 2 and 3 respectively of physiological deterioration for each of the seven physiological variables(Table 3-5), guided by Kyriacos' recommended MEWS call-out algorithm (Appendix 1). This means that the respondents would initiate the MEWS call-out algorithm(calling for more skilled assistance) at that level of deranged physiology (Table 3-6).

Table 3-6: Response to physiological deterioration

Physiological variable	MEWS	Statistical analysis
For example, respiratory rate low		Number of respondents (%), Chi square,p value

3.9.3 Data analysis: Section 3interview data

Interview data wereanalyzed forinformation processing required for clinical decision-making, usingthe Elstein *et al.*(1978) model as a guide for the analysis,as shown in Table 3-4 (reliability testing).

3.10 Ethical considerations

Established ethical principles and the basic principles of the Declaration of Helsinki (World Medical Association, 2008) were upheld when the study was conducted.

3.10.1 Respect for autonomy

During recruitment it was stressed that participation was voluntary, that informed consent was based on full disclosure of all study details, and that confidentiality, privacy and anonymity would be respected (Terre Blanche& Durrheim, 2002:66). Code numbers replaced participants' names to maintain confidentiality, privacy and anonymity.

Obtaining informed consent was firmly embedded in the principle of respect for autonomy and a prerequisite for all research involving human subjects. The researcher was legally and ethically obligated to meet the following three requirements of informed consent: a person's ability to give consent, voluntariness of participant and adequate information regarding the research study in order to make an informed decision.

3.10.1.1 Voluntary participation

Voluntary consent was obtained and participants werenot deceived or coerced into making a decision. Participants were informed of their right to withdraw from the study at any stage without penalties (Appendix 6).

3.10.1.2 Information provided for consent

Written consent was onlyobtained after full verbal disclosure of the study details (Appendix 6): the nature and purpose of the research, data collection methods, types of questions, the use of research results, method of anonymity and the extent to which participants' utterances would be used in reports.

The professional background of the researcher was made clear to the participants in order to minimise risk of exploitation and coercion, particularly that she is a health professional involved in nursing education, as this was relevant to the present study. The role of the researcher and participant was clarified.

3.10.2 Confidentiality

The confidentiality of the participants was respected throughout the course of this study by implementing the following measures. The participant questionnaire was coded ,which was known to the researcher only; participants' nameswill not be linked to any results which will be published at the completion of the study; all information on electronic devices will be kept in the possession of the researcher; and no names were used at any stage of the research project.

3.10.3 Non-maleficence

The principle of non-maleficence refers to the obligation of not imposing physical, emotional or social risk or harm during research to the research participants or any other person or group of persons. This obligation requires the researcher to thoroughly assess potential adverse effects, risks or hazards for the research participants.

The principle of non-maleficence was upheld by the researcher having thoroughly assessed that there were no foreseeable adverse effects, risks or hazards for participants. The study design was non-invasive and participants' responses were confidential. In addition to the measures already described, potential risks were limited by protecting participants and the research institution from harmful publicity by not publishing anything defamatory or untruthful and ensuring that the use of language will not imply moral criticism of participants' academic behaviour or accomplishment. The researcher did where possible anticipate and avoid misinterpretation that could cause harm.

Participation in this study did not in any way affect participants' academic programme. The researcher was mindful of the significance of the relationship that could have developed due to the duration and nature of the research method and will conclude the study appropriately (Connolly, 2003:18).Benefits were not overstated to unduly influence participants to agree to participate.

3.10.4 Beneficence

The principle of beneficence refers to the obligation to act for the benefit of others (Beauchamp & Childress,2013:260). To uphold this principle, all study details were disclosed to potential recruits to enable them to give informed consent for voluntary participation: purpose, ethical approval number, what was required of participants including the time it would take to complete (30 minutes) the questionnaire and that 10 participants were randomly selected for voluntary participation in an interview (30 minutes). The researcher conducted the study in such a manner that benefits were maximised and risks reduced by implementing initiatives to avoid potential risk. This study will contribute to understanding student nurses' cognitive clinical decision-making processes to inform curriculum development and teaching approaches that can be implemented to enhance student nurses' decision-making skills.

3.10.5 Justice

The concept of justice refer to what is "fair, equitable and appropriate treatment in light of what is due or owed to persons" (Beauchamp & Childress,2013:327). This principle refers to distributive justice, which according to the Medical Research Council (2000) means the equal distribution of risks and benefits. The power relation between the researcher and the participant was especially an issue due to the position of authority of the researcher and her constant

presence during data collection. The researcher did flatten the power gradient from the onset of the study by respecting the students' choice not to participate.

3.11 Summary

Chapter Three describes the methods employed to conduct this descriptive study of limited scope. An attempt was made to do good descriptive reporting of each of the research activities by answering five basic 'W' questions:Who, what, why, when and where?A description of the research aim answered both the 'what' and 'why' questions, while a descriptionof the research design answered the 'what', of the research site answered the 'where' and 'when',and of the study population and sampling answered the 'who' question. A description of the data collection procedure includes the design and validation of the data collection instruments. The accomplishment of validity included content and face validity. Instrument reliability was determined by conducting a pilot study,and the results and subsequent changes to the instrument are explained. Due consideration was given to uphold established and basic ethical principles when conducting this study. The sixth 'So what?' question will be answered when the study results are presented in Chapter Four.

CHAPTER FOUR

RESULTS

4.1 Introduction

A descriptive, observational design using a survey at one time point was employed to determine whether final year nursing students following a 4-year diploma programme 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 secondary aim was to analyse participants' clinical decision-making processes.

This chapter reflects the results of data collected from a sample of 77 (36.3%) respondents from a final yearstudent nurse population of 212 in the Western Cape Province, South Africa.The estimated sample size was 177 (95% CI; 1.0% margin of error). The statistical analyses include descriptive and inferential statistics where appropriate for each study objective.

4.2 Objective: To describe the respondents' demographic characteristics

Although this is a sub-objective of the study, a description of the demographic characteristics of the respondents is presented first to contextualise the results. Demographic data(Questionnaire Appendix 2, Section 1)are presented in Tables 4-1to4-3. An example of SPSS analysis for data for age is shown in Appendix 7A).

Table 4-1: Respondents' age (years)

	Respondents (n=77)				
Variable	**No. (%)**	**Median≠**	**Mean**	**95% CI**	**Minimum-Maximum**
Age*	62 (80.5)	25.0	27.13	25.74-28.52	21-42

Note to table:
*15 (19.5%) missing data.
≠Data are not normally distributed so the median is taken.

Data in Table 4-1 show that the median age of 62/77 (80.5%) of the respondents was 25.0 and the mean was27 years, with a narrow 95% CI (25.7-28.5), and therefore there ismore certainty about the results. Data for age are presented graphically in Figure 1-1.

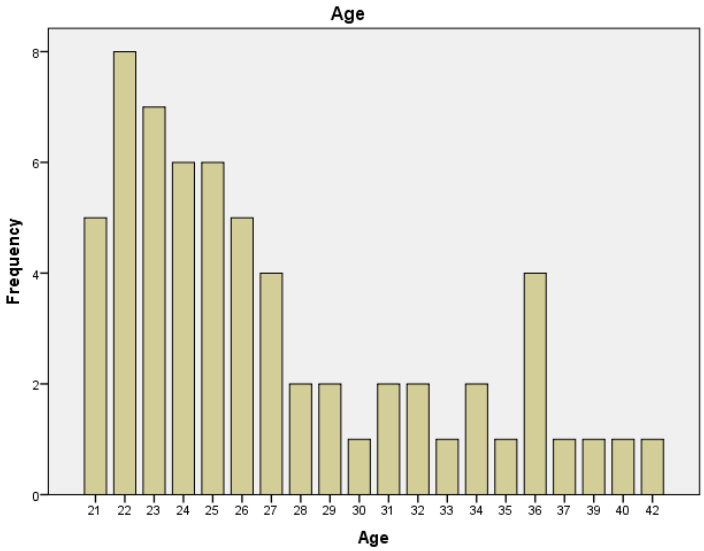

Figure 4-1: Respondents' age

Respondents' previous qualifications and gender are shown in Table 4-2, and the measure of association between the two variables. An example of SPSS data analysis for variables qualification and gender is shown in Appendix 7B).

Table 4-2: Measure of association between respondents'(n=76) qualification and gender

Variable	Number (%)	χ^2 (df=1)	p-value
Qualification#	None=73 (96.1) Enrolled Nurse =3 (3.9) Enrolled Nursing Assistant = 0	Fisher's Exact taken	0.35
Gender ≠	Female=66 (85.7) (Valid % 86.8) Male=10 (13.0) (Valid % 13.2)		

Note to table:
#1 missing data.
≠1 missing data.

Data in Table 4-2(Appendix 7B) show that 96.1% of respondents had no previous qualifications and 3 respondents (3.9%) were Enrolled Nurses, having a 2-year training certificate in basic nursing and now embarking on becoming a registered nurse and midwife. Sixty-six (86.8%)of 76 respondents were female. The Fisher's Exact pvalue (0.35) shows that there is no statistically significant association between qualification and gender. Phi and Cramer's V (-0.12) both show that the strength of association between the variables is very weak (p=0.29).

Respondents' first-language preferences are shown in Table 4-3 and the measure of association between gender and language. An example of SPSS data analysis for variables gender and language is shown in Appendix 7C).

Table 4-3: Measure of association between respondents'(n=76) gender and language preference

Variable	Number (%)	χ^2(df=3)	p-value
Gender ≠	Female=66 (86.8) Male=10 (13.2)	17.21	0.001
Language†	Afrikaans=33 (43.4) IsiXhosa=31 (40.8) English=10 (13.2) Other=2 (2.6)		

Note to table:
≠1 missing data.
†1 missing data.

Data in Table 4-3 show that the majority (33/76, 43.4%) of respondents had Afrikaans as their first language, followed by isiXhosa (31/77, 40.8%), English (10/77, 13.2%) and 'other' (2/77, 2.6%). There was a statistically significant association between gender and language (Chi-square 17.21, df=3, p=0.001). Phi and Cramer's V (0.78) both show that there is a strong association between the variables (p=0.001).

A graphic display of the distribution of language among males and females is presented in Figure 4-2.

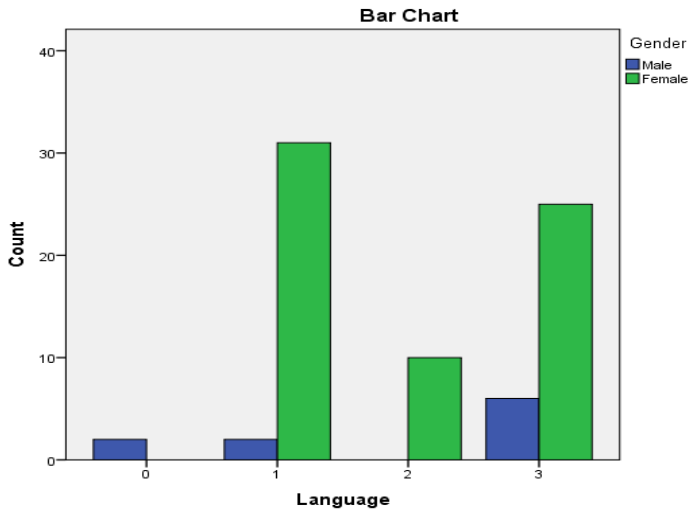

Figure 4-2: Language distribution among male and femalerespondents (0 = 'other' languages, 1 = Afrikaans, 2 = English, 3 = isiXhosa)

Data in Table 4-3 and Figure 4-2 show that more females had Afrikaans as a first language (31/66, 47.0%) than isiXhosa (25/66, 37.9%) or English (10/66, 15.2%),whereas most males had isiXhosa as a first language (6/10, 60.0%), followed by Afrikaans (2/10, 20.0%), and no males had English as

a first language. Theonly participants who had indicated an ‘other’ first language were two males (2.6%).

4.3 Primary objective A: To assess respondents’ ability to identifyearly signs of deterioration

Respondents’ selections of the range of values for each of the six physiological variables (abnormal respiratory rate, oxygen saturation levels (SAT/SpO2), heart rate (pulse), systolic BP, level of consciousness and urinary output volume) were converted to a MEWS and analysed as described in section 3.6.1.1. Data in Table 4-4 show the frequency of respondents’ (N=77) selections as an indication of their ability to recognize early signs of physiological deterioration. The MEWS thresholds (cut-points)guided the interpretation of participants’ selections as low risk of deterioration (MEWS of 1), medium risk (MEWS of 2) and high risk of deterioration (MEWS of 3).An example of SPSS data analysis for respondents’ selections is shown in Appendix 8).

Table 4-4:Respondents' (N=77†) selections of low and high ranges of values for recordings of vital signs that they would be concerned about

Physiological variable	MEWS	Number of respondents (% of 77 respondents)
RESPIRATORY RATE (Lower) 9 or less	2	45 (58.4)
RESPIRATORY RATE (Upper) 15-20	1	5 (6.5)
RESPIRATORY RATE (Upper) 21-29	2	14 (21.2)
RESPIRATORY RATE (Upper)30 or more	3	47 (71.2)
***OXYGEN SATURATION** **Less than** 85%	3	52 (67.5)
OXYGEN SATURATION85-89%	2	20 (26)
OXYGEN SATURATION90-92%	1	4 (5.2)
HEART RATE (Lower)40 or lower	2	44 (57.1)
HEART RATE (Lower) 41-45)	1	25 (32.5)
HEART RATE (Upper)101-110	1	14 (18.2)
HEART RATE (Upper)111-129	2	8 (10.4)
HEART RATE (Upper)130 or more	3	37 (48.1)
Systolic BP (Lower)70 or lower	3	45 (70.3)
Systolic BP (Lower)71-80	2	14 (21.8)
Systolic BP (Lower)81-100	1	5 (7.8)
Systolic BP (Upper)200 or higher	2	48 (62.3)
***Conscious level**UNRESPONSIVE (same as GCS<8)	3	54 (70.1)
Conscious levelRESPONDS TO PAIN/Confused (same as GCS 13-9)	2	20 (26.0)
Conscious level RESPONDS TO VOICE (same as GCS 14)	1	2 (2.6)
Urine output (Lower)NIL	3	53 (70.7)
Urine output (Lower)30 ml/hr or less	2	13 (16.9)
Urine output (Lower) Less than 60 ml/hr	1	9 (11.7)
Urine output (Upper)>300ml/hr for 2 hrs	1	32 (41.6)

Note to table: MEWS 1=low risk, 2=medium risk, 3=high risk.
†Number of respondents varied.
*Only low range of values possible.

Datain Table 4-4 are presented graphically in Figures 4-3 to 4-4 for respiratory rate.

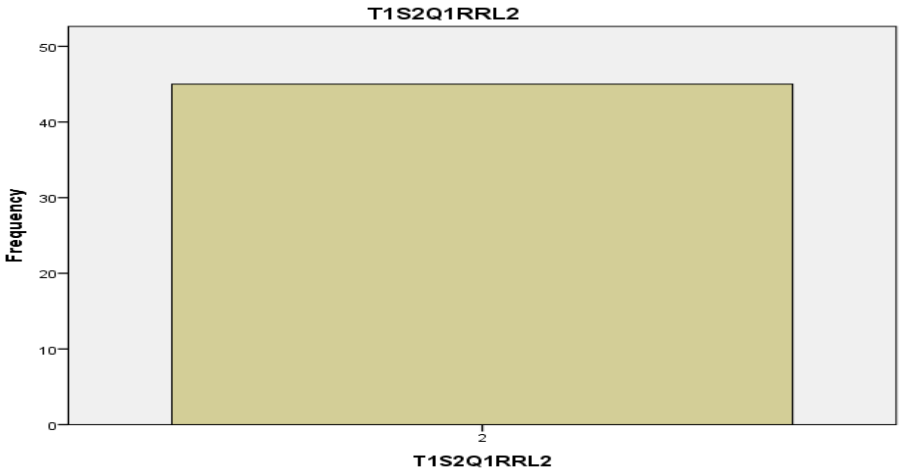

Figure 4-3: Distribution of respondents' selections when asked to identify low respiratory rates (RRL) (displayed as MEWS value low 2)

When the respondents' selections were converted to MEWS for a slow respiratory rate, 45/77 48.4% would call for more skilled assistance to assess patients who are at a medium risk for MEWS level 2.

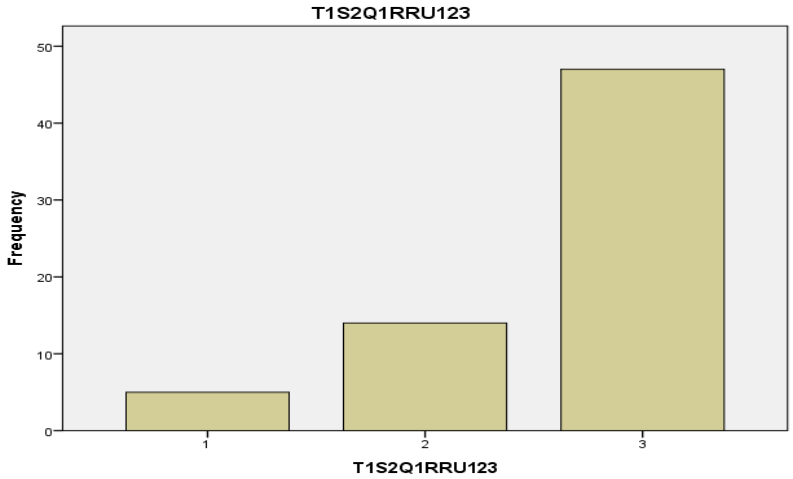

Figure 4-4: Distribution of respondents' selections when asked to identify high respiratory rates (RRU) (displayed as MEWS values: upper 1, 2, 3)

When the respondents' selections were converted to MEWS, for a fast respiratory rate of low risk MEWS level 1 only 5/77 (6.5%) would respond appropriately by calling for more skilled assistance, while 14/77 (21.2%) would respond to a medium risk MEWS level 2 and 47/77 (71.2%)would only respond to a high risk MEWS level 3.

Data in Table 4-4 are presented graphically in Figure 4-5 for oxygen saturation.

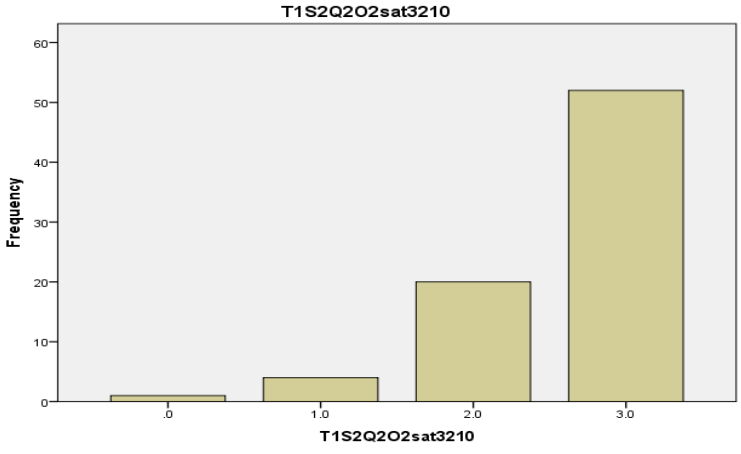

Figure 4-5: Distribution of respondents' selections when asked to identify 1 SATS range of values of concern to them (displayed as MEWS values: 0 (normal), 1, 2, 3)

When the respondents' selections were converted to MEWS, for oxygen saturation only 4/77 (5.2%) would respond appropriately and call for more skilled assistancefor a low risk MEWS level 1 while 20/77 (26%) would respond to a medium risk MEWS level 2 and 52/77 (67.5%) would only respond to a high risk MEWS level 3.

Data in Table 4-4 are presented graphically in Figure 4-6 and Figure 4-7 for heart rate.

Figure 4-6: Distribution of respondents' selections forlow heart rate (displayed as MEWS values: 1 (low & upper), 2 (low & upper)

When the respondents' selections were converted to MEWS, for a slow heart rate 25/77 (32.5%)would respond appropriately and call for more skilled assistance for a low risk MEWS level 1 while 44/77 (57.1%) would only respond to a medium risk MEWS level of 2. A small number of respondents would only call for more skilled assistance when a fast heart rate is identified for a low risk MEWS level 1,2/77 (2.6%), a medium risk MEWS level of 2, 2/77 (2.6%) and would not respond to a slow heart rate at all.

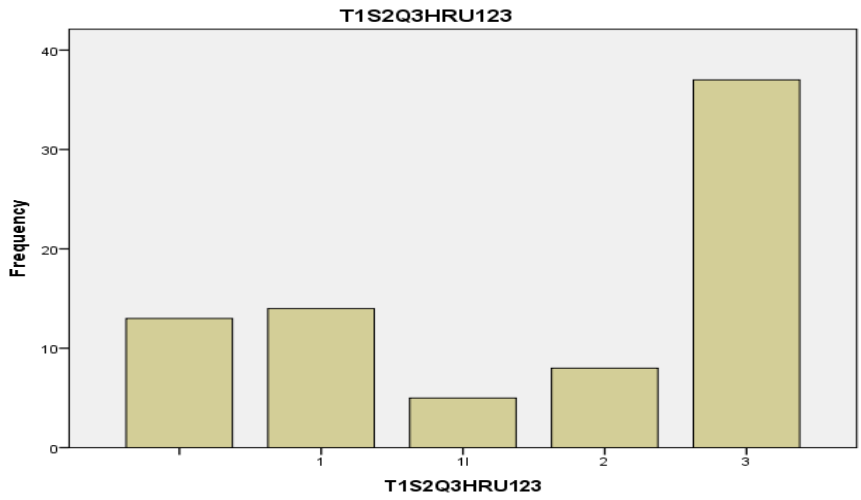

Figure 4-7: Distribution of respondents' selections when asked to identify a high range of HR values of concern to them (displayed as MEWS values: [missing], 1, 1 low, 2, 3)

When the respondents' selections were converted to MEWS, for a fast heart rate 14/77 (18.2%) would respond appropriately and call for more skilled assistance for a low risk MEWS level 1 while 8/77 (10.4%) would only respond to a medium risk MEWS level of 2 and 37/77 (48.1%) would respond to a high risk MEWS level 3.A small number of respondents 5/77 (6.5%) would only call for more skilled assistance when a slow heart rate is identified for a low risk MEWS level 1and would not respond to a fast heart rate at all.

Data in Table 4-4 are presented graphically in Figures 4-8 and 4-9 for systolic blood pressure (SBP).

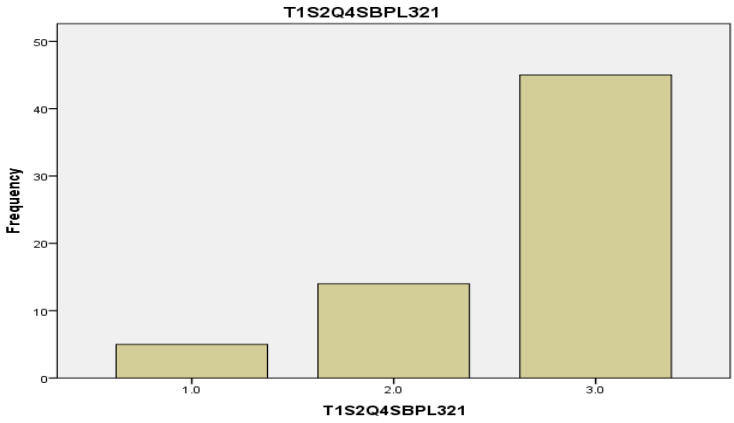

Figure 4-8: Distribution of respondents' selections when asked to identify a low range of SBP values of concern to them (displayed as MEWS values: 1, 2, 3)

When the respondents' selections were converted to MEWS, for a low systolic blood pressure 5/77 (7.8%) would respond appropriately and call for more skilled assistance for a low risk MEWS level 1 while 14/77 (21.8%)would only respond to a medium risk MEWS level of 2 and 45/77 (70.3%)would respond to a high risk MEWS level 3.

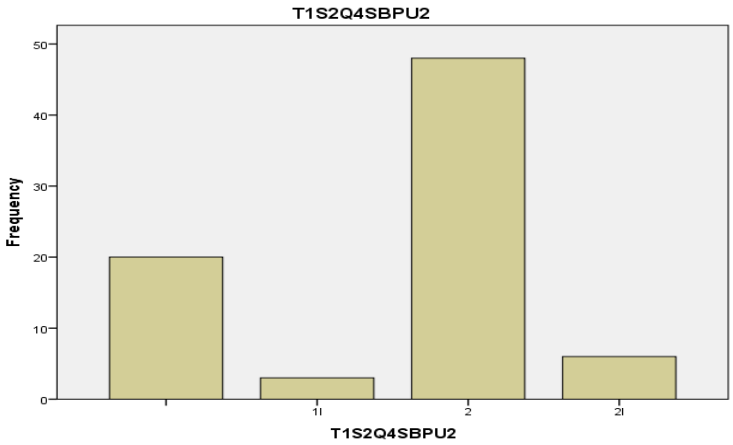

Figure 4-9: Distribution of respondents' selections when asked to identify a high range of SBP values of concern to them (displayed as MEWS values: [missing], 1 low, 2, 2 low)

When the respondents' selections were converted to MEWS, for a high systolic blood pressure48/77 (62.3%)would respond and call for more skilled assistance for a medium risk MEWS level 2.A small number of respondents would only respond to a low systolic blood pressure and not at all to a high systolic blood pressure 3/77 (3.9%) to a low risk MEWS level 1 and 6/77 (7.8%) to a medium risk MEWS level 2 while 23/77 (29.9%) responded to a normal systolic blood pressure.

Data in Table 4-4 are presented graphically in Figure 4-10 for temperature.

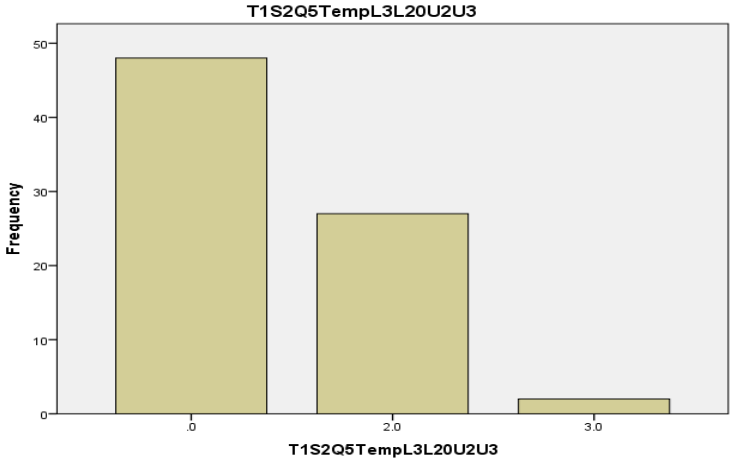

Figure 4-10: Distribution of respondents' selections when asked to identify the normal range of values for temperature (displayed as MEWS values = 0 (normal), 2, 3)

When the respondents' selections were converted to MEWS, for a normal temperature 48/77 (62.3%) responded appropriately while incorrect responses indicating an abnormal temperature accounted for 27/77 (35.1%) for a medium risk MEWS level 2 and 2/77 (2.6%) for a high risk MEWS level 3.

Data in Table 4-4 are presented graphically in Figure 4-11 for level of consciousness.

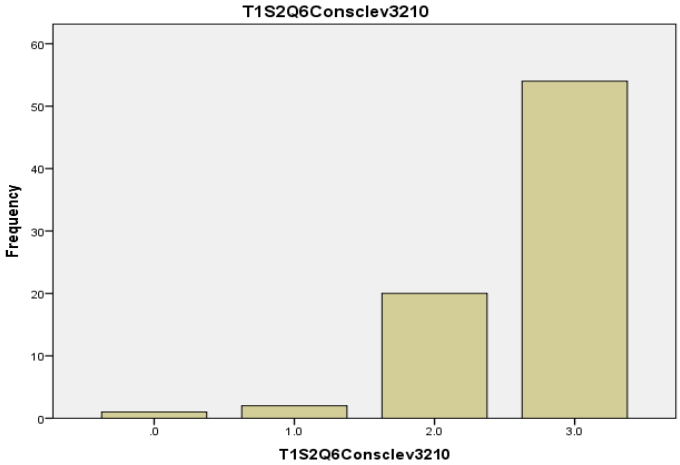

Figure 4-11: Distribution of respondents' selections when asked to identify 1 range of values for level of consciousness of concern to them (displayed as MEWS values: 0 (normal), 1, 2, 3)

When the respondents' selections were converted to MEWS, for level of consciousness 2/77 (2.6%)would respond appropriately and call for more skilled assistance for a low risk MEWS level 1 while 20/77 (26.0%) would only respond to a medium risk MEWS level 2 and 54/77 (70.1%) to a high risk MEWS level 3.

Data in Table 4-4 are presented graphically in Figures 4-12 and 4-13 for urine output.

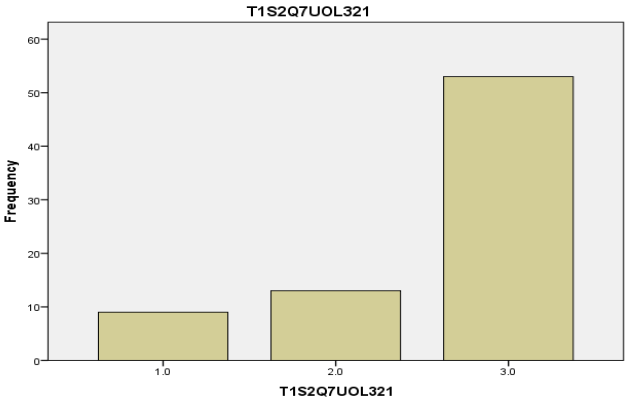

Figure 4-12: Distribution of respondents' selections when asked to identify a low range of urine output (UO) values of concern to them (displayed as MEWS values: 1, 2, 3)

When the respondents' selections were converted to MEWS, for low urine output 9/77 (11.7%)would respond appropriately and call for more skilled assistance for a low risk MEWS level 1 while 13/77 (16.9%) would only respond to a medium risk MEWS level 2 and 53/77 (70.7%) to a high risk MEWS level 3.

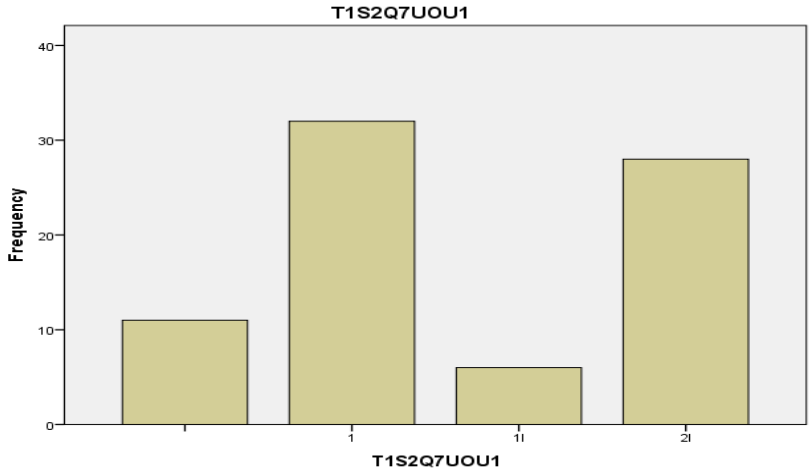

Figure 4-13: Distribution of respondents' selections when asked to identify a high range of UO values of concern to them (displayed as MEWS values: [missing], 1, 1 low, 2 low)

When the respondents' selections were converted to MEWS, for high urine output 32/77 (41.6%)would respond appropriately and call for more skilled assistance for a low risk MEWS level 1. A number of respondents would only respond to a low urine output and not a high urine output 6/77 (7.8%) would only respond to a medium risk MEWS level 2 and 53/77 (70.7%) to a high risk MEWS level 3.

A summary of the analysis of the actual numbers of respondents for each parameter converted to a MEWS level follows.

4.3.1 Response to a low risk of deteriorationata MEWS levelof 1

Overall there were 96 intended responses at a MEWS levelof 1.This relates torespiratory rate upper 5/66 (7.6%); oxygen saturation 4/76 (5.3%); heart rate lower 25/69 (36.2%) and upper 14/59 (23.7%); systolic BP lower 5/64 (7.8%);level of consciousness 2/76 (2.6%);urine output lower 9/75 (12%)and upper 32/77 (41.6%).

4.3.2 Response to a medium risk of deterioration ata MEWS level of 2

Overall there were 226intended responses at MEWS level 2. This relates to respiratory rate lower 45/77 (58.4%) and upper 14/66 (21.2%); oxygen saturation 20/76 (26.3%); heart rate lower

44/69(63.8%) and upper 8/59 (13.5%); systolic BP lower 14/64 (21.9%) and upper 48/77 (62.3%); level of consciousness 20/76 (26.3%); and urine output lower 13/75 (17.3%).

4.3.3 Response to a high risk of deterioration ata MEWS level of 3

Overall there were 288intended responses at MEWS level 3. This relates to respiratory rate upper (fast rate) 47/66 (71.2%); oxygen saturation 52/76 (68.4%); heart rate upper (fast rate) 37/59 (62.7%); systolic BP lower 45/64 (70.3%); level of consciousness 54/76 (71%); and urine output lower 53/75 (70.7%).

4.3.4 Incorrect selections

Respondents made incorrect selections of high and low parameter values to indicate the level of risk of clinical deterioration at which they would call for help.The MEWS thresholds (cut-points) were used as a guide for analysing the data,which are presented in Table 4-5.An example of SPSS data analysis for respondents' incorrect selections is shown in Appendix 9.

Table 4-5:Respondents' (n=77) incorrect selectionsofhigh and low parameter values

Instead of	Incorrect MEWS selected	Number of incorrect selections (%)
RESPIRATORY RATE (Lower)	2 upper	3 (3.9)
RESPIRATORY RATE (lower)	1 upper	1 (1.3)
RESPIRATORY RATE (Lower)	0=normal	23 (29.9)
RESPIRATORY RATE (Upper)	0=normal	8 (10.4)
[¥]OXYGEN SATURATION	0=normal	1 (1.3)
HEART RATE (Lower)	2 upper	2 (2.6)
HEART RATE (Lower)	1 upper	2 (2.6)
HEART RATE (Upper)	1 lower	6 (7.8)
HEART RATE (Upper)	0=normal	6 (7.8)
Systolic BP (Lower)	0=normal	11 (14.3)
Systolic BP (Upper)	0=normal	12 (15.6)
Systolic BP (Upper)	1 lower	3 (3.9)
Systolic BP (Upper)	2 lower	7 (9.1)
[¥]Level of consciousness	0=normal	1 (1.3)
Urine output (Lower)	0=normal	1 (1.3)
Urine output (Upper)	0=normal	6 (7.8)
Urine output (Upper)	1 lower	6 (7.8)
Urine output (Upper)	2 lower	26 (33.8)
[¥]Temperature (normal)	2 lower	24 (31.2)
Temperature (normal)	3 lower	1 (1.3)
TOTAL 20* x 77 = 1540		150†/1540 (9.7)

Note to table:

Respondents were instructed to circle two blocks(one with high values and one with low values) for respiratory rate, heart rate, systolic BP and urine output,that would be of concern to them as **early** signs of deterioration in a patient and for which they would summon more skilled help (one block to be selected for[¥]).
The number of variables* (20) was multiplied by the number respondents (n=77); the number of incorrect selections† (150) is expressed as the numerator.

Data in Table 4-5 indicate that there were150/1540(9.7%) incorrect responses. Instead of selecting a low respiratory rate, 3/77 (3.9%) of respondents selected a fast rate at a medium-risk MEWS of 2; 1/77 (1.3%) selected a fast rate at a low-risk MEWS of 1; and 23/77 (29.9%) selected a normal MEWS. Instead of selecting a fast respiratory rate (upper MEWS),8/77 (10.4%) respondents selected a normal range.

Instead of selecting an abnormal oxygen saturation level, 1/77 (2.5%) respondent selected a normal range. Instead of selecting a low heart rate, 2/77 (2.6%)selected a fast rate at a medium-risk MEWS of 2; 2/77 (2.6%) selected a fast rate at a low-risk MEWS of 1.Instead of selecting a fast heart rate (upper MEWS), 6/7 (7.8%) respondents selected a low-risk MEWS of 1 and 6/77 (6.8%) respondents selected a normal range.

Instead of selecting a low systolic BP,11/77 (14.3%)respondents selected a normal range.Instead of selecting a high systolic BP (upper MEWS),12/77 (15.6%)selected a normal range, 3/77 (3.9%) selected a low-risk MEWS of 1, and 7/77 (9.2%) selected a low systolic BP at a medium-riskMEWS of 2.

Instead of selecting an abnormal level of consciousness, 1(1.3%) of the 77 respondentsselected a normal range.

Instead of selecting a low urine output, 1/77 respondents (1.3%) selected a normal range. Instead of selecting a high urine output (upper MEWS), 1 (1.3%) selected a normal range, 6 (7.8%) respondents selected a low urine output at a low-risk MEWS of 1, and 26 (33.8%) selected a low urine output at a medium-risk MEWS of 2.

Instead of selecting a normal temperature,24 (31.2%) respondents selected a low temperature at a medium risk of a low MEWS 2 and 1/77 (1.3%) selected a high temperature at a high risk of a low MEWS 3.

4.4 Primary objective B: ability to identify normal temperature range

Data showing respondents' ability to identify a normal temperature are presented in Table 4-6.

Table 4-6: Respondents' recognition of a normal temperature

Physiological variable	MEWS	No. of respondents (%)
Temperature (normal)		48 (62.3)

Data in Table 4-6 indicate that 48 (62.3%) of the 77 respondents identified a normal temperature reading and 29 (37.7%) did not.

4.5 Secondary objective: clinical reasoning process

A sample of 10 participants was randomly selected from the 77 respondents and requested to participate voluntarily in individual interviews. Selected participants were given their completed questionnaires (Appendix 2, Section 3) and asked to reflect on and describe the clinical reasoning process they had adopted when deciding to call for more skilled assistance for each abnormal range of readings for each of the seven parameters (respiratory rate, oxygen saturation, heart rate, systolic BP, level of consciousness, urine output and temperature).

Interview data were analyzed usingthe Elstein *et al.*(1978) model as a guide for information processing, as shown in Table 3-3 (reliability testing).A summary of the frequency of occurrence of each of the four components of the information-processing model is presented in Table 4-7.

Table 4-7: Checklist for analysing randomly selected participants' (n=10) transcribed interviews for frequency of occurrence of four aspects of information-processingpatterns

		Evidence found or not			
Checklist for evidence of information processing,Elstein *et al.*(1978)	**Participant code No.**	**Yes**	**No**	**Other - describe**	**Frequency of occurrence**
1. Cue acquisition which comprises of a process of obtaining information.	201353 201361 201359 201357 201360 201352 201356 201354 201355 201351	√		The questionnaire survey did not contain a scenario/patient problem from which cue acquisition could be made. The participants were shown their completed surveys but limited cue acquisition occurred as respondents did not change responses that were incorrect.	N=10
2. Generating initial hypotheses, when alternative problem formulations are retrieved from memory using cues to link up to the long-term memory.	201353 201361 201359 201357 201360 201352 201356 201354 201355 201351	√		All participants justified their selections of values for calling for assistance by working back from normal values which they could recall from theory and ward experiences. Respondents then deduced the abnormal values of the vital signs from these.Participants recalled incidents relating to oxygen saturation and level of consciousness of patients from a ward situation, and 9/10 participants would respond to a high-risk MEWS 3 for both saturation levels as well as level of consciousness. Participants interpreted their information by recalling a patient scenario,for example "the low urinary output of a dehydrated postoperative, renal failure and a patient with urinary retention".	n=10
3. Cue interpretation occurs when data interpretation follows in light of the alternative hypotheses under consideration.	201351 201361 201357 201360 201352 201356 201353	√		Respondents made deductions by first determining the normal physiological parameters.201353- One participant interpreted the low systolic BP as "hypotension and patient may be bleeding from somewhere" and chose a high-risk MEWS 3 and medium-risk MEWS 2. 201353-" if a patient	n=7

Checklist for evidence of information processing,Elstein *et al.*(1978)	Participant code No.	Yes	No	Other - describe	Frequency of occurrence
				excreted 30ml or less it is very low and it could be indicating renal failure or a urine retention, it could also be a danger sign for a patient"; this participant chose a high-risk MEWS 3 for low, and medium-risk MEWS 2 for high. 201361: "as dit nou minder as 30 is beteken hy kan miskien gedehidreed" [if it is less than 30 it means he can be dehydrated] – participant's interpretation for medium-risk MEWS 2 for low and low-risk MEWS 1 for high.	
4. Hypothesis evaluation		0	√	Participants did not display any information that indicated weighing-up of cues to confirm the initial/tentative hypothesis or determine the diagnoses.	n=0
Total		3	1		

Table 4-7 was constructed for the purpose of analysing the data.

Examples of the data for the four major components of the clinical decision-making/reasoning process (Elstein *et al.*,1978 reported by Dowie and Elstein (1988:111-115) presented in frequencies in Table 4-7,are summarised below and presented in full in Appendix10.

1. Cue acquisition (a process of obtaining information from participants' completed questionnaires), for example reading the question and looking at the answers circled to recognize and gather cues.

2. Generating initial hypotheses (when alternative problem formulations are retrieved from memory using cues to link up to the long-term memory), for example an explanation offered or an assumption as a starting point for the reasoning or action taken.

3. Cue interpretation (when data interpretation follows in light of the alternative hypotheses to confirm or disconfirm hypotheses or as non-contributory), for example reflecting on answer chosen and explaining how they arrived at the answer or why they made the particular decision.

4. Hypothesis evaluation (data are weighted and combined to determine if one of the hypotheses generated is confirmed); there was no evidence of this.

The summary of frequencies of occurrence of the four processes in Table 4-7 indicates that of the 10 respondents who reflected on their completed questionnaires for a hypothetical patient,all provided evidence of cue acquisition (level 1) and could retrieve alternative problem formulations from memory using cues to link up to the long- term memory albeit limited (domain-specific knowledge and ward experience) (level 2).However, although there was limited evidence of initial hypothesis generationthere was no evidence of hypothesis evaluation (level 3).

4.6 Summary

Chapter Fourreported on the results for each research objective of this study. Themedian age for 62 (80.5%) of the respondents who responded to this questionwas 25.0 years. Very few had a previous nursing qualifications (3/77, 3.9% had an enrolled nurse qualification). Themajority of respondents were female (66/77; 85.7%) and Afrikaans was the first language preference for 33 (42.9%) respondents, followed by isiXhosa for 31/77 (40.8%) respondents and English for 10/77 (13.2%) respondents.Respondents' selections of low and high values for seven physiological parameters showed that overall there were288/416(69.2%) intended responses at a high-risk MEWS level 3, 226/639(35.4%) intended responses at a medium-risk MEWS level 2, and 96/562(17.1%) intended responses at a low-risk MEWS level 1.The majority of respondents (48/77, 62.3%) recognized a normal temperature reading (35-38.4^{o} C).Interview data from 10 randomly selected participants indicated limited cue acquisition, hypothesis generation andcue interpretation, and no evidence of hypothesis evaluation.

CHAPTER FIVE

DISCUSSION, IMPLICATIONS, RECOMMENDATIONS AND CONCLUSION

5.1 Introduction

In this study reported published studies have shown that, to prevent serious adverse effects, nurses should recognize early signs of clinical and physiological deterioration in patients and take appropriate action.Effective observation of ward patients is the first step in identifying the deteriorating patient and effectively managing their care, but detectable physiological signs and symptoms of deterioration have been overlooked, neglected or poorly managed by health care professionals.

It is also important to understand nurses' practice of recording vital signs and how they employ their ways of knowing in nursing in making clinical decisions. Although the primary purpose of the observation charts used by nurses for recording patients' vital signs is to alert health care practitioners to a deteriorating condition in a patient, performance of these non-standardised charts is under-reported.

EWSTTS,employed since 1979, are designed to provide a standard method of interpreting one or more physiological signs(with predetermined ranges)andresponding to signs of clinical deterioration. However,apart from one South African study (Carter, 2008)the published literature about nurses' use of EWS charts is from the developed countries.

No study appears to have been undertaken internationally or in South Africa to explore and describe student nurses' ability to recognizephysiological deterioration and the clinical decision-making processes involved when deciding at what level of physiological deterioration to call for more skilled assistance. The primary purpose of this study was to determine whether fourth-year nursing students have the knowledge and clinical decision-making skills to identify and respond to abnormal vital sign recordings for hypothetical patients needing assessment. The respondents were in their final year of study on a 4-year programme of the SANC for preparation of a nurse (general, psychiatric and community) and midwife in terms of Regulation R425 of 1978.

The aims of the study were achieved by objectives. The principal findings are summarised for each objective.

5.2 Principal findings

5.2.1 Sub-objective: Respondents' demographic characteristics

The 'typical' final year student was female, approximately 27 years old (95% CI 25.74-28.52), had Afrikaans as a first language and no previous qualification. Most male respondents had isiXhosa as a first language. There was a statistically significant association between gender and language preference (Chi-square 17.21, df=3, p=0.001).

5.2.2 Primary objective A: Ability to identify early signs of physiological deterioration

Findings refer to respondents' ability to identify early signs of physiological deterioration when deciding to call for more skilled assistance. In this study the range of normal and abnormal values for each of the six variables (abnormal respiratory rate, oxygen saturation levels (SAT/SpO_2), heart rate (pulse), systolic BP, level of consciousness and urinary output volume) was derived from the Cape Town MEWS (Kyriacos, 2011:413).

5.2.2.1 Respiratory rate (Section 2, question 1)

Forty-seven of 66 (71.2%) respondents woulddelay calling for more skilled assistance until a respiratory rate of ≥30 a minute was reached(a high-risk MEWS levelof 3).Forty-five of the 77 (58.4%) respondents would call for more skilled assistance for a slow respiratoryrate of ≤9 a minute (at a medium-risk MEWS level of 2), whereas 14/66 (21.2%)would respond to a fast respiratory rate of 21-29 (medium-risk MEWS levelof2).

5.2.2.2 Oxygen saturation (Section 2, question 2)

Most respondents (52/76, 68.4%) would delay a response until oxygen saturation dropped to 85%, a high-risk MEWS level of 3;20/76 (26.3%)respondents would respond to a medium-risk MEWS level of 2; and 4/76(5.3%) respondentswould respond to a low-risk MEWS level of 1.Instead of selecting an abnormal oxygen saturation, 1 (2.5%) of the 77 respondents selected a normal rangeat which they would call for help.

5.2.2.3 Heart rate (Section 2, question 3)

Respondents were more concerned about a slow heart rate (44/69, 63.8%) at a medium-riskMEWS level of 2 (40 beats per minute or lower) than a fast heart rate (37/59, 62.7%) ata high-risk MEWS level of 3(130 beats per minute or more) or a medium-risk MEWS level of 2 (111-129 beats per minute) for fast heart rate (8/59, 13.5%).Respondents regarded a slow heart rate as having greater potential for adverse effects than a fast heart rate.

5.2.2.4 Systolic BP (Section 2, question 4)

Most respondents (45/64, 70.3%)would delay a response untila low systolic BPof ≤70 mmHg was recorded(at a high-risk MEWS level of 3), recognizing this range as an early sign of deterioration. For a high systolic BP of ≥200 mmHg(a medium-risk MEWS level of 2), 49 of the 77 (63.3%) would delay a call for assistance. More respondents (48/77, 62.3%) were concerned about a high systolic BPof ≥200 mmHgat a medium-risk MEWS level of 2 than a low systolic BP of 71-80 mmHgat a medium-risk MEWS level of 2 (14/64, 21.9%).

5.2.2.5 Level of consciousness (Section 2, question 6)

Respondents (54/76, 71%) regardeda high-risk MEWS level of3 as an early sign of deterioration for level of consciousness,followed by a medium-risk MEWS level of 2 (20/76, 26.3%) for responds to pain,and 2/76(2.6%) would respond to a level of consciousness at a low-risk MEWS level of 1.

Most respondents (54/76, 71%) wouldonly call for more skilled assistance when the patient is unresponsive(ahigh-risk MEWS level of 3, equivalent toa GCS reading of <8). Twenty of 76 (26.3%) respondents would call for assistance for a medium-risk MEWS level of 2 (responds to pain) and 2/76(2.6%)for a low-risk MEWS level of 1 (reacts to voice).

5.2.2.6 Urine output (Section 2, question 7)

Most participants (53/75, 70.7%) would delay a response until the patient is passing no urine (a high-risk MEWS level of 3). Thirty-two of 77 (41.6%) participants would call for assistance for a urinary output of ≥300 ml for2 hours (a low-risk MEWS level of 1). Thirteen of 75 (17.3%) would call for assistance for a urine output of <30 ml/hour (a medium-risk MEWS level of 2).

5.2.3 Primary objective B: Respondents' ability to identify a normal temperature range

In this study the range of normal and abnormal values for the physiological variable of temperature was derived from the Cape Town MEWS (Kyriacos, 2011:413). The majority (48/77, 62.3%) of participants identified a normal temperature range (Section 2, question 5).

5.2.4 Secondary objective: Clinical reasoning processes

The secondary aim of the study was to analyse clinical decision-making processes adopted by 10 randomly selected participants when deciding at what level of physiological deterioration to call for more skilled assistance (Appendix 2, Section 3). The aim was achieved by interviewing these participants using the Elstein *et al.*(1978) four-phase model as a guide foranalysing frequency of occurrence of the four components of information processing.

The 10 participants who were randomly selected for interviewingwere considered to have the requiredlevel of knowledge for the low-complexity task of identifying the abnormal physiological variable for which they would summon more skilled assistance. The survey questionnaire was not based on a case scenario, although students were provided with their completed questionnaires populated with their selections of vital sign values. This information was used by students for cue acquisition. Hammond (1964:315) asserts that a cue refers to signs, symptoms and other information available to the nurse, so their completed questionnaires were considered to be confirming and contextual (Botti & Reeve, 2003:42) for this exercise.

The cuesverbalised by respondents during the cue acquisition phase were limited to recognition of the recorded abnormal vital signs; this indicated poor or incomplete cue acquisition.This is evident from the exclusion or oversight that the questionnaire referred to a vital sign "of concern to you as early signs of deterioration in a patient and for which you will summon more skilled help", and "early sign" appeared to be overlooked as all 10 participants chose high-risk MEWS level 3 for oxygen saturation and level of consciousness; for low urine output 2 chose medium-risk MEWS level2 and 5 chose high-risk MEWS level 3;for low systolic BP 6 chose a high-risk MEWS level 3; and for fast heart rate 7 chose a high-risk MEWS level3.

Respondents first identified the normal values for the vital signs either from what they had been taught or as found in their textbook. These reasoning processes used by respondents appeared to be consistent with those described by Tanner (2006:207), who asserts that the analytical process is used when there is a lack of knowledge and then textbook information is compared to assessment data.Only 3 of the 10participants used past experience during cue acquisition. Botti and Reeve (2003:39) reported that novices are in the process of acquiring domain-specific knowledge and have limited experience with nursing-related problems. It seems probable that novices are more reliant on their general problem-solving ability in making clinical judgements. Botti and Reeve (2003:40) assert that according to Elstein*et al.* (1978) regarding the information-processing model, effective problem-solving depends on the individual's ability to adapt to limitations of both short- and long-term memory by generating hypotheses to conserve limited information-processing resources.Participants in this study generated an initial hypothesis but did not evaluate the hypothesis. Hoffman(2007) asserts that cue collection, which is perceived external stimuli in the short-term memory and leads to generation of the initial tentative hypothesis, transpires as cues link to knowledge in the long-term memory.

In this study it was difficult to determine whether, or to what extent, students used a hypothetico-deductive reasoning process to generate hypotheses (the third stage of the model), as respondents provided 'thin' evidence of reasoning and no evidence of evaluation of hypotheses (the last phase of the model). Poor evidence of hypothesis generation could possibly be ascribed to poor cue acquisition in the first phase of the reasoning process.Poor cue collection can also be ascribed to backward reasoning when an hypothesisis used to generate or evaluatedata and the hypothesis impedes the data type searched for (Botti & Reeve, 2003:41).

5.3 Limitations and strengths of the study methods

The scope of this study is limited by definition of it being a minor dissertation. Nevertheless, the study may have been strengthened by having more pilot study participants, selecting a research setting not related to the researcher's place of work and a larger sample size.

The pilot study was conducted with two participants, far below the recommended 10 participants (Nieswiadomy, 2002) or 10% of the final study size (Lackey & Wingate, 1998:375), which would have been 8 as the final study size was 77. In this study the final decision was determined by cost and time constraints (Hertzog, 2008:180). The pilot study experts validated an existing survey questionnaire (Kyriacos, 2011), for use in a different context to that of the original study and a new section for the interview had been added. The existing instrument and modification (the addition of the clinical reasoning component) was validated by the experts, followed by a pilot study to ensure its reliability. The subsequent data analysis was enhanced by converting responses to a validated MEWS. Validation of the data collection tool informed interpretation of the data for Section 1 (demographic data) and Section 2 (identification of abnormal vital signs), and therefore will inform implementation of the results (Rattray & Jones, 2007).

The researcher was a member of the academic staff at the research setting and participants could have perceived her as an authority figure, despite measures to lower the power gradient by ensuring that participants understood ethical concepts such as voluntary participation and withdrawal from the study with no penalties. All participants signed consent to participate in the study. Nevertheless, this may have influenced the number of respondents recruited into the study and their responses during the interviews.An analysis of the students' background of those who declined to participate may have strengthened the study.

The estimated sample size of 177 was not achieved therefore the data have to be interpreted with caution and there are implications for implementation of the findings as these cannot be

generalized to the population of student nurses.Although English is the language of instruction at the research site and the questionnaire and interview were in English, Afrikaans was the first language of choice for 43.4% of the respondents, isiXhosa was spoken by 40.8% of the respondents and English was the preferred language for 13.2% of respondents. Language difficulty may therefore have influenced the quality of data for the interviews.

Further limitations of the questionnaire survey used in this study were that the tables with MEWS values were not scenario-based which may have been more realistic for the students in that they may have seen the physiological deterioration in a clinical context. A clinical scenario-linked MEWS may have limited student guessing. This feedback from students may have been elicited if the interview that followed with a randomly selected number of participants had included a question such as: "How would the use of a clinical scenario have made it easier for you to identify early signs of deterioration in a patient?"

The use of a pen-and-paper exercise rather than a realistic clinical setting is a limitation of this study as contextual factors have a profound influence on decision-making (Tanner, 2006:206). In addition to textbook knowledge, nursing judgement in the actual care setting is influenced by knowledge of the unit, routine workflow and specific patient information that assists in prioritising tasks (Ebright*et al.*, 2003:635). In addition, the novice nurse frequently responds to complex and unfamiliar clinical situations by drawing on theoretical knowledge and psychomotor skills rather than enacting decision-making that addresses the complex and multidimensional nature of the situation(Gillespie & Paterson, 2009:164).

The Elstein *et al.*(1978) four-phase model was not useful as a guide foranalyzing the frequency of occurrence of the four components of information processing as there were few guidelines for interpreting the data; therefore results have to be interpreted with caution.It was expected that it would have been relatively easy to identify the four components of the participants' reasoning process from the model (Elstein *et al.*,1987),but this was not so. Respondents were not forthcoming with a description of their reasoning process when asked to reflect on their selections of parameters for calling for more skilled assistance, and the data were 'thin'. The process of analysis of the data may have been facilitated by having set an"*a priori*factor structure" (Rattray & Jones, 2007:235) as a guidefor analysis of the interview data or alternatively, a clinical scenario.

5.4 Limitations and strengths of the study findings in relation to published studies

A limitation of the study is that many of the references cited are dated, mainly because the focus area of this study is under-researched. The keywords could possibly have been expanded to include more specific words such as 'student nurses' AND 'physiological' AND vital signs' as the literature search was narrow and results disappointing. Nevertheless, following the completion of the study, having used these search terms, a total of only 60 sources were located, of which 5 were found relevant and 1 of these were included in the reference from the original search.

The finding that 74 of the 77 (96.1%) respondents had no previous qualifications is not surprising, as they were in a pre-registration programme. Of the 77 respondents,1 (1.3%) had an enrolled nurse qualification.For nurses in South Africa to become Registered Professional Nurses there are two career pathways: 1) a 2-year bridging programme for Enrolled Nurses, leading to single registration as a General Registered Nurse; and 2) a 4-year Diploma or Degree programme leading to registration as a Nurse (R425 of 1985) and Midwife. In 2012 approximately 1000 Enrolled Nurses in the Western Cape completed the bridging programme (SANC online), so this 1 respondent seems to have been in the minority amongst Enrolled Nurses to elect the 4-year pathway.

English is the medium of instruction at the College, so even if participants were English second- or third-language speakers, language was not an exclusion criterion as all the students would have had basic English language competence. Interestingly, the majority of respondents (33 or 43.4%) had Afrikaans as their first language, followed by isiXhosa in 31 (40.8%) and then English in 10 (13.2%).The finding that 66 (86.8%) of the 77respondents were female is to be expected, as nursing has historically been a female-dominated profession.Cooper*et al.*(2010:2312)reported on a study population of final year students where 48 (94.1%) of 51 were women.

The respondents in the present study had no prior exposure to the MEWS in their 4 years of training, andtherefore their responses were based on knowledge gained from thecurriculum content and clinical placement experiences.The study results could not be compared with previous studies, as no such study was located that examined student nurses' ability to recognize early signs of clinical deterioration;therefore the results have to be interpreted with caution.

The results of the data analyses for the seven physiological variables will be discussed respectively as indicated by the respondents' ability to recognize physiological deterioration.Interpretation of responses was guided byconverting values to MEWS weighted cut-points.

The results for respiratory rate indicate that most respondents would delay calling for assistance until clinical deterioration had reached a high-risk MEWS level of 3.Respondents did not recognizethatboth a fast and a slow respiratory rate areof equal concern. These findings are of great concern, as published studies have shown that certain physiological parameters such as respiratory ratealong with changes in heart rate have been identified as being the most sensitive and earliest indicator of deterioration in a patient's condition (Ridley, 2005:320).

MEWS offers an attempt to identify deteriorating patients early so that timely interventionscan occur, thus reducing SAEs (Hammond *et al.*, 2013:18).The responses for respiratory rate indicate an inability of final year nursing studentsto recognizeearly signs of deterioration. Buist *et al.* (2004:139)reported that the strongest predictor of mortality wasa decrease in respiratory rate (<6 breaths/min),which was associated with an increased risk of dying in hospital, and thattachypnoea (>30 breaths/min; OR 6.1, 95% CI 0.5–1.8) was associated with increased mortality athospital discharge.Burch, Tarr and Morroni (2008:677) concur that respiratory rate was found to be an independent predictor of in-hospital death, and a respiratory rate of 30 breaths per minute in the emergency department was found to be a predictor for admission.

Most respondents would delay a response until oxygen saturation had dropped to 85% (a high-risk MEWS level of 3), and this is of concern as oxygen saturation is one of the three most common call criteria for METs (Nurmi *et al.*, 2005:703).An oxygen saturation of <90%, which in thepresent study is equal to a mediumrisk MEWS level of 2, was reported as a late sign of deterioration by Jacques *et al.* (2006:179), who also reported that a milder reduction in oxygen saturation of 90-95% was also found to be significant in their study but too frequent for realistic management by METs. The inability to recognize the significance of abnormal oxygen saturation levels was also reported as being associated with SAEs such as death, cardiac arrest, severe respiratory problems and resulting in transfers to critical care(Jacques*et al.* 2006:179).

The results indicate that most respondents identified a low heart rate of ≤40 bpm (medium-risk MEWS of 2) and fast heart rate of ≥130 (high-risk MEWS of 3) as an early sign of deterioration for which more skilled assistance would be summoned. A heart rate of 130 or more was identified as one of five abnormal physiological parameters that independently predicted hospital admissions in an emergency department and was associated with 1.4 deaths (Burch *et al.*, 2008:676). Similarly, Jacques *et al.*, 2006:178) reported that a pulse rate of 40-49/min or 121-140/min was associated with 5/232 deaths; 3/232 severe respiratory problems and 15/2320transfer to intensive care unit.

The findings for systolic BP indicate that a high percentage of respondents will only call for more skilled assistance for a systolic BP of ≥200mmHg (a medium MEWS level of 2)and when a systolic BP of ≤70mmHg is reached (a high-risk MEWS level of 3). In previous studies these late responses have been reported to result in SAEs such as death 4.6 (95%) for a systolic BP more than 200mmHg (Burch *et al.*, 2008:676). Jacques *et al.* (2006:178) reported systolic BP <80mmHgas a late sign which led to 3/55 deathsand2/55 cardiac arrests. Furthermore, a systolic BPof more than 200mmHgin an emergency department required admission (Burch *et al.*, 2008:676).

The results for final year student nurses' ability to recognize early signs of altered level of consciousness indicate that a high number of respondents will only call for more skilled assistance when a patient is unresponsive (at critical high-risk MEWS level 3 which is equivalent to a GCSreading of <8). Jacques *et al.* (2006:178) reported a level of consciousness identified as unresponsive to verbal commands as a late sign which lead to death in 3/20 cases, cardiac arrest in 0/20 cases, severe respiratory problems in 1/20 cases and transfer to intensive care wards for 2/20 cases in 3046 non-DNAR[1] admissions. The number of deaths reported by Burch *et al.*(2008:676) was 5.1cases in a sample size of 113 and 2.8 cases in a sample size of 469 patients who had an abnormal level of consciousness andwere admitted via the emergency department.

Most participants (53/77, 70.7%) would delay a response until the patient is passing no urine (a high-risk MEWS level of 3), and 32/77 (41.6%) participants would call for assistance for a urinary output of ≥300 ml for 2 hours (a low-risk MEWS level of 1). These findings indicate potential for SAEs, as Jacques *et al.* (2006:178) reported SAEs OR 188.6 (30.1—1179.8), $p < 0.0001$ and admissions with events of SAEs versus all admissions with signs = [3/5] deaths of 3046 non-DNAR patients with a urine output <200 ml in 24 hours.

It is of concern that even a small number of final yearstudent nurseswere unable to identify a normal temperature range,as this is the most basic parameter to interpret.

From responses to the physiological variables, it is evident that a high-risk MEWS level 3 elicited the highest response rate for respiratory rate (47/66, 71.2%), oxygen saturation (52/76, 68.4%), level of consciousness (54/76, 71%) and for low urine output (53/75, 70.7%). Sharpley and Holden (2004:99) reported that the further the deviation from the physiological norm, the higher the EWS will be and the sicker the patient. In a study conducted byLudikhuize *et al.*(2012:423) to determine the predictive value of MEWS, 81% of unexpected deaths or patients who suffered

[1]Non-do not actively resuscitate

another SAE could have been identified early using the MEWS, ashalf of these patients showed clear signs of deteriorationwith a MEWS value of 3 or more 25 hours beforethe event (MEWS calculated on all measurements, n=2688).

The findings from the present study are disappointing, as final year nursing students lacked the ability to recognize early signs of clinical deterioration and would have delayed responses even to late signs of deterioration. This is of concern as observation practice is regarded as a core skill required for physiological assessment of patients, and it raises questions about the students' clinical practice. A systematic review by Odell*et al.* (2009:2002) showed that nursing staff on the wards are struggling to detect and managedeteriorating patients adequately, being hampered byinexperience, lack of skill and excessive workloads. The participants in this study are exposed to task allocation in the clinical placement setting,which impacts negatively on clinical experience, as research findings of qualitative studies reported that sometimes clues to patients condition are overlooked because observations appear to be viewed as a 'task to be done' (Wheatley 2006:119).A task-orientated culture was identified by (Hogan 2006:491), who asserts that nurses will be unable to experience the whole situation of observation and assessment practice.A study by Hoffman*et al.* (2004:53) found that personal factors such as education and experience were not significantly associated with clinical decision-making. Their study (Hoffman*et al.*, 2004:53), which examined Australian nurses' decision-making, found that the"greatest variability to decision-making was holding a professional occupational orientation, followed by level of appointment area of clinical speciality and age, in that order".

An understanding of which variables affect clinical decision-making in this study is difficult to determine due to the absence of the clinical context in which participants in this study made their decisions.However, it should be noted that the participants in this study are required to practice under direct/indirect supervision of the registered nurse, and this position has a direct bearing on their occupational orientation. Thus participants will be inclined to see themselves as accountable to superiors, and believe in the right of managers and those in higher positions to make decisions for them (Hoffman *et al.*,2004:54).

5.5 Meaning of the study: implications for clinicians or policymakers

The inability of final year nursing students in the present study to recognize that a slow heart rate is as important as a fast rate could be related to a lack of understanding of how physiological processes influence trends in the patient's observations (Kisiel & Perkins, 2006:1052), and could be vital in the prevention of a serious life-threatening event. Furthermore, this lack of

understanding of a patient's physiological response can be related to the fact that these respondents are in the process of acquiring tacit knowledge through experience.Cioffi(2000:108) reported that nurses' knowledge of the patient and past experience were involved in the recognition of patient deterioration. This acquisition of foundational knowledge is also derived from multiple dimensions, such as the socialisation process to and in the nursing profession, the nurse herself and the patient(Gillespie, 2010:334), which these respondents are in the process of acquiring.

Kyriacos (2011)reported that while training resulted in a statistically significant difference (p=0.01) between post-intervention knowledge test scores of nurses in the intervention wards who had training (19.5, SD 25.6)and those in the control arm who had no training (4.0, SD 13.2), nurses in both trial arms failed to respond appropriately to recorded disturbed physiological parameter recordings. This means that knowledge alone will not determine a change in nurses' behaviour.

5.6 Unanswered questions and future research

Further questions for future research were raised by this study and address the 'so what' aspect of this descriptive study, such as the following:

- What factors contribute to final year student nurses' delay in calling for assistance to assess clinical deterioration in a patient?
- What clinical guidelines for vital sign monitoring, recognition of early signs of clinical deterioration and reporting are available in South African hospitals?
- How many nursing schools in South Africa incorporate the MEWS, and what is its effectiveness in enabling student nurses to recognize early signs of clinical deterioration?
- What clinical reasoning model would be suitable for analyzing student nurses' clinical decision-making skills?

5.7 Recommendations

Although the response rate was low, the following recommendations are tentatively proposed in the interests of patient safety.

5.7.1 Nursing education institutions

Respondents had not previously been exposed to the MEWS or any form of track-and-trigger systemthat incorporated a reporting algorithm. A structured programme for vital sign monitoring, interpretation and reporting that incorporates the MEWS should be designed as a core

competency within the 4-year training programme for nurses that incorporate 4000 hours (334 days for a 12-hour shift) of clinical experience in various patient care settings. This is particularly important as the MEWS is not yet recommended for national implementation in South Africa, unlike the National MEWS (NEWS) that is advocated for implementation throughout the UK by the Royal College of Physicians (2012).

Nursing education programmes need to focus on teaching strategies that will allow integration of physiology,such as experiential and problem-based learning, in order to develop a sound knowledge base of vital sign measurement, monitoring, documentation and interpretation.

Pre-service educational programmes need to incorporate an educational framework that develops students' thinking strategies in order to employ sound clinical reasoning skills,such asthe situated clinical decision-making framework proposed by Gillespie (2010:334).

Pre-service educational programmes need to incorporate clinical decision-making models such as the cognitive continuum model developed by Hammond (1987:767) that exposes nursing students to a combination of a systematic step-by-step rationale as well as an intuitive approach to decision-making to improve their decision-making skills.

A collaborative framework between nursing education institutions and health care institutions ought to be established to enhance the consolidation and integration of the theoretical content of pre-registration programmes.

5.7.2 Health care institutions

Health care institutions ought to work with nursing schools to ensure that personal and environmental factors that impact on the complex decision-making processes for the delivery of safe patient care are addressedduring clinical placements.

The implementation of a validated TTS such as the MEWS, augmented by a MET or other such rapidresponse system should be considered by health care institutions to provide uniform guidelines for health care professionals for the early identification of deteriorating patients and appropriate response.

Continuous professional development programmes should incorporate the recognition of early signs of clinical deterioration.Currently an additional compulsory 1-year community service clinical placement is a requirement by national government for all health care professionals after completion of their undergraduate programme. During this year a structured programme should

be implemented for the recognition of early signs of clinical deterioration and effective management thereof to consolidate learning and to ensure quality and safe patient care.

5.8 Conclusion

This descriptive study examined final year nursing students' ability to recognize abnormal vital sign recordings and clinical decision-making processes, and found that respondents will delay calling for more skilled assistance at a critical high-risk MEWS level of 3 and 2 for respiratory rate, oxygen saturation, heart rate, systolic BP, level of consciousness and urine output, all indicators of critical illness. This has implications for SAEs for patients. The MEWS is recommended as the first-line TTS for implementation in nursing schools and health care institutions in South Africa.

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APPENDICES

Appendix 1: MEWS Chart

Appendix 2: Self-administered survey questionnaire and Semi-structured interview

Appendix 3: Checklist to establish the content and face validity of the self-administered structured questionnaire

Appendix 4: Request for Permission to Conduct a Research Study, from theWestern Cape College of Nursing Research Committee

Appendix 5A: Approval for Permission to Conduct a Research Study, from the Western Cape College of Nursing

Appendix 5B: Ethics approval UCT Faculty of Health Sciences, Human Research Ethics Committe

Appendix 6:Information sheet and consent form

Appendix 7A-C:Demographic Data Analysis

Appendix 8:Data Analysis of variables for the primary objective – respondents' selections

Appendix 9: Data Analysis of incorrect selections for primary objective

Appendix 10: Transcript of the interviews

APPENDIX 1:MEWS Chart

SCORING KEY					MODIFIED EARLY WARNING SCORING (MEWS) VITAL SIGNS CHART											
0	1	2	3													
No action	Re-check after 1/2 hour/report if no improvement	Check after 5 min/report immediately if no improvement	Critical		PATIENT'S NORMAL BP /											
					PATIENT'S IDENTIFICATION & HOSPITAL NUMBER STICKER											
			POST-OPERATIVE DAY	SCORE	∅										SCORE	
			DATE		2.9.2012	2.9.2012	2.9.2012	2.9.2012	2.9.2012	2.9.2012	2.9.2012	2.9.2012	2.9.2012			
			TIME		08h30											
RESPIRATORY RATE			30 or more	3											3	30 or more
Write in full eg. 22			21-29	2	22										2	21-29
			15-20	1											1	15-20
			9-14	0											0	9-14
			9 or less	2											2	9 or less
HEART RATE			130 or more	3	130										3	130 or more
Write in full eg. 98			111-129*	**2**											**2**	111-129*
			101-110	1											1	101-110
			51-100	0											0	51-100
			41-50	1											1	41-50
			40 or less	2											2	40 or less
O_2 Saturation %			93+	0											0	93+
			90-92	1											1	90-92
			85-89	2	85										2	85-89
			less than 85	3											3	less than 85
Inspired O_2			%		40% FM											%
SYSTOLIC BP			200 or more	2											2	200 or more
Write in full eg. 120			101-199	0											0	101-199
			81-100*	1											1	81-100*
			71-80	2	78										2	71-80
			70 or less	3											3	70 or less
DIASTOLIC BP write in full eg. 80					60											
Temperature °C			39.6 or higher	3											3	39.6 or higher
Write in full eg. 37.5			38.5 or higher	2											2	38.5 or higher
			35-38.4	0											0	35-38.4
			lower than 35	2											2	lower than 35
			34 or lower	3	34										3	34 or lower
PERFUSION - capillary refill <2 sec					4 sec											Perfusion
SKIN COLOUR			Pale/Cyanotic		Pale											Pale/Cyanotic
PAIN		Severe	3													Pain 3
		Moderate	2		2											2
		Mild	1													1
		No pain	0													0
HAD PAIN MEDICATION			YES/NO		Yes											YES/NO
Sweating			YES/NO		Yes											YES/NO
Wound oozing			YES/NO		Yes											YES/NO
Other: write																
Pedal pulses			YES/NO		Yes											YES/NO
Blood glucose																
Finger prick Hb					8 gm%											
CONSCIOUS LEVEL																
		Alert (A)	(eg. GCS 15)	0											0	A
		Reacting to voice (V)	(eg. GCS 14)	1	V										1	V
		Reacting to pain (P)/Confused	(eg. GCS 13-9)	2											2	P/Confused
		Unresponsive (U)	(eg. GCS 8 or less)	**3**											**3**	U
		Pupil size:														
		Right	Size		●											Right: Size
			Reaction		B											Reaction
		Left	Size		●											Left: Size
			Reaction		B											Reaction
IV THERAPY			YES/NO		Yes											IV YES/NO
URINE OUTPUT			more than 300ml/hr for 2 hrs	1											1	more than 300ml/hr for 2 hrs
[Indicate if normally anuric]			60ml/hr	0											0	60ml/hr
C=Catheter			less than 60ml/hr	1											1	less than 60ml/hr
			less than 30ml/hr	2	20										2	less than 30ml/hr
			No output	3											3	**No output**
Looks unwell			YES/NO		YES											YES/NO
			TOTAL SCORE		15											**TOTAL SCORE**
			SIGNATURE													

Adapted with permission from Luton and Dunstable NHS Foundation Trust Hospital, United Kingdom by Una Kyriacos PhD RN, UCT Division of Nursing & Midwifery

* These patients are at risk of deterioration, watch carefully.

Appendix 2: Clinical decision-making survey

Participant Code Number:

CLINICAL DECISION-MAKING SURVEY

Title of study: **A DESCRIPTION OF FINAL YEAR NURSING STUDENTS' ABILITY TO RECOGNIZE ABNORMAL VITAL SIGN RECORDINGS AND CLINICAL DECISION-MAKING PROCESSES**

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Faculty of Health Sciences
University of Cape Town
OBSERVATORY 7925

(021) 406 6410

Thank you for agreeing to participate in this study after you were given an information sheet with details of the study. Please sign two copies of the attached consent form (Appendix 6) and keep one copy which also contains the information sheet.

SECTION 1: DEMOGRAPHICS

Q1. What is your age: ☐

Q2. Tick the box that applies to you: I have the following qualifications:

ENA (Enrolled Nursing Auxiliary)	EN (Enrolled Nurse)	Bridging Course	Other

Q3. Gender. Tick the box that applies to you:

Female	Male

Q4. 1st Language:

Afrikaans	English	isiXhosa	Other

SECTION 2:

THE RECOGNITION OF **EARLY WARNING SIGNS** OF **DETERIORATION** IN A PATIENT:

PLEASE NOTE THAT YOU ARE ASKED TO RECOGNIZE**EARLY** SIGNS AND NOT LATE SIGNS OF DETERIORATION IN A PATIENT.

Please answer all the questions on this sheet.

Instructions:

Each question has a row of values and you are asked to **circle** either **one ortwo** of these **as instructed** – so read the question carefully.

The questions are about recordings of **respiratory rate, oxygen saturation (SAT/SpO_2), heart rate, systolic blood pressure, temperature, level of consciousness**and **urine output.**

1 **Circle two blocks** to indicate the respiratory rate readings (breaths/min) in the list below that would be of concern to you as early signs of deterioration in a patient and for which you will summon more skilled help:

9 or less	9-14	15-20	21-29	30 or more

2 **Circle the one block** for aSAT/SpO_2 reading in the list below that would be of concern to you as an early sign of deterioration in a patient and for which you will summon more skilled help:

Less than 85%	85-89%	90-92%	93+%

3 **Circle two blocks** to indicate the heart rate readings (beats/minute) in the list below that would be of concern to youas early signs of deterioration in a patient and for which you will summon more skilled help:

40 or lower	41-50	51-100	101-110	111-129	130 or more

4 **Circle** t**wo blocks** to indicate the systolic blood pressure readings (mmHg) in the list below that would be of concern to youas early signs of deterioration in a patient and for which you will summon more skilled help:

70 or lower	71-80	81-100	101-199	200 or higher

5 **Circle** the **one block** of temperature readings in the list below that would not be of concern to you in a patient and for which you will take no action:

34^{o} C or lower	Lower than 35^{o} C	35-38.4^{o} C	38.5^{o} C or higher	39.6^{o} C or higher

6 **Circleone response** in the list below that will alert you to an early sign of deterioration for which you would seek more skilled help:

ALERT (A) (same as GCS 15)	RESPONDS TO VOICE (V) (same as GCS 14)	RESPONDS TO PAIN (P) / Confused (same as GCS 13-9)	UNRESPONSIVE (U) (same as GCS <8)

7 **Circletwo blocks** of values for urine output in the list belowthat are early signs of deterioration for which you would seek more skilled help:

Nil	30 ml/hr or less	Less than 60 ml/hr	60 ml/hr	>300 ml/hr for 2 hrs

THANK YOU

Adapted with permission from Una Kyriacos, PhD thesis 2011: The development, validation and testing of a vital signs monitoring tool for early identification of deterioration in adult surgical patients. University of Cape Town.

SECTION 3: STRUCTURED INTERVIEW

Ten randomly selected participants were interviewed and audio-tape recorded.

Instructions*:*

Thank you for agreeing to be interviewed after you completed the questionnaire.

Have a look at the consent form you signed before you completed the questionnaire to remind yourself that you had been informed that ten students would be randomly selected for an interview. Your name was drawn. You were also informed that this interview would be audiotape-recorded.

Do you have any questions? Are you ready to start?

Have a look at your completed questionnaire – it does not have your name only a code number but I have a cross-reference to your name.

Please tell me:

How you made your selection for Question 1

How you made your selection for Question 2

How you made your selection for Question 3

How you made your selection for Question 4

How you made your selection for Question 5

How you made your selection for Question 6

How you made your selection for Question 7

APPENDIX 3

Validation Expert Code Number:

CHECKLIST
For Content and Face Validity of the
SELF-ADMINISTERED STRUCTURED QUESTIONNAIRE

Researcher: Ms MARTHA MARIA LEONARD
Western Cape College of Nursing
Klipfontein Road
Athlone 7762

e-mail:Mmleonar@westerncape.gov.za

Telephone Number: (021)6841231

Supervisor: Dr U Kyriacos, (PhD)
Division of Nursing & Midwifery
Department of Health &
Rehabilitation Sciences
Faculty of Health Sciences
University of Cape Town
OBSERVATORY 7925

(021) 406 6410

Title of study:**A DESCRIPTION OF FINAL YEAR NURSING STUDENTS' ABILITY TO RECOGNIZE ABNORMAL VITAL SIGN RECORDINGS AND CLINICAL DECISION-MAKING PROCESSES**

INFORMATION:

Thank you for agreeing to evaluate the content and face validity of the self-administered questionnaire (Appendix 2). Please e-mail or post the completed checklist to the researcher at the above address.

The purpose of this checklist was to ensure uniform evaluation by all experts using a structured procedure.

You, the expert, will establish the index of content validity (CVI) for each item using a 4-point ordinal rating scale and this was taken as the proportion of items that received a rating of 3 or 4.[1] If, in your opinion, there are omissions, these can be listed at the end of each item.

For evaluation of face validity, the checklist will include layout, format, quality of printing, the length of the questionnaire, the response scale of 1-4, if visually easy to read and comprehend and if instructions at the beginning of the questionnaire are clear and easy to understand.[2]

Expert opinion on index of content validity (CVI) of EACH question on the questionnaire (Appendix 2)

Index of content validity (CVI)				
Section/Question	1 = irrelevant	2 = unable to assess relevance without item revision or item is in need of such revision that it would no longer be relevant	3 = relevant but needs minor alteration	4 = extremely relevant
Section 1				
Q1				
Q2				
Q3				
Q4				
Section 2				
Q1				
Q2				
Q3				
Q4				
Q5				
Q6				
Q7				
Section 3				
Q1				
Q2				
Q3				
Q4				
Q5				
Q6				
Q7				

Omissions:

Comments:

Expert opinion on face validity

	Very skilful	Satisfactory	Needs improvement	Unacceptable
Layout				
Format				
Quality of printing				
Length of the questionnaire				
The response scale of 1-4				
If visually easy to read				
If visually easy to comprehend				
If instructions at the beginning of the questionnaire are clear and easy to understand				

Omissions:

Comments:

THANK YOU VERY MUCH

References

1. Lynn MR. Determination and quantification of content validity. *Nursing Research* 1986;35(6 November/December):382-85.

2. Bowling A, Ebrahim S, editors. *Handbook of health research methods.Investigation, measurement and analysis.* 1st ed. Berkshire, England: Open University Press, 2007.

3.Kyriacos, U. 2011. The development, validation and testing of a vital signs monitoring tool for early identification of deterioration in adult surgical patients [PhD]. Cape Town: University of Cape Town.

Appendix 4

Request for Permission to Conduct a Research Study

81 Princess Margaret Str
Ruyterwacht
7460

24 October 2012

The Chairperson
Western Cape College of Nursing Research Committee
Western Cape Department of Health
Klipfontein Road
Athlone
7762
Dear Ms T Bock,

Re: Proposed research study: A DESCRIPTION OF FINAL YEAR NURSING STUDENTS' ABILITY TO RECOGNIZE ABNORMAL VITAL SIGN RECORDINGS AND CLINICAL DECISION-MAKING PROCESSES

I am a Masters student in the Division of Nursing & Midwifery, Department of Health and Rehabilitation Sciences, at UCT. The title of my minor dissertation is as above. My research proposal has been approved by the HREC of UCT (REC REF 660/2012 a copy of which is attached).

I attach the Protocol summary of the study. I have identified the college as a recruitment site, and I hereby request permission to conduct the study.

In the event of a favourable consideration of my request, a letter of request to the Head of College for approval to use the college as a recruitment site will follow.

My e-mail address and telephone number are provided below. Please contact me or my supervisor, Dr. U Kyriacos [021 4066410] if you require more information.

Your cooperation is appreciated.

Sincerely,

Mrs M M Leonard

Tel no 0215350098
E-mail: Mmleonar@pgwc.gov.za

APPENDIX 5 A

Approval from Western Cape College of Nursing

Western Cape Government
Health

DIRECTORATE: WESTERN CAPE COLLEGE OF NURSING
Terebock@pgwc.gov.za
Enquiries: Ms T M Bock
Date: 2013/01/29

Dear Mrs Leonard

RE: Your research project titled: *A DESCRIPTION OF FINAL YEAR NURSING STUDENTS' ABILITY TO RECOGNISE ABNORMAL VITAL SIGN RECORDINGS AND CLINICAL DECISION-MAKING PROCESSES*, **refers.**

The Interim Institutional research ethics committee perused your proposal and herewith grant you the necessary permission to conduct your project here at the WCCN and all its campuses.

The permission is granted on the proviso that the project does not infringe on any academic activities of the students here at the WCCN, and that on completion of the project you would provide management with feedback on the outcome of your research.

The management wishes you success in this project

Sincerely

T M Bock

Acting Chair of the Interim Research Ethics committee WCCN

Pone: 021 648 1202: 021 638 6899 (fax)
Klipfontein Road, Surwell, Athlone 7764

APPENDIX 5 B

Approval from the University of Cape Town Human Research Ethics Committee

UNIVERSITY OF CAPE TOWN

Faculty of Health Sciences
Human Research Ethics Committee
Room E52-24 Groote Schuur Hospital Old Main Building
Observatory 7925
Ms S Ariefdien - Tel: [021]4066492 • Fax: [021]4066411
email: sumayah.ariefdien@uct.ac.za

20 December 2012

HREC REF: 660/2012

Mrs MM Leonard,
c/o Dr U Kyriacos
Health & Rehab Sciences
F-45
OMB

CC. Ms U Kyriacos
Nursing and Midwifery
Health & Rehab
F56/27 OMB

Dear Mrs Leonard,

PROJECT TITLE: A DESCRIPTION OF FINAL YEAR NURSING STUDENT'S ABILITY TO RECOGNISE ABNORMAL VITAL SIGN RECORDINGS AND CLINICAL DECISION-MAKING PROCESSES

Thank you for submitting your new study to the Faculty of Health Sciences Human Research Ethics Committee

It is a pleasure to inform you that the Ethics Committee has formally approved the above-mentioned study.

Approval is granted until 28 December 2013

Please submit an annual progress report (FHS016) if the research continues beyond the expiry date. Please submit a brief summary of findings if you complete the study within the approval period so that we can close our file (FHS010).

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Please quote the HREC. REF in all your correspondence.

Yours sincerely

PROFESSOR MARC BLOCKMAN
CHAIRPERSON, FHS HUMAN RESEARCH ETHICS

Federal Wide Assurance Number: FWA00001637.
Institutional Review Board (IRB) number: IRB00001938

This serves to confirm that the University of Cape Town Human Research Ethics Committee complies to the Ethics Standards for Clinical Research with a new drug in patients, based on the Medical Research Council (MRC-SA), Food and Drug Administration (FDA-USA), International Convention on Harmonisation Good Clinical Practice (ICH GCP) and Declaration of Helsinki guidelines.

The Human Research Ethics Committee granting this approval is in compliance with the ICH Harmonised Tripartite Guidelines E6: Note for Guidance on Good Clinical Practice (CPMP/ICH/135/95) and FDA Code Federal Regulation Part 50, 56 and 312.

Participant Code Number:

Appendix 6

INFORMATION SHEET AND
CONSENT TO PARTICIPATE IN RESEARCH

Who you can contact if you have questions:

Researcher: Ms MARTHA MARIA LEONARD
Western Cape College of Nursing
Klipfontein Road
Athlone 7762

e-mail:Mmleonar@westerncape.gov.za

Telephone Number: (021)6841231

Supervisor: Dr U Kyriacos, (PhD)
Division of Nursing & Midwifery,
Dept of Health & Rehabilitation Sciences
Faculty of Health Sciences
University of Cape Town
OBSERVATORY 7925

(021) 406 6410

HUMAN RESEARCH ETHICS COMMITTEE:
Faculty of Health Sciences
Human Research Ethics Committee
Room E52-24 Groote Schuur Hospital Old Main Building
OBSERVATORY
7925

TEL: 021-406 6626

Title of study: **A DESCRIPTION OF FINAL YEAR NURSING STUDENTS' ABILITY TO RECOGNIZE ABNORMAL VITAL SIGN RECORDINGS AND CLINICAL DECISION-MAKING PROCESSES**

INFORMATION SHEET:

Why is this study being done?

The purpose of this study is to discover how final year student nurses identify and manage adult patients who show early warning signs of deterioration.

Does the study have ethics approval?

Ethics approval has been obtained from the UCT Faculty of Health Sciences' Human Research Ethics Committee (REC Ref xxx). Approval has also been obtained from the research department of the Provincial Government of the Western Cape (PGWC) (Appendix 4) and the Director: Nursing of the Western Cape College of Nursing (Appendix 5).

Why are you being asked to take part?

This study is about recordings of vital signs and recognizing signs of deterioration in a patient. You have been selected to participate in the study because you are a final year nurse student. You will therefore have the educational background and skills in vital sign monitoring.

What do we do to decide if you are eligible to take part?

You are eligible to take part in this study because you are a fourth year student.

What will happen if you decide to take part in the study?

If you agree to participate in the study after I have explained to the class of fourth year students what the study is about you will be asked to sign a consent form that is at the end of the Information Sheet. I will keep this and give you a copy. This will indicate that your participation is voluntary and you may withdraw from the study at any stage, that there will be no monetary incentive, no foreseeable risks and that your information is confidential and anonymous as you will be given a code number. The benefit of your participation is to improve the curriculum.

You will be given a questionnaire to complete and be asked to give biographical data of yourself: age, gender, first language and previous relevant nursing qualifications (Nursing Auxiliary, Enrolled Nurse, Bridging programme) if applicable. Questions are based on a patients' recorded vital signs data. The questionnaire will have a code number for you that will be known only to me the researcher. Your name will not be linked to any results that are published at the completion of the study. Your participation in the study will not in any way affect your academic programme at the College. It should take about 30 minutes to complete the questionnaire. You will place your completed questionnaire in a specially marked box "Mrs Leonard: Research" in the venue. I will be in the venue and will seal and remove the box to a secure location. Once I have analysed the questionnaires I will place them in a locked cupboard and only I will have the key. I will enter the data onto software on my computer and only I will have the password. Data will be copied onto a CD and stored in a locked cupboard for three years as this is a legal requirement.

Once all voluntary participants have completed the questionnaire the names of ten students who were randomly sampled will be announced and these will be invited to participate in a brief interview. In the event that your name is randomly selected it is still required of you to indicate your willingness to participate in the interview phase. You may withdraw from the study at any stage without penalties. The interview of 30 minutes will be about how you reached the decision to call for more skilled help for each of the vital signs. The interview will be audiotaped and transcribed onto software on my computer so that I can analyse the recordings. Only I will have the password.

Confidentiality and anonymity will therefore be maintained in both the survey and interview phases of this study by using a code number for you.

How long will this study last?

The study will take about two months to collect and analyse the data.

What are the risks and discomforts of this study?

This study does not have any foreseeable adverse effects, risks or hazards for participants and will not in any way affect your academic programme or results. Confidentiality and anonymity will be maintained in both the survey and interview phases of this study by using a code number for you that will be known only to me the researcher.

Who do I speak to (or contact) if I have any questions about the study?

If you have any further questions regarding the study, you may contact me directly or my supervisor, Dr U Kyriacos. You may also contact the Human Research Ethics Committee for more information about your rights and welfare as a research participant at telephone number 021- 4066626. Details are provided at the top of the first page.

What if you decide not to take part?

All the fourth year students will be invited to participate voluntarily and your choice not to participate will be respected. Non-participation will not in any way affect your academic programme or results. Participants have the right to withdraw from the study at any stage without penalties.

Are there any benefits to you for being in this study?

The study will assist nurse educators in understanding student nurses 'observation/vital signs practice as well as how they make clinical decisions. This information will be used to adapt/develop the curriculum and teaching approaches which will be implemented to enhance student nurses' observation practice and decision-making skills. Please note that there will be no remuneration for taking part in this study.

What will happen if the study is over?

If you agree to participate voluntarily in the study then once you have completed the questionnaire (and participated voluntarily in the interview if you are selected) then nothing else will be required of you. The anonymised research results will be published in peer reviewed nursing journals at the completion of the study and a copy of the dissertation will be given to the Head of College for the library. You will have access to this copy.

CONSENT FORM

CONFIDENTIALITY/ANONYMITY: The researcher has explained that all information is confidential and that my name will not appear on the data emerging from the study. The researcher has also explained that she is the only person who will have a copy of my name and the number assigned to my data.

RISKS: The researcher has explained that there are no physical risks involved. Information offered by me is confidential and protected. There are no known or anticipated risks.

BENEFITS: The researcher has explained that this study should help nurse educators to revise the curriculum to help future students to identify patients at risk of an adverse clinical outcome and when to call for help.

AUTONOMY/RIGHT TO WITHDRAW: The researcher has explained that participation is voluntary and that I have the right to withdraw from the study at any stage without penalties. All my questions will be answered by the researcher.

I agree to participate in the study on the terms specified above.

_____ _____

Date Participant's Signature

Appendix 7A: Example of SPSS printout Demographic Data Analysis (age)

4.2 Objective: To describe the respondents' demographic characteristics

Data for age are not normally distributed.

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Age	.178	62	.000	.880	62	.000

a. Lilliefors Significance Correction

Statistics

Age

N	Valid	62
	Missing	15
Mean		27.13
Median		25.00
Mode		22
Std. Deviation		5.485

Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	21	5	6.5	8.1	8.1
	22	8	10.4	12.9	21.0
	23	7	9.1	11.3	32.3
	24	6	7.8	9.7	41.9
	25	6	7.8	9.7	51.6
	26	5	6.5	8.1	59.7
	27	4	5.2	6.5	66.1
	28	2	2.6	3.2	69.4
	29	2	2.6	3.2	72.6
	30	1	1.3	1.6	74.2
	31	2	2.6	3.2	77.4
	32	2	2.6	3.2	80.6
	33	1	1.3	1.6	82.3
	34	2	2.6	3.2	85.5
	35	1	1.3	1.6	87.1
	36	4	5.2	6.5	93.5
	37	1	1.3	1.6	95.2
	39	1	1.3	1.6	96.8
	40	1	1.3	1.6	98.4
	42	1	1.3	1.6	100.0
	Total	62	80.5	100.0	
Missing	System	15	19.5		
Total		77	100.0		

SPSS printout Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Age	62	80.5%	15	19.5%	77	100.0%
Qualification	76	98.7%	1	1.3%	77	100.0%
Gender	76	98.7%	1	1.3%	77	100.0%
Language	76	98.7%	1	1.3%	77	100.0%

Appendix 7B: Example of SPSS printout Demographic Data Analysis (gender)

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	10	13.0	13.2	13.2
	Female	66	85.7	86.8	100.0
	Total	76	98.7	100.0	
Missing	System	1	1.3		
Total		77	100.0		

Qualifications

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NONE	73	94.8	96.1	96.1
	EN	3	3.9	3.9	100.0
	Total	76	98.7	100.0	
Missing	System	1	1.3		
Total		77	100.0		

Language

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	2	2.6	2.6	2.6
	1	33	42.9	43.4	46.1
	2	10	13.0	13.2	59.2
	3	31	40.3	40.8	100.0
	Total	76	98.7	100.0	
Missing	System	1	1.3		
Total		77	100.0		

0=Other
1=Afrikaans
2=English
3=isiXhosa

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Qualifications * Gender	76	98.7%	1	1.3%	77	100.0%

Qualifications * Gender Crosstabulation

			Gender		
			Male	Female	Total
Qualifications	NONE	Count	9	64	73
		% within Qualifications	12.3%	87.7%	100.0%
		% within Gender	90.0%	97.0%	96.1%
		% of Total	11.8%	84.2%	96.1%
	EN	Count	1	2	3
		% within Qualifications	33.3%	66.7%	100.0%
		% within Gender	10.0%	3.0%	3.9%
		% of Total	1.3%	2.6%	3.9%
Total		Count	10	66	76
		% within Qualifications	13.2%	86.8%	100.0%
		% within Gender	100.0%	100.0%	100.0%
		% of Total	13.2%	86.8%	100.0%

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.476	.001
	Cramer's V	.476	.001
N of Valid Cases		76	

Appendix 7B: Example of SPSS printout Demographic Data Analysis (continued)

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.113[a]	1	.292		
Continuity Correction[b]	.034	1	.854		
Likelihood Ratio	.846	1	.358		
Fisher's Exact Test				.349	.349
Linear-by-Linear Association	1.098	1	.295		
N of Valid Cases	76				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is .39.
b. Computed only for a 2x2 table

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	-.121	.292
	Cramer's V	.121	.292
N of Valid Cases		76	

Appendix 7C: Example of SPSS printout demographic data (language & gender)

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Language * Gender	76	98.7%	1	1.3%	77	100.0%

Language * Gender Cross tabulation

			Gender		
			Male	Female	Total
Language	0	Count	2	0	2
		% within Language	100.0%	0.0%	100.0%
		% within Gender	20.0%	0.0%	2.6%
		% of Total	2.6%	0.0%	2.6%
	1	Count	2	31	33
		% within Language	6.1%	93.9%	100.0%
		% within Gender	20.0%	47.0%	43.4%
		% of Total	2.6%	40.8%	43.4%
	2	Count	0	10	10
		% within Language	0.0%	100.0%	100.0%
		% within Gender	0.0%	15.2%	13.2%
		% of Total	0.0%	13.2%	13.2%
	3	Count	6	25	31
		% within Language	19.4%	80.6%	100.0%
		% within Gender	60.0%	37.9%	40.8%
		% of Total	7.9%	32.9%	40.8%
Total		Count	10	66	76
		% within Language	13.2%	86.8%	100.0%
		% within Gender	100.0%	100.0%	100.0%
		% of Total	13.2%	86.8%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	17.212[a]	3	.001
Likelihood Ratio	13.633	3	.003
Linear-by-Linear Association	.075	1	.784
N of Valid Cases	76		

a. 5 cells (62.5%) have expected count less than 5. The minimum expected count is .26.

Appendix 8: Example of SPSS printout for data analysis of variables for the primary objective (vital signs)

4.3 Primary objective A:To assess respondents' ability to identify early signs of deterioration: abnormal respiratory rate, oxygen saturation levels (SAT/SpO2), heart rate (pulse), systolic blood pressure, level of consciousness and urinary output volume

Statistics for respiratory rate (RR)

		S2Q1RRL2*	T1S2Q1RRU123*	T1S2Q1RRN0*
N	Valid	77	66	29
	Missing	0	11	48
Mean			2.636	.000
Median			3.000	.000
Std. Deviation			.6235	.0000
Minimum			1.0	.0
Maximum			3.0	.0

RR = respiratory rate

*L2 = MEWS low 2, U123 = MEWS upper 1,2, 3; N0 = normal MEWS

Oxygen saturation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	1	1.3	1.3	1.3
	1	4	5.2	5.2	6.5
	2	20	26.0	26.0	32.5
	3	52	67.5	67.5	100.0
	Total	77	100.0	100.0	

Distribution of MEWS = 0 (normal), low 1, 2, 3

Heart rate (HR)Low

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		4	5.2	5.2	5.2
	1	25	32.5	32.5	37.7
	1u	2	2.6	2.6	40.3
	2	44	57.1	57.1	97.4
	2u	2	2.6	2.6	100.0
	Total	77	100.0	100.0	

Distribution of respondents' selections when asked to identify low range of HR values of concern to them (displayed as MEWS values: 1 (low & upper), 2 (low & upper)

HR

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		13	16.9	16.9	16.9
	1	14	18.2	18.2	35.1
	1l	5	6.5	6.5	41.6
	2	8	10.4	10.4	51.9
	3	37	48.1	48.1	100.0
	Total	77	100.0	100.0	

Distribution of respondents' selections when asked to identify rapid/low HR values of concern to them (displayed as MEWS values: 1, 1 low, 2, 3)

HR

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	7	9.1	100.0	100.0
Missing	System	70	90.9		
Total		77	100.0		

Distribution of respondents' erroneous selections of normal (MEWS = 0) HR values when asked to identify rapid/low HR values of concern to them

Statistics for systolic blood pressure (SBP)

		Q4SBPL	Q4SBPU	Q4SBP0
N	Valid	64	77	23
	Missing	13	0	54
Mean		2.625		.000
Median		3.000		.000
Std. Deviation		.6299		.0000
Minimum		1.0		.0
Maximum		3.0		.0

SBPLow

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	5	6.5	7.8	7.8
	2	14	18.2	21.9	29.7
	3	45	58.4	70.3	100.0
	Total	64	83.1	100.0	
Missing	System	13	16.9		
Total		77	100.0		

Distribution of respondents' selections when asked to identify a low range of SBP values of concern to them (displayed as MEWS values = 1, 2, 3)

SBP high

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		20	26.0	26.0	26.0
	1l	3	3.9	3.9	29.9
	2	48	62.3	62.3	92.2
	2l	6	7.8	7.8	100.0
	Total	77	100.0	100.0	

Distribution of respondents' selections when asked to identify a high range of SBP values of concern to them (displayed as MEWS values = 1 lower, 2, 2 lower)

T1S2Q4SBPN0

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	23	29.9	100.0	100.0
Missing	System	54	70.1		
Total		77	100.0		

Distribution of respondents' erroneous selections of normal (MEWS = 0) SBP values when asked to identify high/low SBP values of concern to them

Normal Temperature

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	48	62.3	62.3	62.3
	2	27	35.1	35.1	97.4
	3	2	2.6	2.6	100.0
	Total	77	100.0	100.0	

Distribution of MEWS = 0, 2, 3
Distribution of respondents' selections when asked to identify the normal range of values for temperature (displayed as MEWS values)

Level of consciousness

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	1	1.3	1.3	1.3
	1	2	2.6	2.6	3.9
	2	20	26.0	26.0	29.9
	3	54	70.1	70.1	100.0
	Total	77	100.0	100.0	

Distribution of MEWS = 0, 1, 2, 3

Statistics

		T1S2Q7UOL321	T1S2Q7UOU1	T1S2Q7UON0
N	Valid	75	77	6
	Missing	2	0	71
Mean		2.587		.00
Median		3.000		.00
Std. Deviation		.6993		.000
Minimum		1.0		0
Maximum		3.0		0

T1S2Q7UOL321

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	9	11.7	12.0	12.0
	2	13	16.9	17.3	29.3
	3	53	68.8	70.7	100.0
	Total	75	97.4	100.0	
Missing	System	2	2.6		
Total		77	100.0		

Distribution of MEWS = low 1, 2, 3

T1S2Q7UOU1

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		11	14.3	14.3	14.3
	1	32	41.6	41.6	55.8
	1l	6	7.8	7.8	63.6
	2l	28	36.4	36.4	100.0
	Total	77	100.0	100.0	

T1S2Q7UON0

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	6	7.8	100.0	100.0
Missing	System	71	92.2		
Total		77	100.0		

Appendix 9: Data Analysis of incorrect selections for variables of primary objective.

4.2.4 Incorrect selections

Chapter 4 (Table 4.5)

Statistics

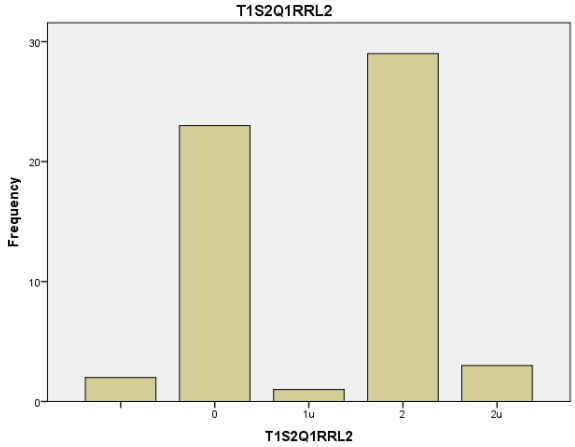
		T1S2Q1RRL2	T1S2Q1RRU123
N	Valid	58	56
	Missing	0	2
Mean			2.196
Median			3.000
Std. Deviation			1.0858
Minimum			.0
Maximum			3.0

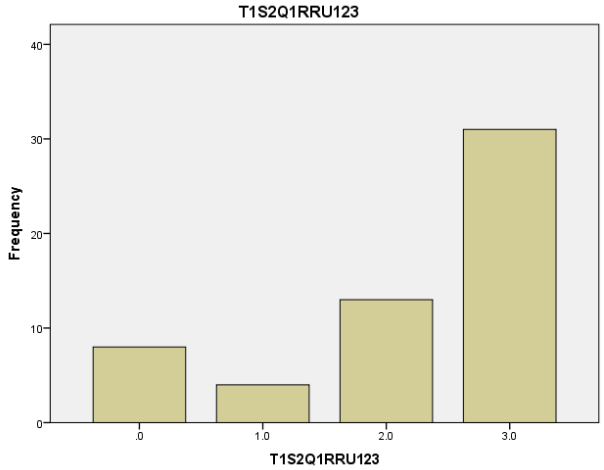
T1S2Q1RRL2

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		2	3.4	3.4	3.4
	0	23	39.7	39.7	43.1
	1u	1	1.7	1.7	44.8
	2	29	50.0	50.0	94.8
	2u	3	5.2	5.2	100.0
	Total	58	100.0	100.0	

T1S2Q1RRU123

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.0	8	13.8	14.3	14.3
	1.0	4	6.9	7.1	21.4
	2.0	13	22.4	23.2	44.6
	3.0	31	53.4	55.4	100.0
	Total	56	96.6	100.0	
Missing	System	2	3.4		
Total		58	100.0		





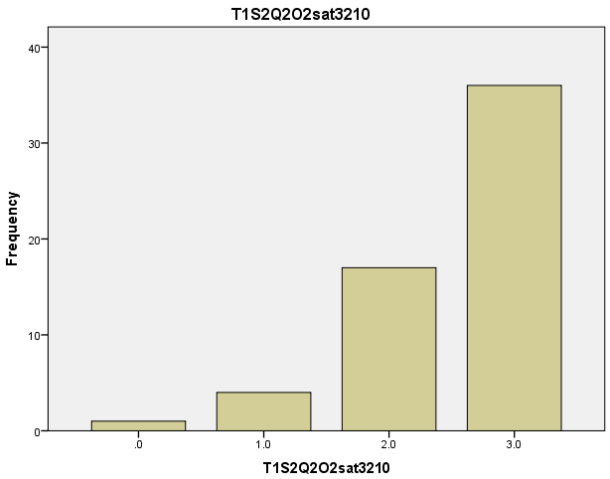
Statistics

T1S2Q2O2sat3210

N	Valid	58
	Missing	0
Mean		2.517
Median		3.000
Std. Deviation		.7069
Minimum		.0
Maximum		3.0

T1S2Q2O2sat3210

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.0	1	1.7	1.7	1.7
	1.0	4	6.9	6.9	8.6
	2.0	17	29.3	29.3	37.9
	3.0	36	62.1	62.1	100.0
	Total	58	100.0	100.0	



Statistics

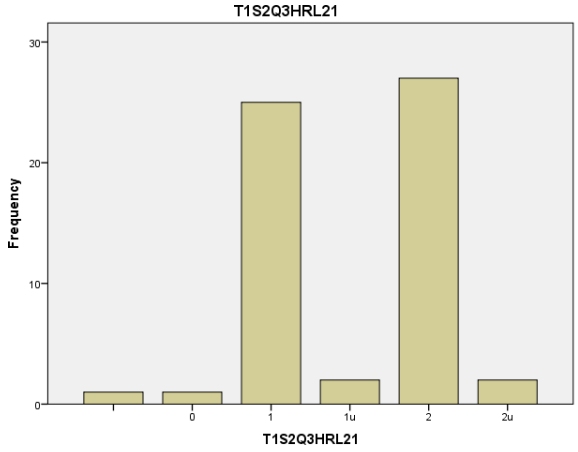
		T1S2Q3HRL21	T1S2Q3HRU123
N	Valid	58	58
	Missing	0	0

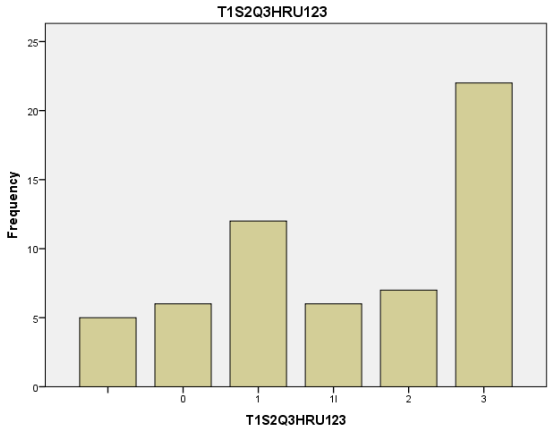
T1S2Q3HRL21

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		1	1.7	1.7	1.7
	0	1	1.7	1.7	3.4
	1	25	43.1	43.1	46.6
	1u	2	3.4	3.4	50.0
	2	27	46.6	46.6	96.6
	2u	2	3.4	3.4	100.0
	Total	58	100.0	100.0	

T1S2Q3HRU123

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		5	8.6	8.6	8.6
	0	6	10.3	10.3	19.0
	1	12	20.7	20.7	39.7
	1l	6	10.3	10.3	50.0
	2	7	12.1	12.1	62.1
	3	22	37.9	37.9	100.0
	Total	58	100.0	100.0	





Statistics

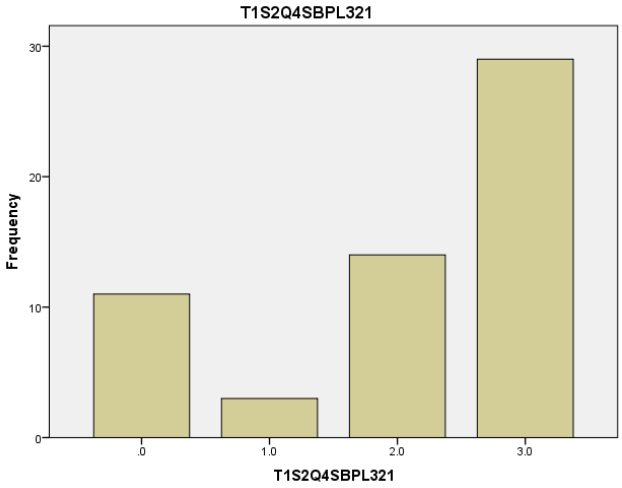
		T1S2Q4SBPL321	T1S2Q4SBPU2
N	Valid	57	58
	Missing	1	0
Mean		2.070	
Median		3.000	
Std. Deviation		1.1628	
Minimum		.0	
Maximum		3.0	

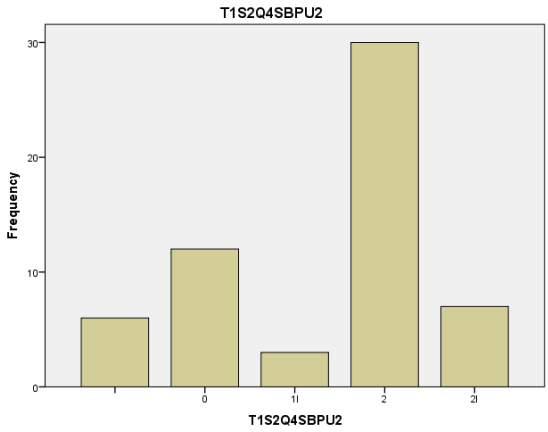
T1S2Q4SBPL321

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.0	11	19.0	19.3	19.3
	1.0	3	5.2	5.3	24.6
	2.0	14	24.1	24.6	49.1
	3.0	29	50.0	50.9	100.0
	Total	57	98.3	100.0	
Missing	System	1	1.7		
Total		58	100.0		

T1S2Q4SBPU2

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		6	10.3	10.3	10.3
	0	12	20.7	20.7	31.0
	1l	3	5.2	5.2	36.2
	2	30	51.7	51.7	87.9
	2l	7	12.1	12.1	100.0
	Total	58	100.0	100.0	





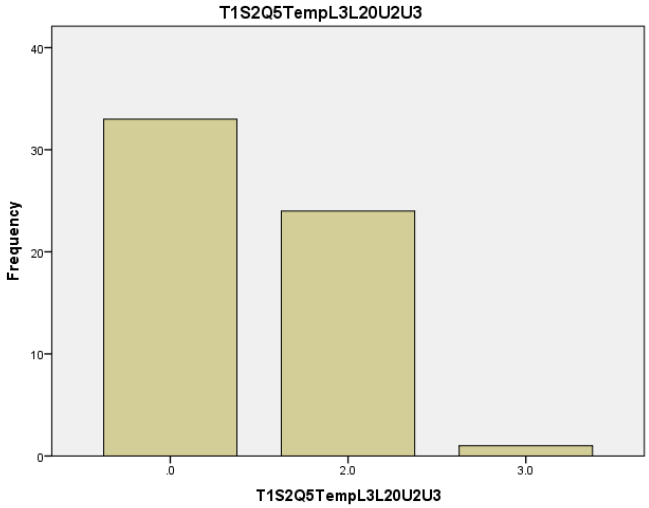
Statistics

T1S2Q5TempL3L20U2U3

N	Valid	58
	Missing	0
Mean		.879
Median		.000
Std. Deviation		1.0273
Minimum		.0
Maximum		3.0

T1S2Q5TempL3L20U2U3

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.0	33	56.9	56.9	56.9
	2.0	24	41.4	41.4	98.3
	3.0	1	1.7	1.7	100.0
	Total	58	100.0	100.0	



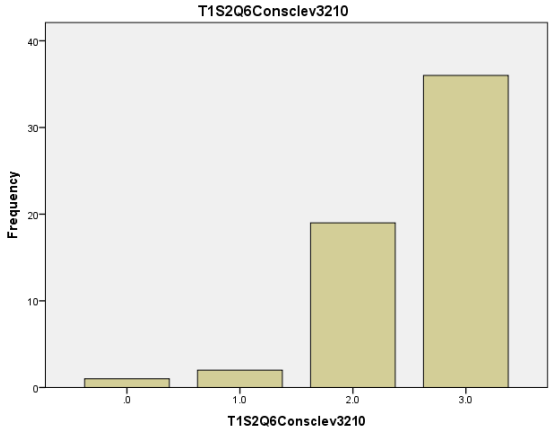
Statistics

T1S2Q6Consclev3210

N	Valid	58
	Missing	0
Mean		2.552
Median		3.000
Std. Deviation		.6535
Minimum		.0
Maximum		3.0

T1S2Q6Consclev3210

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.0	1	1.7	1.7	1.7
	1.0	2	3.4	3.4	5.2
	2.0	19	32.8	32.8	37.9
	3.0	36	62.1	62.1	100.0
	Total	58	100.0	100.0	



Statistics

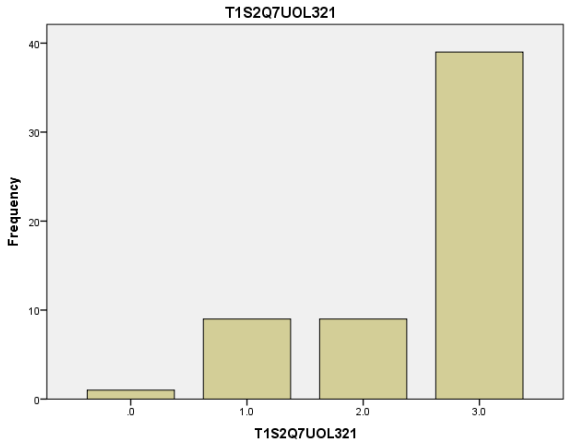
		T1S2Q7UOL321	T1S2Q7UOU3
N	Valid	58	58
	Missing	0	0
Mean		2.483	
Median		3.000	
Std. Deviation		.8217	
Minimum		.0	
Maximum		3.0	

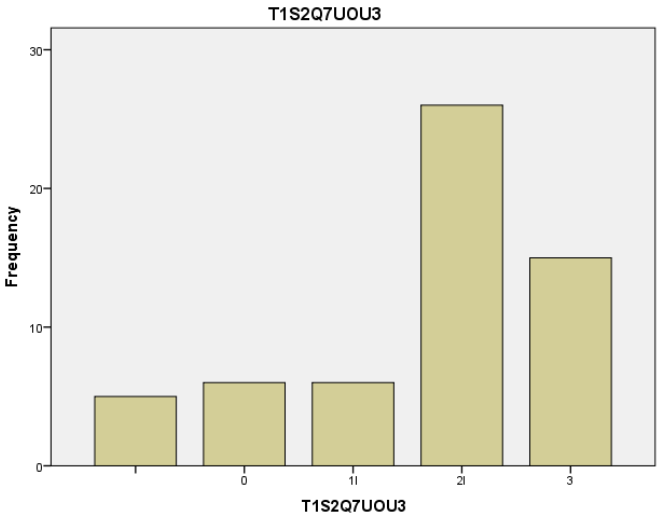
T1S2Q7UOL321

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.0	1	1.7	1.7	1.7
	1.0	9	15.5	15.5	17.2
	2.0	9	15.5	15.5	32.8
	3.0	39	67.2	67.2	100.0
	Total	58	100.0	100.0	

T1S2Q7UOU3

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		5	8.6	8.6	8.6
	0	6	10.3	10.3	19.0
	1l	6	10.3	10.3	29.3
	2l	26	44.8	44.8	74.1
	3	15	25.9	25.9	100.0
	Total	58	100.0	100.0	




T1S2Q7UOU3
30
20
10
0
Frequency
0
1
2
3
T1S2Q7UOU3

Appendix 10:Transcription of interviews

Researcher: Okay you can start. (four components of the clinical reasoning process (Elstein *et al.*,1978 reported by Dowie and Elstein, 1988:111-115))[2]

Participant: 201351	CR level
Participant:Okay I chose the two options because it is not within the normal ranges, I was taught like that.	1-2
Participant: and number two about the oxygen saturation normally it should be hundred percent so I chose 85 ya 85% because not within the normal range.	1-2
Participant: and number three the heart rate I did not come across a patient with, I did not experience it but I just for me it was knowledge basically because of the normal values so ,we were taught about the normal values we know we need to be alert when it is not normal but I never came across a patient with a abnormal heart rate nor an abnormal saturation or anything. We know about the normal is 60 to 80 to 90 beats per minute.	1-2
Participant: number four the blood pressure, why I chose it okay the ones I chose okay the ones I chose was the least because the systolic must not be less than 60.	1-2
Participant: number five the temperature reading ya the normal range it is 35, 36 to 37and that was the only option what looked within the normal ranges.	1-2
Participant: number six, which one the early signs of deterioration, normally when the patient is deteriorating then than the patient is not responsive and you do the test the Glasgow coma scale the patient is not responding to any pain than will you do the unresponsive because the patient is now not responding that is the sign that you will know that the patient is deteriorating	1-3
Participant: number seven the urinary output ya if it is less than what I could remember like is it should not be less than 30 ml a hour that is what I can remember	

CR= clinical reasoning

[2] 1. Cue acquisition (a process of obtaining information from participants' completed questionnaires), for example reading the question and looking at the answers circled to recognize and gather cues.

2. Generating initial hypotheses (when alternative problem formulations are retrieved from memory using cues to link up to the long-term memory), for example an explanation offered or an assumption as a starting point for the reasoning or action taken.

3. Cue interpretation (when data interpretation follows in light of the alternative hypotheses to confirm or disconfirm hypotheses or as non-contributory), for example reflecting on answer chosen and explaining how they arrived at the answer or why they made the particular decision.

4. Hypothesis evaluation (data are weighted and combined to determine if one of the hypotheses generated is confirmed).

Appendix 10: Transcription of interviews (continued)[3]

2 Participant 201353	CR level
Participant: Die hoogste en die laagste dit kom neer op die respirasie.	
[The hidhest and the lowest comes down to the respiration]	
Researcher: Jy kan maar rustig wees ontspan.	
[You can relax]	
Participant: The first one I chose 9 or less the second one 30 or more because the respiratory rate is an indication of tagipnee or bradignee which can be indicating that something is wrong if the patient have a respiratory condition in the rate, increase or is more than a certain or less a certain amount. (Medium-risk MEWS 2 for low; High-risk MEWS 3 for high)	1-2
The second block is about saturation. I choose less than 85% because the saturation has to be 95 and more for a person to have adequate saturation from the oxygen to be oxygenated. (High-risk MEWS 3)	1-2
Researcher: Then you just page over.	
Participant: At the systolic blood pressure I chose 70 or lower or 200 or lower which is the lowest number and the highest number. I chose those two because the blood pressure it is so high, it is indicating very hypertensive; and blood pressure less than 70 it is very very hypotensive. It could be indicating there is something wrong with the patient or the patient is bleeding from somewhere. (High-risk MEWS 3 for low; medium-risk MEWS 2 for high)	3
For temperature I chose 35 degrees Celsius because 35 degrees Celsius; it is a little bit lower than the normal but it is not that subnormal that the patient is in danger. (Medium-risk high MEWS 2)	1-2
Researcher: It is level of consciousness.	
Participant: At the level of consciousness I selected an unresponsive patient because that would mean that the patient is not responding or anything and that would be one of the danger signs. (High-risk MEWS 3)	
Participant: At the urine output I selected 30 or 30 ml an hour or less because if a patient excreted 30 ml or less it is very low and it could be indicating renal failure or urine retention; it could also be a danger sign for a patient. (High-risk MEWS 3 for low; Medium-risk low MEWS 2 for high)	1-2

CR= clinical reasoning

[3] 1. Cue acquisition (a process of obtaining information from participants' completed questionnaires), for example reading the question and looking at the answers circled to recognize and gather cues.

2. Generating initial hypotheses (when alternative problem formulations are retrieved from memory using cues to link up to the long-term memory), for example an explanation offered or an assumption as a starting point for the reasoning or action taken.

3. Cue interpretation (when data interpretation follows in light of the alternative hypotheses to confirm or disconfirm hypotheses or as non-contributory), for example reflecting on answer chosen and explaining how they arrived at the answer or why they made the particular decision.

4. Hypothesis evaluation (data are weighted and combined to determine if one of the hypotheses generated is confirmed).

Appendix 10: Transcription of interviews (continued)[4]

3 Participant 201361 Participant: Dit vra circle two blocks wat vir jou sal concern. n normale lesing vir my is mos nou 16 tot 20. Onder 9 sal ek nou aanspreek want dit is mos nou n stadige asemhaling en bo 30 is mos nou vinnig. Ek het 9 or less en 30 or more. n Mens kan ook nou kyk na miskien was die pasient excited of iets soos dit sal ook n indikasie gee. (Medium-risk MEWS 2 for low; high-risk MEWS 3 for high	CR
[It require that you circle two blocks that will be of concern to you, normal reading for me is 16 to 20 below 9 I will address it because it is a slow respiration and above 30 is fast.I have 9 or less and 30 or more.A person can look perhaps the patient was excited or something and that will also be an indication.]	1-2
Participant : Nommer 2 van die Sats; normal Sats vir my is van 90 en op, soos ek het less than 85 gedinges want dit sal nou regtig wat vir my sal se daar iets fout is. (High-risk MEWS 3)	
[Number two of the Sats, normal Sats for me is from 90 and above, so I chose 85 because it it will really indicate to me that there is a problem]	1-2
Dan het ek by nommer 3 vra hulle respiratory rates; die normal is so 60 tot en met 120 of so ek het gekies minder as 40, or less sal vir my concern en 30 or want dit is mos 40 or less, dit kan bradicardia wees en 30 or more tachycardia. (Medium-risk MEWS 2 for low; high-risk MEWS 3 for high)	
[Than at number three they ask the respiratory rates, the normal is so 60 to 120 or so I chose less than 40 or less will be of concern to me and 30 or because it is 40 or less, it can be a bradicardia or 30 or more tachycardia.]	
Nommer 4 vra hulle die bloeddruk; systolic normal is ook 100 tot 140 dan het ek gekies 70 or less sal vir my concern. (High-risk MEWS 3 for low; normal MEWS 0 for high)	1-2
[number four they ask the blood pressure , systolic normal is also 100 to 140 than I chose 70 or less which will be of concern to me.]	
Dan nommer 5 het ek one block of temperature that would be of a concern toe vat ek 35 to 38 want 39 en op is pyrexia, dit sal vir my dringend is, so 35-38 is nognie so ernstig nie. (Normal MEWS 0)	
[Than number 5 I chose one block for temperature that would be of concern so I chose 35 to 38 because 39 and higher is pyrexia it is urgent for me, so 35 to 38 is not that serious.]	1-2
En dan nommer 6 is oor early signs of deterioration as die pasient niks gestimuleer deur niks dan moet ek mos nou iets doe nom uit te vind wat is die probleem want n Glasgow scale van minder as 8 beteken mos nou die pasient is unresponsive, dan kan daar mos n problem wees, so jy moet mos nou reageer op dit. (High-risk MEWS 3)[Number 6 is about early deterioration if the patient cannot be stimulated by anything than I must do something to determine what the problem is because a Glasgow coma scale of less than 8 means the patient is unresponsive, than there may be a problem and you must respond to it.]	1-2
By nommer 7 het ek gese die normale is … ek dink dit moet omtrent 30 ml urine per uur, so as dit nou minder as 30 is beteken hy kan miskien gedehidreed of so en meer as 300 ml kan beteken of kan n indikasie wees dat daar n problem is met die niere en as dit nou meer as 300 ml per uur is beteken die pasient verloor baie vloeistof in so n kort tydtjie. Is n kans dat hy gedehidreerd kan wees. (Medium-risk MEWS 2 for low; low-risk MEWS 1 for high)	
[At number 7 I said the normal is I think it must be 30 ml urine per hour, so if it is less than 30 it can indicate that the patient can perhaps be dehydrated or so and more than 300ml can indicate that there is a problem with the kidneys and if it is more than 300ml it can indicate that the patient is losing fluids in a short space of time is a possibility that he can be dehydrated.]	3

[4] 1. Cue acquisition (a process of obtaining **information** from participants' completed questionnaires), for example reading the question and looking at the answers circled to recognize and gather cues.

2. Generating initial hypotheses (when alternative problem formulations are retrieved from memory using cues to link up to the long-term memory), for example an explanation offered or an assumption as a starting point for the reasoning or action taken.
3. Cue interpretation (when data interpretation follows in light of the alternative hypotheses to confirm or disconfirm hypotheses or as non-contributory), for example reflecting on answer chosen and explaining how they arrived at the answer or why they made the particular decision.
4. Hypothesis evaluation (data are weighted and combined to determine if one of the hypotheses generated is confirmed).

Appendix 10: Transcription of interviews (continued)[5]

4 Participant 201359	**CR**
Researcher: You can just start from number 1.	
Participant: The respiratory rate which is abnormal here is 9 or 9 or less, which means it is below normal because the normal respiratory rate is 18-20 breaths per minute. (Medium-risk MEWS 2 for low; normal MEWS 0 for high)	**1-2**
Question 2, the SATS reading which is abnormal is less than 85%, because when you are in the wards the doctor used to say to write on the prescription charts, if SATS is below 90 you call the doctor because normal SATS must be from 90 to 100%. (High-risk MEWS 3)	**1-2**
The heart rate which is pulse here is the one that is below normal here in 41-50 and the other one that is above normal is 101 to 110, because the normal heart rate is between 60 and 80 beats per minute. (Low-risk MEWS 1 for low; low-risk MEWS 1 for high)	**1**
The systolic reading in the list that is below normal, systolic here is 71-80 the one that is below normal; the one that is above normal is 200 because the normal systolic blood pressure is from 100 to140 mm per mercury. (Medium-risk MEWS 2 for low; medium-risk MEWS 2 for high)	**1**
And the temperature here is 35 degrees Celcius which is below normal because the normal temperature must be 36 -37,5 degrees Celsius in adults. (Medium-risk MEWS 2 for normal temperature)	**1**
The level of consciousness, the time we were doing Neuro in GNS 111 here when the patient is unresponsive doesn't respond or the patient must respond to stimuli the level of consciousness is deteriorating then. (High-risk MEWS 3)My level was unresponsive which means the patient needs more help.	**2**
Urine output , okay this one this is 30 ml per hour which means the patient doesn't pass enough urine like might be having a problem, and the one that is above which is 300 ml per hour for 2 hrs, which means the patient might be having a problem - that is too much urine for 2 hours. (Medium-risk MEWS 2 for low; low-risk MEWS 1 for high)	**2**

[5] 1. Cue acquisition (a process of obtaining information from participants' completed questionnaires), for example reading the question and looking at the answers circled to recognize and gather cues.

2. Generating initial hypotheses (when alternative problem formulations are retrieved from memory using cues to link up to the long-term memory), for example an explanation offered or an assumption as a starting point for the reasoning or action taken.

3. Cue interpretation (when data interpretation follows in light of the alternative hypotheses to confirm or disconfirm hypotheses or as non-contributory), for example reflecting on answer chosen and explaining how they arrived at the answer or why they made the particular decision.

4. Hypothesis evaluation (data are weighted and combined to determine if one of the hypotheses generated is confirmed).

Appendix 10: Transcription of interviews (continued)[6]

5 Participant 201355 Participant: Nommer een is mos wat ons die twee blokkies gekies het vir die signs of deterioration. Die rede hoekom ek die twee antwoorde gekies het 9 or less en 30 or more is omdat ek die normal ranges gehad het, die normal ranges van respiratory kan ek mos se is 60 to 80, ja nee nee daai is die pols wat ek nou aan dink. Die respirasie is 12 tot 18 so obviously as dit 30 en meer is dan is dit te veel en 9 or less is te min. (Medium-risk MEWS 2 low; high-risk MEWS 3 high)	CR
[Number one is where we chose two blocks for signs of deterioration. The reason why I chose the answers 9 or less and 30 or more is because the normal ranges of respiratory is 60 to 80 yes, no that is the pulse rate I am thinking about. The respiration is 12 to 18 so obviously if it is 30 and more it is too much and 9 or less is too little.]	1-2
Die tweede blok is die saturasie, moet ons mos net een gekies het. Die normal Sats is mos 95 as ek dit nou reg het, ja 95, so as dit less as 85 is dan is dit definitief te min en even as ek 93 ook moes gekies het ek het mos nou gevat 85. (MEWS 3 high risk)	
[The second block is the saturation wher we had to choose one.The normal Sats is 95 if I remember correctly yes 95, so if it is less than 85 it is definitely too low and even if I chose 93 also so I took 85]	
Die tweede een is die heart rate toe vrae hulle ook die signs of deterioration toe se hulle ook twee blokkies. Dit is die normal rate van die heart rate is ook mos 60 to 80 is mos die pulse so lower as 40 beteken dan daar is te min en dan 130 en more is te veel . (Medium-risk MEWS 2 low; MEWS 3 high-risk high)	1
[The second one is the heart rate they also ask for signs of deterioration so they also ask for two blocks.The normal rate of the heart rate is 60 to 80 it is he pulse so lower than 40 means that there is too little and than 130 and more is too much.]	
Die blood pressure die normal ranges is ook between 110, die systolic is 110 to 190, ja nee 140 en die onderste is 60 to90, en 70, nee 60. My normal range vir systolic is mos 110 to 140 en hierso vra hulle van die systolic less than 70 is mos nou minder, en dan 200 is te veel. (High-risk MEWS 3 for low; medium-risk MEWS 2 for high)	
[The blood pressure the normal ranges is also between 110, the systolic is 110 to 190, yes no 140 and the lower value is 60 to 90 and 70 no 60.My normal range for systolic is 110 to 140 and here they ask for the systolic less than 70 it is less than and 200 is too much.]	1
Die normal temperature is maar hulle se nou nie n adult nie, maar okay dit is maar nou seker groot pasient. Die normal range is 36 point nee 36.2 to 37.5. (Normal MEWS 0)	
[The normal temperature is but they do not say for an adult but okay it is probably for a adult.The normal range is 36 points no 36.2 to 37.5]	
Level of consciousness ek het eintlik verkeerd hierso, nee ja dit is reg, unresponsive – daai is mos nou wat ek gekies het, maar dit mos nou eintlik 15 wees en 8 is te min, so as dan is hy unresponsive: dit is hoe ek by 8 gekom het. (High-risk MEWS 3)	1
[Level of consciousness I actually have it wrong no, yes it is correct unresponsive, that is what I have chosen it should actually be 15 and 8 is too low, so than he is unresponsive that is how I got to 8]	
Dan die urine output is daar ook two circles. As daar niks urine is nie, dan is dit n indication vir jou want n pasient is suppose to be 30 ml per dag - nie per dag nie, per uur - 30 ml te urineer. (High- risk MEWS 3 for low; medium risk 2 for high)	
[The urine output there is also two circles.If ther is no urine output it is indication to you because the patient is supposed to be 30ml per day not per day per hour, to urinate 30ml per]	1

[6] 1. Cue acquisition (a process of obtaining information from participants' completed questionnaires), for example reading the question and looking at the answers circled to recognize and gather cues.

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3. Cue interpretation (when data interpretation follows in light of the alternative hypotheses to confirm or disconfirm hypotheses or as non-contributory), for example reflecting on answer chosen and explaining how they arrived at the answer or why they made the particular decision.

4. Hypothesis evaluation (data are weighted and combined to determine if one of the hypotheses generated is confirmed).

Appendix 10: Transcription of interviews (continued)[7]

6 Participant 201357	CR
Participant: The normal and abnormal of blood pressure [taught] in the first year, so that is how I came to my answer with everything basically. Your normal and your abnormal, then you differentiate between the two; that is how you get your answer. That is how I got to the first answer.	
Researcher: To the temperature, what is the first one?	
Participant: It is the systolic blood pressure.	
Researcher: Okay ja so let's just go, that is number four to the first one, so we start from number one and then you can just go down the line and tell, because if you say this is the abnormal what do you then say is your normal?	
Participant: Okay yes. Like I said, Mrs Leonard, we were taught the normal and abnormal of all your observations, so that is how I came to my answer basically. You said we can circle two blocks so I chose the first block and the last one because the question asks you to indicate the respiratory rate and the early signs of deterioration. So obviously more than 30, which means the patient is probably getting worse, and less than 9, yes it is also an indication that the patient is deteriorating. (Medium-risk MEWS 2 low; high-risk MEWS 3 high)	1-2
Then the second one was the saturation. Usually in the hospitals what the sisters teach us is the normal and the abnormal, so the normal saturation they always tell us it is above 90 - that is what you usually look for - and when it is lower than that or more than that you can just, how can I say, you can go tell them or whatever – you must intervene in a situation like that. (MEWS 3 high risk)	1-2
Number 3 you asked indicate the heart rate reading in the list below that's also or early signs of deterioration - yes that's also the reason why I chose, according to the normal and abnormal heart rate. (Medium-risk MEWS 2 lower; low-risk low MEWS 1 for high)	
Researcher: You spoke about the systolic, did we complete the systolic?	
Participant: Yes we spoke. (High-risk MEWS 3 for low; medium-risk MEWS 2 for high)	
Researcher: So we go to number 5.	
Participant: The temperature, yes normal temperature, that is what they also taught us because that is the first thing you are taught in our first year - the normal and your abnormal observations. So I chose my answers according to what I was taught, because I mean Ms Leonard when you come into nursing you don't know - you must be taught to know, and when you see it when you do your observations on the patient, you see the signs that your patient is presenting with when you do your observations, and according to your readings - that's what you find, that is when you decide: okay, that is normal and this is abnormal. With the abnormal I am going to intervene here, with readings the normal temperature is between 36.5 and 38, that is the answer I chose for temperature. (Normal MEWS 0)	1-2
Yes, why I chose that one: when you talk to the patient the patient is supposed to respond, especially I mean a simple question like what is your name and how are you. You expect the patient to respond and answer you. When you talk to the patient and the patient is just laying there, you are going to get concerned or you want to know why the patient not responding - is something happening, is the condition worsening, you know. Miss Leonard that is why I chose that one. (High-risk MEWS 3)	2
Number 7, the urine output, early signs of deterioration. Yes we were also taught mostly in the general medical ward about the patient's output. If there is less output or no output in the patient it is usually kidney problems or whatever, but the patient must have urine output, that's why they always record during the whole day the patient's urine output, and then at the end of the day you count everything together to see if the patient's condition is improving or worsening. Is the medication working that we are administering to the patient> That's why I came to my answer. (High-risk MEWS 3 for low; medium-risk low MEWS 2 for high)	3

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2. Generating initial hypotheses (when alternative problem formulations are retrieved from memory using cues to link up to the long-term memory), for example an explanation offered or an assumption as a starting point for the reasoning or action taken.
3. Cue interpretation (when data interpretation follows in light of the alternative hypotheses to confirm or disconfirm hypotheses or as non-contributory), for example reflecting on answer chosen and explaining how they arrived at the answer or why they made the particular decision.
4. Hypothesis evaluation (data are weighted and combined to determine if one of the hypotheses generated is confirmed).

Appendix 10: Transcription of interviews (continued)[8]

7 Participant 201360 16/7/13 (first recording)	CR
Participant: Okay I chose 9 or less because the normal respiratory rate is 16 up to 20, so I think the patient has got a problem if he's got less than 10 respiratory rate. I also chose the 30 or more because this is also a problem; it is abnormal if it is more than 24, as in the book I have read. (Medium-risk MEWS 2 low; high-risk MEWS 3 high)	1-2
Coming to the SATs, I chose less than 85%, it is also abnormal; the normal percent is 85 up to 100 SATs. (MEWS 3 high risk)	1-2
Heart rate 40 or lower is also abnormal, and 130 or more is abnormal because your normal range for heart rate is 60 up to 80. Less than 60 is abnormal and more than 100 is also abnormal, but I chose this one because it is more than this one. The normal rate for heart rate is 60 up to 80. (Medium-risk MEWS 2 lower; high-risk MEWS 3 for high)	1-2
I chose the 101 up to 199 because it is abnormal. What is this, systolic? Because thenormal systolic is 110 up to 140 and 200 or higher the patient has got hypertension. (Normal MEWS 0 for low; medium risk MEWS 2 for high)	3
The temperature reading, lower than 35 is abnormal, because the normal reading for temperature is 35 up to 37.5 degrees especially for adults. (Medium-risk MEWS 2 for normal)	1-2
What is the okay level of consciousness - I chose unresponsive as the patient is less than 8 because it is the abnormal one: unresponsive, not alert and less than 8. (High-risk MEWS 3)	1
Then the urine output, I chose a nil because the patient must have at least 1000 ml in 24 hours, so this is abnormal. (High-risk MEWS 3 for low; medium-risk low MEWS 2 for high)	1

[8] 1. Cue acquisition (a process of obtaining information from participants' completed questionnaires), for example reading the question and looking at the answers circled to recognize and gather cues.

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3. Cue interpretation (when data interpretation follows in light of the alternative hypotheses to confirm or disconfirm hypotheses or as non-contributory), for example reflecting on answer chosen and explaining how they arrived at the answer or why they made the particular decision.

4. Hypothesis evaluation (data are weighted and combined to determine if one of the hypotheses generated is confirmed).

Appendix 10: Transcription of interviews (continued)[9]

8 Participant 201352 (second recording A) Researcher: Jy kan maar praat.	CR
[You can start talking]	
Participant: Okay, moet ek nou se according to nommer een, twee , drie?	
[Okay must I say according to number one,two three?]	
Researcher: Jy kan maar by nommer een begin, dan se jy net net nommer een en verduidelik jy nou.	
[You can start with number one and then you say number one and explain.]	
Participant: Okay, nommer 1, die abnormal of respiratory. Die rede hoekom ek 21 till 29 en 30 en more gekies het is omdat dit is die abnormaliteit van n person van respiratory want die normal rate het ons geleer in die klas en according to my knowledge wat ek by die hospitale wat ek mos nou gewerk het, het ek nou gesien wat is die abnormal en wat is signs. Dit is hoekom ek dit gekies het. (Medium-risk high MEWS 2 for low; high-risk MEWS 3 for high)	
[Okay number one the abnormal of respiratory. The reason why I chose 21 till 29 and 30 is because it is the abnormality of a person's respiration because the normal rate we were taught in class and according to my knowledge that I gained working in the hospitals I have seen what abnormal is and what signs is. That is why I have chosen this.]	1-2
By twee, in my in my tweede jaar het ons baie met die saturation masjientjie en dit was baie belangrik, veral in die kinder sale; die dokters se die saturation moet nie minder as 90 wees nie, daarvoor het ek gevat less than 80% en 85 to 89 - daarom het ek dit gekies. (High-risk MEWS 3)	
[At two in my second year we worked a lot with the saturation machines and it was important especially in the paediatric wards, the doctors said the saturation should not be less than 90 therefore I chose less than 80% and 85 to 89 that is why I made that choice.]	1-2
Nommer 3 was die blood pressure; die abnormal blood pressure is wanneer dit 113 - 130 tot meer, dit is hypertension, en ek het gese dit is abnormal en less than 40 is abnormal; ons het geleer in die klas van die normal range en ons het in die hospitale met hoe bloeddruk pasiente gewerk, en dit het nou by my gekom dat dit abnormal is. (Medium-risk MEWS 2 lower; high-risk MEWS 3 for high)	
[Number three was the blood pressure the abnormal blood pressure is when it is 113-130 or more it is hypertension and I said it was abnormal and less than 40 is abnormal.We were taught in class about the normal range and we worked in hospital with blood pressure pasients and it came to me that that is abnormal.]	1-2
Researcher: Watter enetjie is daai nou?	
[Which one was that now?]	
Participant: Nommer 3 en die systolic pressure die abnormal van dit is wanner dit 200 en higher is en ek het gevat 70 en lower, want dit is te doen met blood pressure en toe het ek gese die systolic pressure wat ons geleer het dit moet 110 to 140 wees, so dit is abnormal systolic en daarom het ek daai antwoorde gekies. (Medium-risk MEWS 2 lower; high-risk MEWS 3 for high)	
[Number three and the systolic blood pressure the abnormal of that is when it is 200 and more and I chose 70 and lower this is with regard to blood pressure, the systolic blood pressure we have been taught is must be 110 to 140, so that is abnormal systolic and that is why I chose that answer.]	1-2
By temperature nommer 5 ek het gevat dit is lower than 35, dit is subabnormale temperature daarom het ek dit gevat want dit is abnormal. (Medium-risk MEWS 2 for normal)	
[At the temperature number 5 I chose lower then 35, this is sub-abnormal temperature that is why I chose	1

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4. Hypothesis evaluation (data are weighted and combined to determine if one of the hypotheses generated is confirmed).

that one because it is abnormal.] By 6 het ek gevat unresponsive, dit is wanneer jy die Glasgow Coma Scale [gebriuk], dit is wanneer die person nie alert is nie en dit is wanneer die person se Aquas scale lower than 8, dan kan jy maar die person pinch en sternal pressure doen, daai person sal dit nie voel nie, because is amper soos die person is in n coma, hy voel niks, hy weet niks wat om hom gaan nie. Dit was vir my abnormal wat ek daar gevat het. (High-risk MEWS 3) [At number 6 I chose unresponsive that is when you use the Glasgow coma scale, that is when the person is not alert and that is when the Aquas scale is lower than 8,then you can pinch the person or apply sternal pressure that person will not feel anything, because it is it is almost as if the person is in a coma, he feels nothing and knows nothing about his surroundings. That is abnormal for me and that is why I chose it. Nommer 7 het ek gevat van die urine 0 en ek het gevat 30milligram en less cause in die hospitale se hulle is die pasient nie byvoorbeeld as dit postoperative is dan kom die pasient mos nou saal toe, dan binne se maar binne 6 ure die pasient moet urinate, dan as die pasient nie binne daai 6 ure urinate nie dan is daar abnormaliteit somewhere. En as hy nou vir die hele dag 30 milligram urine dan is dit n abnormaliteit want somewhere is daar iets verkeerd, daarom het ek daai antwoord gekies. (High-risk MEWS 3 for low; medium-risk low MEWS 2 for high)[Number 7 i chose for urine nil and I chose 30milligram and less because in the hospital they say when the patient get to the ward post-operatively then within 6 hours the patient must urinate and if the patient do not urinate within 6 hours then there is an abnormality and somewhere there is something wrong that is why I chose that one.]	3 3

Appendix 10: Transcription of interviews (continued)[10]

9 Participant: 201356 **Participant:** Die rede hoekom ek by vraag nommer een besluit het die twee waardes is vir my van belang as n pasient n afname het in sy asemhaling is omdat ek so geleer gewees het volgens onse boeke van eerste jaar dat n vinnige asemhaling en n baie stadige asemhaling tagipnee en bradipnee beteken. Die pasient is in gevaar want dis as hy baie stadig is kan n pasient beswyk en as hy baie vining is. (Medium-risk high MEWS 2 for low; high-risk MEWS 3 for high)	CR
[The reason why I have decided these two values are important to me, when a patien have a decrease in his respiration is because that is how I have been taught and according to our books in first year, a rapid/fast respiration and a very slow respiration refer to tachipnea and bradipnea.The patient is in danger when he breath slowly and he can collaps and when respiration is rapid.]	1-2
Vragie nommer twee is mos nou die hoeveelheid suurstof in jou bloed, se maar nou Mevrou, dit moet ons leer - dit moet oor 95% wees die saturasie, as hy laer is as 85 dan is daar mos nou n afname, en ek is mos nou geleer dit moet van se maar van 90 af op wees, dan is n pasient buite gevaar tekens. (High-risk MEWS 3)	
[Question number two is when the amount of oxygen in the blood say Mrs we have been taught it must be above 95% saturation, if it is lower than 85 than there is a decrease and I have been taught it must about from 90 and above than the patient is out of danger.]	1-2
Nommer 3 hoekom n pasient se hartslae se hartkloppe nie minder as 40 moet wees of meer as 130 nie, want die baseline soos ons geleer is hoe observasies - die normale ranges moet tussen 60 en 90 wees vir die hartslae en as hy laer as 40 is, is die pasient in bradikardie en in tagikardie as hy meer as 130 is. Dit beteken die pasient is in n gevaar sone en hy kan beswyk ook. (Medium-risk high MEWS 2 for low; high-risk MEWS 3 for high)	
Die rede hoekom ek vir die bloeddruk by nommer 4 gekies het is dat die sistoolise bloeddruk hy moet nie onderkant 70 en oor 200 nie, en dan kan die pasient ook in n hipertensie of hypotention; dit het betrekking op hoe ons geleer gewees het van eerste jaar af. Ja die waardes verander, dit is nou maar hoe ons geleer gewees is: dit moenie onderkant 70 of by 200 en meer gaan nie. (High-risk MEWS 3 for low; medium-risk high MEWS 2 for high)	
[The reason why I chose for blood pressure at number 4 is that the systolic blood pressure must not be below 70 or above 200, then the patient can become hypertensive or hypotensive this is how what we have been taught since first year. Yes the values changed but this is what we were taught it should not be below 70 or reach 200 or more.]	1-2
Wat die temperatuur betref, n normale temperatuur soos ons geleer gewees het is dit van 35.5 tot se maar 37,5, so ek sal se die ene die 35 tot 38.4 is vir my n normale waarde, wat n mens nog kan los, maar hy moet nie onderkant 34 en bo 39 want dan is n pasient pyrexial of hyperpyreksie - wat is dit in Afrikaans, hipopireksie. (Normal MEWS 0)	
[With regard to temperature we have been taught that the normal temperature is 35.5 to about 37.5 so I said this one 35 to 38.4 is a normal value that a person can accept but not below 34 and above 39 than the patient is pyrexial or hyperpyrexial in Afrikaans hipopireksie.]	1-2
Nommer ses se antwoord, wat vir n mens sal alert maak is wanner n pasient se Glasgow Koma Scale is onder 8 en die pasient is unresponsive teenooer pyn of enige stimuli, dan is dit iets wat on se aandag op gaan, as die pasient is mos nou in gevaar. (High-risk MEWS 3)	
[Number 6 the answer that will alert a person is when the Glasgow coma scale is less than 8 and the patient is unresponsive to pain or any stimuli, that is something that will alert one that the patient is in danger.]	2
Nommer sewe vir die urine in uitskeiding, ek sal se die30 en minder is vir ons n gevaar teken. As die pasient per dag bv. 30 en minder uitskei, die pasient kan mos nou hoe raak nie toksienie maar die soute in die uriene wat nie uitgeskei word nie. Die inname en die uitskeiding dit hoef nie dieselfde want daar is mos nou ander maniere hoe ons ook vog verloor, bv soos sweet ens, so dit moet nie net deur uitskeiding nie, maar 30 en minder is n gevaar,	

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en as n pasient nou oor die 300 ml per uur vir minder as twee ure voel ek ook of ek sal nie eintlik se daai ene is, maar n pasient moet mos uitskei .Ek weet nie. (Medium-risk high MEWS 2 for low; low-risk MEWS 1 for high) [Number seven for urinary output I will say 30 and less is a danger sign for me.If the patiet excrete 30 and less the patient cannot get rid of toxins and salts in the urine.The intake and output need not be the same as there are other ways that the body loses fluids eg. Sweating etc. so it need not be through urination only, but 30 and less is a danger and if the patient excrete 300ml per hour for less than two hours I feel that is what a patient should excrete.I don't know.]	3

Appendix 10: Transcription of interviews (continued)[11]

10 Participant 201354	CR
Participant: Nommer 1 ek het 9 or less gekies en 30 en more, want die normal range dit differ verskillend volgens boeke, so vir my die normal range het hulle gese is 12 tot 18 en dan is daar nog n een wat 16 tot 22 se en nog n een wat 16 tot 20 se. Nou ek het daai twee gekies want volgens die drie in die middle kan die person nog normal breathing rhythm het maar daai enetjie is te vinnig, is tagipnee en die een is te laag. (Medium-risk MEWS 2 for low; high-risk MEWS 3 for high)	
Number one I chse 9 or less and 30 or more because the normal range it differ according to different books so for me the normal range they said is 12 to 18 than here is another range 16 to 22 and another one is 16 to 20..Now I chose these two because according to the three values in the middle the person can still breath normally but that one is too fast it is tachipnea and that one is too low.]	1-2
Die tweede een is die saturation; ek het die een gekies want hulle het gese 90 en bo 90 is normal en 85 is nou onderkant 90, ek wil ook nie daai een gekies het nie want miskien is daai ene nog n bietjie normal, daai enetjie is buite uit die wyk uit die 85%. (High-risk MEWS 3)	
The second one is the saturation I chose this one because they said 90 and above is normal and 85 is below 90, I did not want to choose that one because maybe that one is normal and the other one 85 is out of the range.]	
Die heart rate reading beats per minute het ek daardie twee gekies want dit is te vinnig **(**111-129; 130 or more). Ek het al een keer gesien … die man se heart rate se pols was dit die enetjie 40 en lower - dit kan mos nou nie te low nie, maar hy was nog steeds okay,tussen aanhalings tekens, maar ons het die suster toe gevra toe se sy daai is vir hom normal, want hy het altyd so n lae pols gehad. Toe het ek nou maar daai tweetjies gekies want dit is te veel, dit is 111-129; 130 or more. (Medium-risk high MEWS 2 for low; high -risk MEWS 3 for high)	1
[The heart rate beats per minute I chose those two because it is too fast (11-129 and 130 or more).I have previously seen a man with a heart rate/pulse of 40 and lower it cannot be too low but he was still okay between brackets but we asked the sister and she said for him I was normal, because he always had such a low pulse rate.so I chos these two because it was too fast.]	
Die enetjie by die bloeddruk systolic, die boonste enetjie, ek het die 101 - 199 gekies en 200 tot en higher gekies, en dit is vir my buite die nomal perke. Okay ek het daai enetjie gekies want dit is buite die normale perke mos, die systolic is 100 tot 139. (Normal MEWS 0 for low; medium-risk MEWS 2 for high)	
[This one blood pressure systolic, the top one, I chose 101-199 and 200and more, it is out of the normal range for me. Okay I chose this one it is out of the normal range for me the systolic is 100 to 139.	2
Die temperatuur is lower than 35 maar ek kan nie verduidelik nie, ek het net gese die enetjie. (Medium-risk MEWS 2 for normal)	
[The temperature is lower than 35 but I cannot explain , I chose this one.]	
Level of consciousness unresponsive, want ons het die in A4 ook gedoen (i.e. neurosurgical ward TBH) - wanneer die persoon unresponsive is, is daar n problem met die brein. (High-risk MEWS 3)	
[Level of consciousness unresponsive, because we did it in A4,when the person is unresponsive there is a problem with the brain.]	
Die output van urine 60ml per uur en more than 300 ml per hour for two hours, ek het daai twee gekies want dit is buite die normal perke. (Normal MEWS 0 for low; low-risk MEWS 1 for high)	1
[The output of urine 60ml per hour and more than 300ml per hour for two hours, I chose those two because it is out of the nomal range.]	1

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