PATIENT DETERIORATION: The Effect of Humans and Systems in One Health Care System

A thesis submitted for the degree of Doctor of Philosophy of The Australian National University
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1 Declaration

The material presented in this thesis has not previously been submitted, either in whole or in part, for a degree at this or any other university. This thesis is original and to the best of my knowledge and belief contains no material previously published or written by another person except where due acknowledgements has been made.

Imogen Mitchell　　　11th April 2013

A/Prof Imogen Mitchell　　　Date

Margaret Kiley　　　30.04.2013

Dr Margaret Kiley　　　Date

2 Acknowledgements

In trying to understand patient deterioration in the acute hospital environment, education, or lack thereof, was thought to be an important influence on patient care. Why would well-educated nurses and doctors fail to recognise and respond to patient deterioration? Expert advice on tools for examining education was sought at the Centre for Higher Education, Learning and Education at the Australian National University, which is why this doctorate is being submitted through the College of Arts and Social Sciences at the Australian National University.

There are many people that I wish to thank for their help and support in accomplishing this thesis. I thank Dr Margaret Kiley (Convenor, Graduate Research Field Education, Centre for Higher Education, Learning and Education, Australian National University) for giving me the opportunity of pursuing my PhD, her ideas, encouragement, support, never ending enthusiasm and belief in my abilities and for being the most wonderful supervisor. I also thank my other supervisors, Professor Paul Gatenby (Inaugural Dean, ANU Medical School and Professor of Immunology, ANU Medical School) and Professor Rinaldo Bellomo (Professor of Medicine, Faculty of Medicine, University of Melbourne) who have provided me with endless wise counsel to guide me through the quagmire of undertaking a post graduate degree. Alongside my supervisors, Associate Professor Monica Kennedy (Associate Dean, Faculty of Business and Government, University of Canberra), my advisor, provided me with her extreme patience in leading me through foreign lands such as I found qualitative research for which I remain very grateful. An equally important person in supporting my PhD endeavours was Ms Heather McKay (Program Manager for the Early Recognition of the Deteriorating Patient Program, Health Directorate, ACT Government) who continually encouraged me in my endeavours and was the project officer for the Early Recognition of the Deteriorating Patient project, which forms the basis of Chapter 5. Her role included the coordination of the project and data collection for Chapter 5 and without her help the project could not have existed.

The work undertaken in this thesis could not have been performed were it not for a team of people helping me. Much of the work was performed in my role as the Clinical Lead, Recognising the Deteriorating Patient Project and Program, Health Directorate, ACT Government, which was supported both fiscally and in concept by Mr Mark Cormack (previously Chief Executive, ACT Health) and Dr Wayne Ramsey (previously Director, Clinical Governance Unit, ACT Health). I would like to thank Dr Chris Van Leuvan for his never ending tolerance and ability to design functional data bases for Chapters 5 and 7 and extracting interpretable data for Chapters 4, 5 and 7 and Dr Felix Rockmann for developing a database for Chapter 4. I am grateful to Dr Terry Neeman (Statistical Consulting Unit, Australian National University) and Associate Professor Abdel-Latif Mohammed (Neonatology Staff Specialist, The Canberra Hospital) for their advice and guidance on advanced statistics in Chapter 5 and 7 respectively. The development of the education package for the deteriorating patient used in Chapters 5 and 7, COMPASS©, could not have been completed without the input from Drs Bronwyn

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Without doubt, it was Alice's mother who finally made me realise how important it is to understand patient deterioration, the impact that patient deterioration can have upon families, both mentally and physically, and that one should never ignore what families and friends tell the doctors and nurses on the ward.

Lastly, without the support of my family and their never ending understanding, none of what I have done to date would have been possible, I will forever be indebted to them.

3 My Contribution

For all the five studies undertaken in this thesis, I designed the studies and submitted the studies to the Ethics Committee.

For the first study described in Chapter 4, I collected the data, analysed the data, undertook the basic statistical analysis, collated the analysis and wrote the study up.

The second study described in Chapter 5, was part of a Health Directorate's Quality and Safety initiative to improve the recognition and response to patient deterioration. As the Health Directorate's Clinical Lead for this project, I was able to design the study and be the overall editor for the patient deterioration, "COMPASS©", education program. The educational components of COMPASS© included written material in which I wrote two chapters, a quiz, which I designed and four cases for low fidelity simulation, of which, I designed one case. The initiative also involved redesigning the ward observation chart, including colour coding the vital signs for degree of derangement and improving the clarity of the chart and I was the final decision maker for the changes in the chart construction. The governance of the project was overseen by a Health Directorate Steering Committee, of which I was a member as well being a member of the project team which rolled the initiative out to the four pilot wards. The steering committee approved the use of the data for my doctoral thesis. To date, there has only been one peer reviewed publication using these data and the data have not been and will not be used for another doctoral thesis. I performed the data analyses and simple statistics and wrote the study up, including the peer reviewed publication. The paper has been reformatted with minor revisions to enable it to be included in this thesis

In the third and fifth studies described in Chapters 6 and 8, respectively, I collected the data, analysed the data, undertook basic statistical analyses, collated the analysis and wrote the study up.

In the fourth study described in Chapter 7, with the assistance of a project officer I collected the data, analysed the data, undertook any basic statistical analyses, collated the analysis and wrote the study up.

4 Publications by the Candidate Relevant to the Thesis

Mitchell IA, McKay H, Van Leuvan C, Berry R, Avard B, Slater N, Lamberth P. A prospective trial of the effect of a multifaceted intervention on early recognition and intervention in deteriorating hospital patients *Resuscitation* (2010): 81; 658–666

5 Presentations by the Candidate Relevant to the Thesis

Mitchell I, McKay H, Van Leuvan C, Berry R, Avard B, Slater N, Lamberth P

Early Recognition of the Deteriorating Patient Reduces Unplanned ICU admissions.

32nd Annual Scientific Meeting, Australia and New Zealand Intensive Care Society and Australian College of Critical Care Nurses; October 2007, Rotorua, New Zealand

Mitchell I, McKay H, Van Leuvan C, Berry R, Avard B, Slater N, Lamberth P

Early Recognition of the Deteriorating Patient Reduces Unplanned ICU admissions.

21st Annual Congress, European Society of Intensive Care Medicine; September 2008, Lisbon, Portugal

Mitchell I, Van Leuvan C, Rockmann F

The process of recognising and responding to patient deterioration: An observational study

4th Canberra Health Annual Research Meeting; June 2011, Canberra, Australia

Mitchell I, Kennedy M, Kiley M

The human element of managing patient deterioration

4th Canberra Health Annual Research Meeting; June 2011, Canberra, Australia

Mitchell I, McKay H, Kiley M

What influences the change in behaviour following the introduction of a multifaceted intervention for the early recognition and response to patient deterioration?

4th Canberra Health Annual Research Meeting; June 2011, Canberra, Australia

Mitchell I, McKay H, Kiley M

A qualitative study to understand behavioural changes with a multifaceted intervention.

The 7th International Conference on Rapid Response Systems and Medical Emergency Teams; May 2012, Sydney, Australia

Mitchell I, Kennedy M, Kiley M

The human element of managing patient deterioration

The 7th International Conference on Rapid Response Systems and Medical Emergency Teams; May 2012, Sydney, Australia

6 Prize awarded to the Candidate Relevant to the Thesis

Best Student Poster for:

"What influences the change in behaviour following the introduction of a multifaceted intervention for the early recognition and response to patient deterioration?"

4th Canberra Health Annual Research Meeting; June 2011, Canberra, Australia

Abstract

The failure to recognise and to respond to adult deteriorating patients in general hospital wards leads to unexpected and potentially preventable deaths.

Aims

1. To improve the understanding of the clinical processes and influences involved in managing patient deterioration.
2. To examine the effect of a deteriorating patient intervention on clinical processes and patient outcome.
3. To determine if the effects of a deteriorating patient intervention are sustainable.

Methods

Quantitative Studies

i. Observational Study: Clinical processes in 34 patients undergoing 45 Medical Emergency Team reviews were examined retrospectively.

ii. Interventional Study: A prospective controlled trial, before and after a multifaceted intervention for managing patient deterioration was undertaken in two wards in two hospitals for two-four month periods. Changes in deteriorating patient clinical processes and outcome were measured.

iii. Sustainability Study: Adult patients admitted to two wards in one hospital during three four-month periods, one before, one immediately after the patient deterioration intervention and one two years later. Changes in deteriorating patient clinical processes and outcome were measured.

Qualitative Studies

i. Behavioural Study: Interviews of 12 healthcare workers involved in the patient deterioration intervention were undertaken to generate a model of why behaviour changed with the installation of the multifaceted intervention for managing patient deterioration. Grounded theory methodology described on page 80 was used.

ii. Human Element Study: Focus groups of healthcare workers were held to generate discussion and used to generate a model of the influences on healthcare professionals in managing patient deterioration. Grounded theory methodology was used.

Results

Clinical processes for managing patient deterioration were found to be deficient. Deficiencies included infrequent documentation of vital signs, particularly respiratory rate and limited involvement of senior decision makers leaving junior clinicians to manage patient deterioration, which delayed appropriate treatment.

The multifaceted intervention significantly improved patient outcome and improved behaviour such as documentation of vital signs, supported by a hospital policy, and timeliness of medical review, triggered by more confident nursing staff underpinned by objective evidence (the modified early warning score) of patient deterioration. Improvement in timeliness of medical review and documentation of vital signs were sustained two years later but patient hospital outcome and the nurses calling for further medical help were not.

Further investigation of behaviours that were not sustained revealed that junior medical and nursing staff lacked adequate clinical experience to facilitate timely decision making necessitating input from their consultants. Timely and appropriate communication was hindered through fear, lack of confidence or lack of knowledge and poor consultant approachability.

Conclusion

Identified shortcomings in the teamwork managing patient deterioration improved with the installation of a multifaceted intervention and, improved patient hospital outcome. Significant behavioural issues, especially communication with consultants, were identified as likely to hamper further improvement. In an age of shift work and reduced clinical experience, enhanced decision making will need a more intelligent system that can accurately detect patients at risk of patient deterioration and improved access to consultants to gain maximal benefit from the healthcare team.

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Description of the Health Care System

The Australian Capital Territory (ACT) is the capital territory of the Commonwealth of Australia and is the smallest self-governing internal territory. There are two public acute care hospitals in the ACT, The Canberra Hospital (500 beds) and Calvary HealthCare ACT (200 beds), serving a metropolitan population (360 000). The larger tertiary and university affiliated hospital, The Canberra Hospital, also provides tertiary services to the surrounding region in southern New South Wales (population 240 000).

Patients admitted to the two hospitals are cared for by a medical specialist who are either employed by the Health Directorate, ACT Government or contracted to deliver specialist services as a visiting medical officer. The medical specialist commonly supervises a registrar who is either a basic trainee or an advanced trainee of a particular college, which reflects their degree of clinical experience. Additional members of the patient's medical specialist's team, the parent team, include a resident medical officer who is usually two or three years post-graduation and an intern who is in their first postgraduate year and is yet to be a fully registered medical practitioner.

Once patients are admitted to the acute care wards of the two hospitals, nursing care is delivered by, predominantly, registered nurses who are varied in their degree of clinical experience. Occasionally, wards will employ enrolled nurses and nursing assistants to provide some aspects of nursing care. All the nursing staff are supervised by a ward clinical nurse consultant who is responsible for the operational activities on the ward as well as supervision of the nursing care delivered to patients.

Staffing in-hours, which is considered between the days of Monday through to Friday and the hours of 0800 hrs until 1800 hrs is significantly different for both medical and nursing. For the medical staff, the medical specialist is more likely to be available to both the patient and junior medical staff on site but they are often in the operating theatre or outpatient clinics. The junior medical staff; registrar, resident medical officer and intern, will be caring for the patient directly and will hand over care to an out of hours medical team. The composition of the out of hours medical team varies but there is a significant reduction in the availability of doctors, particularly senior experienced doctors, out of hours. Out of hours, most medical specialists will be on call from home and not in the hospital to provide advice for patient management.

For the nursing staff, the staffing ratios for direct patient care remains similar between in hours and out of hours but the clinical nurse consultant is no longer available out of hours. Instead, there is one clinical nurse consultant available for the whole of the hospital.

LIST of ABBREVIATIONS

AIN	Assistant in Nursing
APACHE	Acute Physiology and Chronic Health Evaluation
ATP	Adenosine triphosphate
BP	Blood Pressure
BPM	Beats per minute
BpM	Breaths per minute
CI	Confidence Interval
CNC	Clinical Nurse Consultant
EN	Enrolled Nurse
GCS	Glasgow Coma Scale
Hb	Haemoglobin
HR	Heart Rate
ICU	Intensive Care Unit
MERIT	Introduction of the Medical Emergency Team
MEWS	Modified Early Warning Score
OR	Odds Ratio
RN	Registered Nurse
RR	Respiratory Rate
RRR	Relative Risk Rate
SaO_2	Arterial Oxygen Saturation
SBAR	Situation, Background, Assessment and Recommendation
UO	Urine Output

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CHAPTER 1: INTRODUCTION

1.1 Introduction

1.1.1. Setting the Scene

> *"Alice's provisional diagnosis, made earlier in the Emergency Department on Saturday 21st March 2009, was mycoplasma pneumonia, noting positive Epstein Barr Virus and erythema multiforme. Her condition continued to deteriorate throughout Saturday and all of Sunday. As her mother I will never forget that Sunday. My daughter was so very ill and I felt completely powerless to have someone, anyone do anything other than simply look at the monitor and walk out of the room and leave me with her. I was anxious and fearful. It was not until I asked "does my daughter have to have a respiratory arrest before someone will do something?" that action was taken"*
>
> *"...I still believe that either someone or something failed my daughter on that weekend. In looking back later on the Saturday and Sunday as the hours passed, I should have insisted that she be reviewed with a view to intervention and much sooner as I most certainly had presided over copious monitoring and review but a seemingly total lack of clinical assessment and decision making affording early intervention in order that her deterioration was halted"*

The mother of Alice, a 16-year-old school girl, wrote a ten page article on her daughter's thirty six hour journey on a general ward in a tertiary, university affiliated teaching hospital in Australia following admission for an acute pneumonia. The article describes missed opportunities in the management of her daughter acutely deteriorating on a general ward. The deterioration eventually led her to an unplanned, out of hour's admission to an intensive care unit (ICU), a scenario associated with an increased risk of hospital death (Bhonagiri et al., 2011). Alice's story is one local example of the apparent failure of healthcare professionals to recognise and respond appropriately to deteriorating patients and provides a compelling reason why this failure of healthcare professionals needs to be understood and addressed.

1.2 Definition of the "Deteriorating Patient"

The definition of a health care professional in the context of this doctoral thesis includes a medical practitioner, nurse or an allied health care worker that is licensed and regulated to provide some type of health care.

In contrast, there is controversy over the precise definition of a deteriorating patient (McQuillan et al., 1998; Hillman et al., 2001; Parr et al., 2001; Whitehead et al., 2002). This lack of precise definition provides challenges in a number of ways because until healthcare professionals and researchers are working from the same definition, it will be difficult to study and design a consistent appropriate system to recognise and respond to "deteriorating patients".

For the purposes of this thesis, the definition of a deteriorating patient will be taken as a general ward patient at risk of developing critical illness often with signs of deranged vital signs and organ dysfunction usually caused by inadequate tissue oxygenation leading to eventual exhaustion of cellular energy in the form of adenosine triphosphate (ATP). If inadequate oxygen delivery continues, organs will fail, increasing the mortality (Knaus et al., 1985). If patients with inadequate tissue oxygenation are identified prior to organ dysfunction, treatments are available that can improve the outcome of these patients (Shoemaker et al., 1988; Boyd et al., 1993; Rivers et al., 2001) but if the treatments are delivered late in the disease process there is an observed increase in mortality (Hayes et al., 1994; Chernow, 1996; Kirschenbaum, 1998). However, if the patient is not identified until they undergo a cardiac arrest, they have an even worse prognosis (So et al., 1994). Treatments for patient deterioration often include an admission to an ICU, which can provide intense monitoring of their physiology (Bennett et al.; Harrison et al., 1999). This helps identify haemodynamic instability (Pinsky, 2007) and potentially inadequate oxygen delivery to the tissues, with the aim that these can be corrected; however, if not corrected they can lead to a worse outcome (Hayes et al., 1994; Chernow, 1996; Kirschenbaum, 1998).

1.3 The Importance of Patient Deterioration

On a general ward, intense monitoring of haemodynamic parameters, such as heart rate, respiratory rate, blood pressure and urine output, does not occur and so early identification of patients with haemodynamic instability and inadequate oxygen delivery is less likely to occur. The inability to detect inadequate oxygen delivery on the general wards early in the disease process is reflected by the fact that patients admitted to the ICU from the general ward are more likely to have had a respiratory or cardiac arrest (Goldhill et al., 1998), a late sign of inadequate tissue oxygenation and loss of adequate sources of cellular energy. These patients are known to have a poor outcome (Schein et al., 1990).

1.4 Aims of the Thesis

Undoubtedly Alice's deteriorating patient experience is one of many. Three aims to improve the care of deteriorating patients are proposed:

1. To improve the understanding of the clinical processes and influences involved in managing patient deterioration.
2. To examine the effect of a deteriorating patient intervention on clinical processes and patient outcome.
3. To determine if the effects of a deteriorating patient intervention are sustainable

In answering these aims, it is hoped that deteriorating patient care can be advanced to improve patient outcome and experiences like those of Alice can be reduced.

CHAPTER 2: Literature Review

2.1 Introduction

If a deteriorating patient is managed inadequately, the potential for a poor outcome is high. To find future strategies to ensure deteriorating patients are managed adequately, it is critical to understand:

1. The epidemiology of patient deterioration
2. The current clinical processes that are engaged to manage patient deterioration
3. The specific hospital systems that have been developed to facilitate and improve the management of patient deterioration.

2.2 Epidemiology of Patient Deterioration

2.2.1 The Incidence of a Deteriorating Patient?

The incidence of a deteriorating patient on a general ward is difficult to quantify given that there is no standard definition of patient deterioration. If using abnormal vital signs as the marker of a deteriorating patient, only a few researchers have examined all admissions to general wards patients. Buist et al (Buist et al., 2004) reviewed over 6 000 general ward patients and only 8.9% (564/6303) of patients (564/6303, 8.9%) had abnormal vital signs and the majority (66.7%) resolved without critical care intervention. In contrast, another study of 3160 admissions to general wards in five hospitals found that 55.3% of patients had abnormal vital signs (Harrison et al., 2005).

Importantly patients with abnormal vital signs had an higher hospital mortality (146/564, 26%) than the general ward population although patients with a "do not resuscitate" order were included (Buist et al., 2004). Similarly, a more recent study of 27 772 adult patients in Canada, found an hospital mortality rate of 23.6% if the patient had one or more significantly deranged vital sign (Bleyer et al., 2011).

Variations in the incidence of abnormal vital signs are also found depending on which high risk group is being studied and vary from 28% (125/447) in patients prior to a hospital death (Hillman et al., 2001), 80% (61/76) in unplanned admissions to intensive care (Goldhill et al., 1999) to 91.5% (54/59 patients) in patients undergoing a cardiac arrest (Schein et al., 1990). There is no consistency in the study duration ranging from 15 minutes to 48 hours prior to an adverse event. This lack of consistency also changes the incidence of abnormal signs from 60% (383/627 patients) occurring at least once in a 24 hour period prior to an unplanned admission to intensive care, cardiac arrest or hospital death to 4.4% (17/383) if occurring for a four hour duration, to 2.3% (9/383) occurring for an eight hour duration and only 0.8% (3/383) occurring for a total of 24 hours (Kause et al., 2004). In addition, the inclusion or exclusion of patients not for resuscitation is inconsistent. This is important since it remains essential to identify patients who are likely to benefit from critical care management and presumably, patients who are not for resuscitation would not benefit from critical care management.

2.2.2 Can the "Deteriorating Patient" be Detected?

A deteriorating patient is a patient that is at risk of developing critical illness, which in turn is due to inadequate oxygen delivery to the tissues. Thus, it is important to understand the relevance of oxygen to life, the concept of how oxygen is delivered to tissues and what mechanisms exist to ensure that oxygen delivery to tissues is maintained.

Intra cellular energy in the form of ATP, is used by regulatory and structural proteins, including those involved in biosynthetic reactions, motility and cell division. ATP is an essential component to maintaining cell function and a critical requirement to life. The most efficient method of producing ATP is through the aerobic metabolism of a substrate molecule, such as glucose, a process called oxidative phosphorylation. During this process, there is the production of between 30 to 36 ATP molecules from one molecule of glucose, compared with only two ATP molecules if glycolysis occurs in the absence of oxidative phosphorylation. During oxidative phosphorylation, electrons are transferred from electron donors to electron acceptors such as oxygen (redox reactions) and this releases energy in the form ATP (Hall, 2011). Oxygen delivery to the cells is a critical part of maintaining cellular function and any disruption can lead to inadequate energy production, in the form of ATP, and the production of lactic acid can lead to cellular dysfunction and eventual death (Hall, 2011).

Oxygen delivery requires oxygen to be transported to the cells. This requires an adequate haemoglobin concentration (the transporter) in an adequate volume of fluid to be pumped from the heart (cardiac output) and an adequate gaseous exchange allowing oxygen saturation of the haemoglobin molecule. Any disruptions to these three elements can lead to a reduction in oxygen transportation to cells unless compensatory mechanisms are engaged.

The compensatory mechanisms utilised to maintain oxygen delivery to the tissues depend upon the primary insult and duration or severity of inadequate oxygen delivery (Table 1).

Table 1: Compensatory Mechanisms to Differing Types of Insults

Insult	Compensatory Mechanism	Physical Sign
Fall in Stroke Volume		
	Stimulation of sympathetic nervous system:	
	β_1: Positive inotropy	
	Positive chronotropy	Increased HR
	α_1: Peripheral vasoconstriction	Narrow pulse pressure Pallor Peripheral cyanosis Cool peripheries
Fall in Gaseous Exchange		
	Stimulation of chemoreceptors in medulla oblongata	Increased RR
	A rise in CO_2 following inadequate O_2 supply	
Fall in Hb Concentration	Stimulation of sympathetic nervous system	
	β_1: Positive inotropy	
	Positive chronotropy	Increased HR
	α_1: Peripheral vasoconstriction	Narrow pulse pressure Pallor Peripheral cyanosis Cool peripheries
Failing Compensatory Mechanism		
	Inadequate cardiac output	Reduction BP
	Lactic acid production	Increase RR

Physical signs for the compensation in reduction in oxygen delivery include pallor, peripheral cyanosis, sweating, tachypnoea, tachycardia, and hypotension. If organ failure ensues; oliguria and altered mental state may occur. Historically, oliguria and altered mental state have become the markers or antecedents of "the patient at risk of critical illness" or "the deteriorating patient" and are included in the classical "vital sign" set (Evans et al., 1999). The classical vital sign set is heart rate, blood pressure, temperature, respiratory rate and more recently, pulse oximetry has been included.

Determining and applying hard and fast criteria for identifying or detecting the "at risk" patient for critical illness to every ward patient are unlikely to work, as ward patients are generally a heterogeneous group of patients. There will be situations where one patient is demonstrating physical signs of compensatory mechanisms for inadequate oxygen delivery whilst another will not, despite similar oxygen delivery values, because the amount of oxygen that cells need vary depending on their requirements and their environment. There are times when classical signs of patient deterioration are not present, e.g. hypotension, because the peripheral vasoconstriction is so efficient at maintaining normotension.

The compensatory mechanisms for inadequate oxygen delivery, probably partly explain why expert clinicians do not just rely on "classical signs" but are still able to identify deteriorating patients by "just knowing" or having a "sixth sense" (Cioffi, 2000) long before the patient exhibits these physiological cues. However, in being able to do this, past experiences are essential (Cioffi, 2000) and lack of experience may explain why some nurses (Fuhrmann et al., 2008) and doctors are unaware of deteriorating patients even with physiological abnormalities. There will be some doctors, despite their seniority and experience, who struggle to recognise deteriorating patients and reasons for this are unclear.

Whilst there are some nurses and doctors who may be able to identify a deteriorating patient early in the course of their disease, it is even harder to know which patients will benefit from the treatment to improve oxygen delivery and how long the window of reversibility is present (Pinsky, 2007). Equally, the implied assumption is that by restoring normal haemodynamic values, reflected by normalising vital signs, further organ injury is prevented and associated with reduced mortality. This argument may not be valid as the vital sign derangements only indicate systemic oxygen delivery values, which may not reflect oxygen delivery at the microcirculation of organs (Pinsky, 2007).

In order to detect patient deterioration accurately and to respond appropriately, the clinical staff are dependent upon a number of critical factors:

- The identification of a sensitive and specific bedside tool for detection of patient deterioration
- The accurate measurement and documentation of the predictive bedside tool
- The interpretation of the bedside tool
- The appropriate and timely communication of the abnormalities detected
- Timely and appropriate response to the communication made

These requirements for the detection and response to a deteriorating patient are discussed, in turn below.

2.2.3 Bedside Tools for Detecting Patient Deterioration

2.2.3.1 Vital Signs

Although global oxygen delivery can be measured in a critical care environment, there are neither the tools to measure these values or interpret them on the general ward. The only measurements that have been accessible and utilised by healthcare professionals on the general wards are vital signs (such as heart rate, blood pressure, temperature, respiratory rate) and clinical markers of organ failure (altered mental state and oliguria) to detect deteriorating patients. These measurements are surrogate markers for adequate oxygen delivery to tissues.

In patients admitted to acute hospitals, vital signs have been measured routinely and regularly for over a century (Evans et al., 1999; Zeitz et al., 2006). Despite the duration of time in use, there are very little data on the normal ranges of vital signs, the optimal frequency of measurement and their usefulness in maintaining a patient's well-being.

Using different values for determining an abnormal vital sign, varying the types of vital signs included in analysis, inconsistent time periods used in only small cohorts, some with the similar data sets (Hillman et al., 2001; Hillman et al., 2002) and a limited number of studies assessing all comers, there is no consensus on the optimal predictive vital sign for detecting patient deterioration. Some have even stated that vital signs are limited in their capacity to detect physiological changes that are relevant to inadequate oxygen delivery (Evans et al., 1999).

2.2.3.2 Normal Ranges of Vital Signs

In order to detect patients at risk of a critical illness, it is imperative to have some knowledge of the normal values of vital signs in acute hospital patient populations. In knowing the normal values, it is possible to detect patients who have deranged values, which may reflect compensatory mechanisms for inadequate oxygen delivery.

Data are sparse but in a small study 3500 hours of data were collected (Tarassenko et al., 2006) of 150 already at risk patients (post-acute myocardial infarction, severe heart failure, acute respiratory problems and elderly patients with a fractured neck of femur). This study found the normal mean values to be - heart rate: 83.8 beats per minute, systolic-diastolic pressure: 94.7 mmHg, peripheral oximetry: 95.2%, skin temperature: 36° C and respiratory rate: 18.3 breaths per minute. Even though this study set out to determine "normal" vital sign values for ward patients, the patients studied were already at risk of clinical deterioration and may not reflect all general ward patients. Indeed, a normal value for one patient may not be normal for another, as many patients receive medication that may alter their compensatory response and an abnormal value may be normalised with treatment, such as the delivery of supplemental oxygen. This highlights the difficulties of setting normal ranges for vital signs across hospital patient populations.

2.2.3.3 Optimal Frequency of Measurement of Vital Signs

There is very limited evidence to determine the optimal frequency of measurement of vital signs (Evans et al., 1999) in acute hospital wards. Thus, many of the recommendations on the frequency of vital sign measurement are based purely upon expert nursing opinion with some consultation with medical colleagues and then ratified by a hospital executive committee (Zeitz et al., 2006). In a survey of 47 hospitals of post-operative regimens for vital sign measurements, the most common regimen was hourly for four hours and then four hourly for a further 16 hours. Interestingly, there was no difference whether the patient had had a major or minor operation (Zeitz et al., 2006). Even in hospitals where there was no policy for the frequency of measurement of vital signs, the recording frequency was similar to those with policies, suggesting that the frequency of measurement is based upon long established nursing routines and therefore not patient centred.

Despite the lack of literature on the optimal frequency of measurement of vital signs, recommendations are being made for acute care settings by National (Australian Commission for Quality and Safety in Healthcare, 2010) and expert (DeVita et al., 2010) organisations for vital signs to be measured at least every 12 hours but individualised where necessary.

2.2.3.4 Other Consequences of Measuring Vital Signs

To date, there is a paucity of evidence to support that measurement of vital signs, early detection of abnormalities and subsequent restoration to normal values to prevent further organ injury can reduce mortality. The statement appears to be logical and measuring vital signs does give the bedside nurse an opportunity to spend up to 3.5 hours per day with the patient allowing an overview of the whole patient (Zeitz et al., 2006). This may be useful to determine whether the patient was at risk of critical illness (Cioffi, 2000), and the human interactions themselves may also promote healing (Kaplan et al., 1989).

2.2.3.5 The Ability of Vital Signs to Detect Patient Deterioration

Despite the paucity of evidence it seems reasonable to assume that vital sign measurements would detect deteriorating patients and predict those likely to require further treatment to restore adequate oxygen delivery to tissues. However, it is important to recognise that some abnormalities in vital signs are not secondary to an event but may reflect a primary event such as a cardiac dysrhythmia, which may lead to compensatory mechanisms to ensure adequate oxygen delivery at all times.

The greatest challenge is to find an ideal vital sign for detecting patient deterioration in all general ward patients. This reflects that only a few studies have assessed vital signs on all ward patients throughout their length of hospital stay and related these measurements to patient outcome (Buist et al., 2004; Harrison et al., 2005). Most studies have focussed on patients that have either arrested (Nurmi et al., 2005), have had an unplanned intensive care admission (Goldhill et al., 1999; Hillman et al., 2002), (Goldhill et al., 1999), have died in hospital (Schein et al., 1990; Hillman et al., 2001) or have undergone a clinical adverse event (Zeitz et al., 2006). By preselecting relatively small high risk groups, sensitivity and specificity for vital signs to be used to detect patient deterioration on all ward patients cannot be determined with any certainty.

Those studies that have studied vital signs and their relationship with patient outcome have also used different values for determining abnormal vital signs and included and excluded different vital signs collected (Table 2).

Table 2: Studies Reviewing Vital Sign Abnormalities and Patient Outcome

	Number of Patients	Type of Ward Patient	Study Period	HR (bpm)	BP (mmHg)	RR (brpm)	GCS	UO (mls)	SaO_2 (%)
(Buist et al., 2004)	6303	All	Hospital Stay	<50 and >130	<90 and >200	<5 and > 30	Decrease ≥2 or GCS 3 or Seizures	-	<90
(Hillman et al., 2002)	496	Pre ICU Admission	0-8h, 8-48h Pre ICU Admission	<40 and >140	<90	<5 and > 36	Decrease ≥2 or seizures	-	
(Goldhill et al., 1999)	76	Pre ICU Admission	24 hours Pre ICU Admission	<70 or >109	MAP <70 or >109	<12 or >24	<15	-	FiO2 >=0.5
(Nurmi et al., 2005)	110	Pre Cardiac Arrest	24 hours Pre Cardiac Arrest	>130	<90	<6 and >30, airway threatened, respiratory distress	Any unexplained decrease in consciousness, agitation, delirium, seizures		<90
(Fuhrmann et al., 2008)	877	Actively treated	Between 1600 and 2130, not visited every day but studied all admission	<50 or >130	<90 or >200	<6 and >30			<90
(Lighthall et al., 2009)	1089	All	Hospital Stay	<40 or >110	<90	<8 or >26	-		<90
(Hillman et al., 2001)	447	Actively treated	0-8h, 8-48	<40 and >140	<90	<5 and > 36	fall ≥2 or seizures	-	
(Harrison et al., 2005)	4617	All	42.3% Hospital Stay	40-49, 121-140	80-100, 181-240	5-9, 31-40	<9-11, or GCS>2, alteration in mentation, any seizure	<200	90-95
(Harrison et al., 2005)	4617	All	42.3% Hospital Stay	<40, >140, cardiac arrest*	<80 or >240	<5, >40	< or =8, unresponsive to verbal commands, two or more seizures*	<200 in 8 hours	<90
(Schein et al., 1990)	64	Pre Cardiac Arrest	24 hours pre arrest	VT or VF		Apnoea or agonal respiration	Acute neurological impairment before cardiac arrest		

2.2.4 The Consequences of Failing to Detect and Respond to Patient Deterioration

The reason why deteriorating patients do badly when poorly managed is that prolonged and inadequate oxygen delivery to the patient's organs leads to organ failure, which is associated with a higher mortality (Knaus et al., 1985). Although there are no direct data to support this theory, there is indirect evidence that delays in admitting deteriorating patients to an ICU are associated with an increase in hospital mortality.

In a review of 100 unplanned admissions to two ICUs (tertiary and metropolitan) (McQuillan et al., 1998), it was found that in 54/100 (54%) patients there was suboptimal care prior to admission to intensive care. In 37/54 (69%) of these patients the admission to intensive care was thought to have been delayed. Patients with suboptimal care, including those that had delays getting to intensive care, had a significantly higher hospital mortality (30/54, 56%) than those with optimal care prior to admission to intensive care and whose admission to the ICU was not delayed (7/20, 35%, p<0.0001). Similar studies have found that delays in admission to intensive care from the ward leads to sicker patients, i.e. they require a more prolonged stay in intensive care or die quickly (Goldhill et al., 1999). There is other indirect evidence to suggest that failure to attend to or delay in attending to the physiological components of oxygen delivery, such as an inadequate management of a patient's airway and the failure to apply supplemental oxygen when needed, can lead to adverse events in hospital and preventable deaths (Dubois et al., 1988; Tarassenko et al., 2006; Calzavacca et al., 2008).

The following paragraphs summarise the current literature on individual vital signs and their ability to detect deteriorating patients as this provides important information to underpin the studies undertaken in this thesis.

2.2.4.1 Summary of Individual Vital Signs' Ability to Recognise Patient Deterioration

2.2.4.1.1 Respiratory Rate

Respiratory function is important prior to any adverse event as evidenced by patients having a high or low respiratory rate prior to an unplanned intensive care admission (Hillman et al., 2002), hospital deaths (Hillman et al., 2001) and cardiac arrests (Schein et al., 1990). In one study of 76 unplanned admissions to an ICU, a respiratory rate of more than 25 breaths per minute was the commonest physiological abnormality (Goldhill et al., 1999). Some have suggested that a respiratory rate of more than 25 breaths per minute is the best warning sign prior to an intensive care admission (Whitehead et al., 2002). However, the sensitivity to predict a cardiac arrest in the preceding 72 hours in ward patients is low (0.54) (Fieselmann et al., 1993). In another study, a high (respiratory rate greater than 30 breaths per minute) and low respiratory rate (respiratory rate less than six breaths per minute) were associated with an high odds ratio for risk of mortality 7.2 [3.9-13.2] and 14.4 [2.6-80] respectively (Buist et al., 2004).

In summary, although a high respiratory rate is a commonly occurring sign in patients who undergo a hospital death, cardiac arrest or unexpected intensive care admission, its ability to fulfil the ideal vital sign criteria is poor.

2.2.4.1.2 Blood Pressure

In studying all ward patients, the incidence of hypotension (systolic blood pressure less than 90 mmHg) varies from 17.3% (1 090/6 303) (Buist et al., 2004) to 20.6% (651/3160) (Harrison et al., 2005).

Limiting the study of blood pressure to selected groups, the incidence of hypotension eight hours prior to all non ICU deaths (excluding cardiac arrests) has been reported to be only 19.2% (86/447) (Hillman et al., 2001). However, hypotension is the commonest antecedent to unexpected deaths, cardiac arrests and unplanned admissions to intensive care (148/485 patients, 30.5%) (Kause et al., 2004). Another study found hypotension to be the third most common antecedent (14/59 patients, 23.7%) of an admission to an ICU (Hillman et al., 2002).

The duration of hypotension prior to death appears to be short, given that it was present in only 8.9% (37/447) for the 48 hours before death but the odds ratio for risk of mortality in hypotensive patients during hospital is significant (OR 2.5 [1.6-4.1]) (Buist et al., 2004).

In summary, although hypotension is a commonly occurring sign of patients who undergo a hospital death, cardiac arrest or unexpected intensive care admission, its ability to fulfil the ideal vital sign criteria is poor.

2.2.4.1.3 Heart Rate

Tachycardia is seen before unplanned admissions to intensive care (Hillman et al., 2002; Kause et al., 2004), unexpected deaths (Hillman et al., 2001) and cardiac arrests but it is not the most common abnormal vital sign occurring on the ward (Harrison et al., 2005). Tachycardia is not associated with an increase in hospital mortality (Buist et al., 2004). Reasons behind this may include that tachycardia is a normal response to inadequate oxygen delivery and so may allow adequate oxygen delivery to be maintained, in doing so reducing the risk of organ failure and increased likelihood of death (Knaus et al., 1985).

2.2.4.1.4 Temperature

There is insufficient evidence to demonstrate a clear relationship between high or low temperature and patients being at risk from critical illness. However, fever is a marker of infection, which is associated with an increase risk in hospital mortality (Osmon et al., 2003).

2.2.4.1.5 Arterial Oxygenation

Arterial oxygen saturation is one of the core components that determine how much oxygen is delivered to tissues and any reduction below the normal value may reflect inadequate oxygen delivery. Traditionally, arterial oxygenation has not been part of the vital sign set but with the advent of portable peripheral oxygen saturation monitors on wards and operating theatres, there have been calls for its inclusion into the classical vital sign set (Evans et al., 1999).

The reported incidence of a low arterial oxygen saturation (<90%) varies from 51% (3215/6303) (Buist et al., 2004), to 31.1% (Harrison et al., 2005) in general ward patients. However, evidence that supports its use in detecting patient deterioration includes Cuthbertson et al (Cuthbertson et al., 2007) who noted that an arterial oxygen saturation <96% 48 hours prior to admission to intensive care, was a better discriminator in determining which high dependency patients would need intensive care than either heart rate or respiratory rate. Associations of low arterial oxygen saturations with unexpected admissions to intensive care (Goldhill et al., 1999) and unexpected death in hospital (Bowton et al., 1994) have also been seen.

In summary, a low arterial oxygen saturation is associated with unexpected admissions to intensive care and hospital deaths but its ability to detect patient deterioration depends whether an unexpected admission to intensive care or unexpected death is used as a marker of patient deterioration. From the available literature, a low arterial oxygen saturation is not as good as predicting an unexpected hospital death (Buist et al., 2004; Goodacre et al., 2006) as it is in predicting those that will need an admission to an ICU (Cuthbertson et al., 2007).

2.2.4.2 Non Vital Sign Parameters' Ability to Recognise Patient Deterioration

2.2.4.2.1 Mental State

A fall in conscious level can suggest that the brain is receiving inadequate amounts of oxygen to function at full mental capacity. A fall in conscious level increases the risk of not being able to maintain an airway, which reduces the ability to allow adequate oxygen into the lungs to maintain adequate oxygen delivery. Direct depression of the respiratory centre can further suppress respiratory function and arterial oxygenation may fall leading to inadequate oxygen delivery. Thus, any change in mental function can suggest either oxygen delivery is inadequate or may lead to it being inadequate.

Although the incidence of a fall in Glasgow Coma Scale (GCS) is low in general ward patients (5%, 315/6303) (Buist et al., 2004), it is a common trigger for the call out of a medical emergency team from intensive care (Parr et al., 2001; Bellomo et al., 2003) although not in all studies of the medical emergency team triggers (Konrad et al., 2010). It is a strong independent predictor of hospital mortality with a decrease in conscious level having an odds ratio of 6.4[2.6-15.7] (Buist et al., 2004).

In summary, although a fall in GCS is strong independent predictor of hospital mortality, because it does not occur frequently it has a low sensitivity but high specificity for detecting patient deterioration. Therefore, it is not an ideal detector of patient deterioration.

2.2.4.2.2 Urine Output

Urine output is frequently measured in hospital patients particularly if the patient has had a surgical procedure or if there is a reason to maintain a close observation on fluid balance. As urine represents the well-being or function of the kidneys, it can provide additional information to determine whether there is adequate oxygen delivered to the kidneys.

In summary, there is inadequate information from studies to determine whether urine output can predict patient deterioration and, as it is frequently inadequately documented in hospital patients, it is unlikely ever to be useful.

2.2.4.2.3 Base Excess

The base excess and base deficit refers to an excess or deficit, respectively, in the amount of base present in the blood. If there is a deficiency of base in the blood, this may represent an excess of acid, which could be lactic acid from tissue ischaemia.. Intensive care patients with a base excess of <- 4 had a hospital mortality of 57% and climbed to 75% if not corrected to < -2 within the next 24 hours (Smith et al., 2001).

In summary, base excess is a useful tool to detect deteriorating patients but it does require an invasive procedure. As there is no available literature on the distribution of base excess in ward patients, its true ability to discriminate those patients with and without deterioration remains unknown.

2.2.4.2.4 Presence of Pre Existing Chronic Illness

The APACHE II system (Knaus et al., 1985) has long been used to predict death in intensive care patients and includes the weighting of prior illness, a common finding in unexpected ICU admissions (Goldhill et al., 1999), as part of its logistic regression equation. This suggests that the presence of a chronic illness prior to an admission to an ICU increases the likelihood of death. Of more relevance to ward patients, it was identified several decades ago that patients with a chronic illness are at risk of deterioration in hospital (Sax et al., 1987).

In summary, underlying chronic illness in patients who are admitted from the ward to ICU is associated with an increase in hospital mortality and so its presence could be used to identify those patients on the ward who are at risk of deterioration.

2.2.4.2.5 Advancing Age

The APACHE II logistic regression equation for the prediction of hospital mortality in patients who have been admitted to ICU also includes a weighting for age (Knaus et al., 1985). A study of 9 987 ward patients found that for each specific derangement in physiology there was an increasing hospital mortality with increasing age (Smith et al., 2008). Increasing age was also an independent predictor of hospital death in patients admitted to hospital via an ambulance (Goodacre et al., 2006).

Summarising, increasing age in patients who are admitted from the ward to ICU is associated with an increase in hospital mortality. Increasing age can be used to identify those patients on the ward who are at risk of deterioration alongside the Frailty Index (Jones et al., 2004), which is associated with an increasing risk of death.

2.2.4.2.6 Summary

To date there are no parameters that completely fulfil the ideal test to allow healthcare staff to detect a deteriorating patient. There are numerous reasons why this is the case. Vital signs do not have uniformly high sensitivity and specificity to detect patients with clinical deterioration. Depending on the vital sign patients will either be incorrectly identified as deteriorating when they are not deteriorating e.g. heart rate or too many deteriorating patients will be missed e.g. GCS . In the Interventional Study, seven of the clinical signs described above (respiratory rate, arterial oxygen saturation, blood pressure, heart rate, urine output, conscious level, temperature) were used to detect patients who were deteriorating.

2.2.5 Clinical Processes to Manage Patient Deterioration

The two major clinical processes that are needed to manage patient deterioration are the ability to recognise patient deterioration and the ability to respond to patient deterioration. Each necessitates prerequisites to ensure that they occur seamlessly to reduce harm to the patient.

2.2.5.1 Recognition of Patient Deterioration

The prerequisites for recognising patient deterioration are the accurate and frequent vital sign measurement and their documentation and the ability to interpret the vital sign measurements.

2.2.5.1.1 The Documentation of Vital Signs

As discussed above, vital signs are not the ideal diagnostic test for patient deterioration. However, vital signs have been measured and documented to reassure healthcare workers that all is well (or not) with their patients and the documentation of vital sign measurements has become part of everyday practice in hospital wards. Although the accuracy of vital sign measurements, particularly respiratory rate remains unknown, a number of studies has found that the frequency of vital sign documentation is inadequate (Goldhill et al., 1999; McBride et al., 2005; Nurmi et al., 2005; Chen et al., 2009). One study demonstrated that only 19% of patients had complete vital sign sets recorded 15 minutes prior to an extreme marker of patient deterioration (unplanned admission to intensive care, cardiac arrest and unexpected death) (MERIT Study Investigators, 2005). The most commonly omitted vital sign measurement is the respiratory rate (Nurmi et al., 2005; Van Leuvan et al., 2008). One study has found that respiratory is up to three times more likely to be missing than heart rate and systolic blood pressure and is the least frequently documented sign in the 24 hours prior to a medical emergency team call (MERIT Study Investigators, 2005). Unfortunately, many clinicians, including nursing staff (Considine, 2005) underestimate the importance and usefulness of respiratory rate monitoring (McBride et al., 2005).

The documentation of vital signs has occurred, for decades, onto observation charts but until recently, there has been very little research into the design of observation charts and so many different observation charts have emerged. Over the last ten years, the healthcare community has increasingly focussed on the ward observation chart being critical in the detection of patient deterioration. To improve their effectiveness to detect patient deterioration, it has been recognised that further research is required to increase their ease of use and decrease the chance of clinical error and that standardisation of observation charts is necessary (Chatterjee et al., 2005). The limited work done in this area has found that there are large differences in the ability of healthcare professionals to detect patient deterioration and this suggests the need for consolidation of skills and retraining in documenting observations (Chatterjee et al., 2005).

Although vital signs have been the mainstay of detecting patient deterioration, their documentation has been sub-optimal reducing their ability to detect deteriorating patients further. The main reasons for poor documentation can be summarised as follows:

- Inadequate hospital policy development and dissemination for vital sign measurement and documentation
- Lack of standardisation of policy for vital sign measurement and documentation from institution to institution
- Inadequate review and audit of the application of the policy for vital sign measurement and documentation
- Inadequate understanding of why vital sign measurement and documentation is relevant to patient care
- Inadequate and confusing ward observation charts for the documentation and interpretation of vital signs.

In appreciating the potential reasons for inadequate documentation of vital signs, it is possible to consider solutions to address these deficiencies to improve the detection of patient deterioration. These deficiencies are addressed through the implementation of a multifaceted intervention for the early detection and response to the deteriorating patient, which was employed and described later in Chapter 5.

2.2.5.1.2 Interpretation of Vital Signs

It is difficult to know whether a healthcare professional can interpret a ward observation chart properly, as there is no adequate measure for whether an healthcare professionals is able to interpret observation charts. Methods used are largely reliant upon the documentation of this information, usually identified as concern for the patient, in the patient's clinical record and can only provide a surrogate for their interpretative ability. Unfortunately, documentation of any kind is often poorly performed and so it is likely that any recorded, relevant information in the medical record will underestimate the correct interpretation of the ward observation chart.

The incidence of documenting concern by healthcare professionals over a deteriorating patient prior to an extreme marker of patient deterioration (death, unplanned admission to an ICU) varies depending on the length of study period. In the eight hours prior to admission to an ICU, the documentation of concern has been reported to be 70% but dropped to 43% in the 48 hours prior to the unplanned intensive care admission (Hillman et al., 2002). However, in another study of unplanned admissions to an ICU, the concern was only documented in 25% of cases (Hillman et al., 2001). The uncertainty here is whether this is inadequate documentation or inadequate recognition that the patient was critically ill prior to the unplanned intensive care admission. Therefore, if it is argued that interpretation is the issue, the clarity and usefulness of nursing communication to the doctor regarding a patient's deterioration will be reduced (Daly et al., 2007), an issue demonstrated later as being critical in intervening with the deteriorating patient.

In contrast to the above observation, it is not infrequent that patients are recognised to be unwell, as determined by patients being monitored and receiving oxygen (Goldhill et al., 1999), prior to any documented evidence on the observation chart (Goldhill et al., 1999). In part, this may be explained by the ability of some nurses to detect deteriorating patients by experiential intuition (Kruse et al., 1988; Cioffi, 2000; Day, 2003). Experiential intuition tends to rely on other criteria other than classical vital signs such as the patient complaining of feeling "not right", the patient's colour changing, the patient being agitated or a marginal deterioration in vital signs (Cioffi, 2000). An experienced nurse's lack of reliance on classical vital signs may explain why medical and nursing staff are unable to agree on common clinical signs for the detection of deteriorating patients (Day, 2003).

Research suggests that, in an age where both medical and nursing student and trainees spend less time at the bedside, experience has been identified as being critical to the detection of the deteriorating patient, (Kruse et al., 1988; Cioffi, 2000; Day, 2003) methods need to be used to bridge these deficiencies. It is likely that education has to play an increasing role in providing the skills for the detection of the patient at risk of critical illness. Indeed, detection and managing patient deterioration has not been, until recently, a core part of nursing or medical education education and training (Harrison et al., 1999; Cook et al., 2004).Education programs have now been designed solely for the detection and response to patient deterioration (Smith et al., 2002) including one (ACT Health, 2007) that was developed specifically for the use in the multifaceted intervention for the early detection and response to the deteriorating patient, which was undertaken and described later in Chapter 5.

2.2.5.2 Response to Patient Deterioration

2.2.5.2.1 Appropriate and timely communication

Currently, the traditional pathway of managing deteriorating patients is for the ward nurse to interpret the clinical signs, including vital signs, and symptoms and then to call for further help to ensure appropriate management is initiated. This usually entails the calling of a patient's doctor and for the doctor to review the patient to initiate appropriate management, which may include the seeking of advice from more experienced doctors. Unlike the frequency of measurement and documentation of vital signs, this traditional process is rarely part of a formal standard operating procedure or hospital policy (Day, 2003) but has become accepted practice over the last century.

However, there are examples that the activation of medical management in the event of patient deterioration is not always timely enough to ensure timely, appropriate action. One example of delayed activation of medical management is the delay in calling the Medical Emergency Team (MET) where up to 22% are delayed MET (Crispin et al., 1998; Calzavacca et al., 2010). Nurses are the prime requester for METs (Parr et al., 2001) and instead of requesting a MET review, nurses are more likely to seek a more junior medical staff review (Crispin et al., 1998; Buist, 2008) rather than a senior medical officer, including the MET (Crispin et al., 1998). This often leads to the "clinical futile cycle" in that there is much clinical activity but does not allow for appropriate management of the deteriorating patient (Buist, 2008). The reasons for nurses and junior medical doctors not calling for appropriate advice and help is complex and illuminates the challenges of the centuries old hospital structure and hierarchy. This is explored later on when groups of nurses and doctors were interviewed to understand these challenges.

Cited reasons for nurses not calling a timely MET review include their need to tell themselves that they are doing the right thing and that they do not wish to feel like "an idiot" (Cioffi, 2000). They also fear retribution from the MET doctors when they arrive to review the patient (Crispin et al., 1998) and cite hierarchy as a major barrier to calling a MET review (Tee et al., 2008). However, there will be some who do not recognise the clinical urgency (McQuillan et al., 1998) and some will have inadequate experience to call for further help including a MET realising that it is a complex decision (Cioffi, 2000). At times, delays arise from the nurses' belief that the patient is inappropriate for acute resuscitation from the MET and instead seek advice from the patient's parent team to provide clarity on the end of life care. In the event they are unable to seek clarity a delayed MET review is sought (Crispin et al., 1998).

Reasons for inexperienced junior medical officers for delaying or not calling for more experienced advice are that they are also often too inexperienced to recognise the clinical urgency of the situation (Day, 2003), which leads to inadequate articulation of the clinical scenario that lies in front of them (McArthur-Rouse F, 2001) and mismanagement (McGloin et al., 1997) of the deteriorating patient. For junior medical officers to call for help, they need a constructive relationship with their supervisor. In the absence of a constructive relationship, junior medical officers are reluctant to call for help for concern over their evaluation and assessment if they believe it is a clinical skill that they should have mastered at their level (Kennedy et al., 2009). Other non-clinical reasons is the lack of physical proximity and availability of the supervisor, the desire for the trainee to be independent clinicians and believing that they do not need help, exacerbated by their lack of expertise to realise that they do need help (Day, 2003; Kennedy et al., 2009). A suggested framework for improving communication for junior medical officers with their supervisors has been developed but not tested (Kennedy et al., 2009) during this thesis as it was deemed too big, which in hindsight was an error. The framework includes:

1. Planning before calling for help
2. Targeting the questions appropriately

3. Providing the junior medical officer with an explicit scope of practice
4. Increasing the numbers of times of day that supervisors and trainees meet and improve proximity

Delays in a medical review by a ward doctor or MET may also be due to nursing reports on patients being inadequate. This can result in an inability to convey the seriousness of the patient's situation to the medical staff and therefore the patient is deemed a lower priority by the medical staff (Day, 2003), which delays initiating appropriate management. Other factors that might influence whether doctors call for expert critical care help or not is the perceived or real lack of intensive care beds (Goldhill et al., 1999) such that they believe it to be a worthless task in seeking further guidance.

The clinical process for managing patient deterioration has multiple deficiencies and includes the usage of vital signs, which may not allow accurate detection of patient deterioration, the inadequacy of documentation of vital signs, the inadequacy of knowledge and experience to interpret vital signs and poor communication, both in timeliness and content. A solution to these many deficiencies was trialled in the Interventional Study described in Chapter 5.

2.2.6 Systems for Recognising and Responding to Deteriorating Patients

As outlined above, the process for the detection and response to patient deterioration is complex. Systems to improve this process are likely to be multifaceted (McQuillan et al., 1998) so that any advances in the care of deteriorating patients would not only improve the state in which patients arrive in the ICU (McQuillan et al., 1998) but also reduce the mortality of patients before and after intensive care (Bion, 1995). Although there has been no globally accepted system; national frameworks for the management of patient deterioration have begun to appear (Department of Health, 2001; Australian Commission for Quality and Safety in Healthcare, 2010).

The following paragraphs summarise the interventions that have occurred to date to improve the recognition and response to patient deterioration. The interventions, have tried to accommodate and improve the deficiencies in the clinical processes involved in the management of the deteriorating patient.

2.2.6.1 Documentation of Vital Signs

The monitoring of a patient's well-being using vital sign documentation has been recognised as a vulnerable part of the rapid response process for the management of the deteriorating patient (Institute for Healthcare Improvement, 2005). This has been identified in a number of studies (Goldhill et al., 1999; McBride et al., 2005; Nurmi et al., 2005; Chen et al., 2009).

Until recently, most efforts aimed at improving the detection and response to patient deterioration have not directly targeted the improvement of documentation of vital sign measurements. In particular, little research has been carried out to determine the best design for a ward observation chart to detect patient deterioration. However, one study has suggested the following attributes of an "ideal" ward observation chart for the detection of patient deterioration (Chatterjee et al., 2005):

- Temperature points should always be joined together and not obscured
- Heart rate values should be joined together if to be written on the same axis as blood pressure
- Values should be joined together in a straight line
- Record percentage of inspired oxygen
- Respiratory rate should not be approximated and be plotted and written
- All values should be plotted

These suggestions for the design of an observation chart were considered for the Interventional Study. More recently, based on an Australian human factor research group (Horswill et al., 2009), the Australian Commission for Safety and Quality in Health Care has published a framework for developing observation charts (Australian Commission for Quality and Safety in Healthcare, 2010). This work allows the healthcare staff cognitive abilities to match the chart development. These attributes should enhance the ease of documentation of vital signs and their interpretation.

From the literature, it would appear that any system that attempts to improve the detection and response to deteriorating patients, increases the documentation of vital signs, including respiratory rate (McBride et al., 2005; Mitchell et al., 2010) but respiratory rate to a lesser extent in some cases (Chen et al., 2009). What drives the increase is unclear but the need to assign a score for each individual vital sign according to its degree of derangement (the modified early warning score) (Morgan et al., 1997) appears to be associated with an improvement in the documentation of vital signs (Dobbs et al., 2002; Ryan et al., 2004; Odell et al., 2007). The documentation appears to improve further if introduced with associated teaching for the calculation of Modified Early Warning Score (MEWS) (McBride et al., 2005; Mitchell et al., 2010). Other modalities that have been used to improve the documentation of vital signs are various hand held devices to record the vital sign digitally (Patientrack, 2006; Smith et al., 2006; Jones et al., 2011).

Although there are technologies available to monitor patients continuously and remotely from their ward bed (British Broadcasting Corporation, 2009), removing the need for nurses or nursing assistants to measure and document the vital signs, these technologies are still in development. Mathematical prediction systems have also been developed to interrogate data from continuously monitored patients on the ward or step down units to allow for earlier detection of patients risk of critical illness but these have not been used outside of their developmental sites (Hravnak et al., 2008) and do not necessarily decrease the lead time to clinically useful levels (Tarassenko et al., 2006).

The above examples suggest that any system that uses vital signs to trigger a medical review of a deteriorating patient needs to focus its efforts on improving the documentation of vital signs. It is likely that the system will need to provide an understanding why staff measure and document vital signs, and install either a paper chart that is easy to use and can readily detect a patient's deterioration, or a digital system that can do the same things.

2.2.6.2 Specific Deteriorating Patient Education

Although there have long been courses available for managing patients who have had a cardiac arrest (Resuscitation Council (UK), 2008; Australian Resuscitation Council, 2010), it is only in the last decade that there have been education programs dedicated to deteriorating patients (Smith et al., 2002; ACT Health, 2007; Buist et al., 2007; NSW Clinical Excellence Commission, 2010). The development of these education programs is probably important in light of the reduction in the hours that healthcare professionals are currently by the bedside. Reduction in clinical exposure to deteriorating patients has been demonstrated to be an important contributor to detecting deteriorating patients (Kruse et al., 1988; Cioffi, 2000; Day, 2003) and training and education may fill this void.

The courses are mostly similar in content and mode of delivery. The majority are aimed at all healthcare professionals (Smith et al., 2002; DeVita et al., 2005; ACT Health, 2007; NSW Clinical Excellence Commission, 2010) but some have a greater emphasis on patient management rather than detection of the deteriorating patient (Smith et al., 2002; DeVita et al., 2005; Buist et al., 2007). Some of the programs require attendees to participate for a day (Smith et al., 2002; Buist et al., 2007) whilst others are more flexible, varying both the content and the time required to suit the delivery environment and the type of healthcare professional being taught (ACT Health, 2007; NSW Clinical Excellence Commission, 2010). Although some of these education programs have been part of a multifaceted intervention to facilitate the detection and response to patient deterioration (Buist et al., 2002; Buist et al., 2007; Mitchell et al., 2010), it is not possible to determine the extent that education played on the outcomes of these studies. As yet, many of the programs have not been adapted for undergraduate education, which is an issue as it has been identified that fifth year medical students, the last year in an undergraduate medical program, do not have the skills to allow them to identify and manage deteriorating patients safely (Harrison et al., 1999). Essential building blocks include an understanding of the pathophysiology of the patient at critical illness and is as important for nurses (Considine, 2005) as it is for doctors.

Indirect education on the recognition of the deteriorating patient has probably occurred through the introduction of systems that facilitate the recognition and response to deteriorating patients. These systems include the introduction of a MET (Hourihan et al., 1995; Lee et al., 1995; Bristow et al., 2000; Bellomo et al., 2003; Bellomo et al., 2004; DeVita et al., 2004; MERIT Study Investigators, 2005; Konrad et al., 2010), early warning scores (Morgan et al., 1997; Day, 2003) and critical care outreach teams (Priestley et al., 2004). All have introduced the patient deterioration systems with some training, the content of which inevitably includes subject matter pertaining to the deteriorating patient. The time allocated for the delivery of the education as well as the audience of the education has varied between studies, and the education programs have had varying degrees of success in ensuring that the content reaches a wide range of health care workers and knowledge maintained.

An often neglected part of any healthcare education curriculum has been the provision of a structure to help communicate meaningfully to peers and other healthcare professionals. This is particularly crucial when the time for a doctor to review a deteriorating patient is limited. This means that the person receiving the information needs to understand the information delivered and its urgent nature. One method utilised for structuring communication between healthcare professionals for situational briefing has been the adaptation of a military and aviation industries method, the "SBAR" (Situation, Background, Assessment and Recommendation) method. This method allows for the description of the current situation, the background to the situation, the assessment by the healthcare practitioner and the recommendation made by the healthcare practitioner. The original adaptation for healthcare was by Kaiser Permanente in Colorado, USA (Leonard et al., 2004) and used in a general health care setting and provided a standardised communication process for healthcare professionals. More recently, it has been embedded into education programs for the recognition of the deteriorating patient (Day, 2003; ACT Health, 2007; NSW Clinical Excellence Commission, 2010) and systems to improve the recognition and response to the deteriorating patient (Daly et al., 2007).

2.2.6.3 Detection of Patient Deterioration

The introduction of deteriorating patient education programs (Smith et al., 2002; ACT Health, 2007; Buist et al., 2007; NSW Clinical Excellence Commission, 2010) and systems to facilitate the recognition and response to a deteriorating patient (Hourihan et al., 1995; Lee et al., 1995; Morgan et al., 1997; Bristow et al., 2000; Bellomo et al., 2003; Day, 2003; Bellomo et al., 2004; DeVita et al., 2004; Priestley et al., 2004; MERIT Study Investigators, 2005; Konrad et al., 2010) are likely to improve the interpretation of vital signs required to detect patient deterioration. The difficulty is being able to identify definitively that these education programs facilitate the understanding of vital signs, as there is only a surrogate marker, the occurrence of timely and appropriate intervention and documented in the clinical record.

2.2.6.3.1 Early Warning Scores

With the advent of a diminishing exposure to clinical experiences in the United Kingdom through the European Working Directive, efforts have been made to simplify the interpretation of vital signs. An early warning score was developed to help nurses and doctors to identify patients at risk of developing critical illness (Morgan et al., 1997) and subsequently modified by various institutions in the United Kingdom (Stenhouse et al., 1999; Subbe et al., 2001; Day, 2003; Pittard, 2003; Subbe et al., 2003; Odell et al., 2007) (Appendix A).

The early warning scores are derived from scoring individual vital signs according to their degree of derangement from "normal" values. The individual scores are then totalled for each set of observations and the higher the score, the greater the likelihood of developing critical illness (Goldhill et al., 2005). On this basis, those healthcare professionals taking the vital sign sets do not necessarily need to interpret deranged vital signs or have any experience of recognising patients at risk of critical illness. Instead, a simpler approach is to understand that the higher the early warning score, the sicker the patient and the necessity for further medical intervention. It also allows healthcare professionals to track deterioration or improvement in the patient's condition and should a certain score be experienced, as set out by hospital policies, it should trigger the nurse at the bedside to activate an appropriate management pathway as determined by hospital policy. These policies often determine that a medical review is required, the level of medical review required, the frequency of vital sign measurements and whether a patient requires an escort to an area outside of the ward area e.g. to medical imaging (ACT Health, 2007).

As stated previously, early warning scores improve the often inadequate frequency of documentation of vital signs and reduce the time for a medical review of a deteriorating patient (Day, 2003). The scores also provide substantiating evidence for nurses to call doctors for a further medical review (Andrews et al., 2005). Advantages of this system also include a policy that avoids the need to rely on medical hierarchy to ensure that a more experienced doctor review the patient should the need arise. Nursing staff can call for an experienced doctor if a patient reaches a high enough score, and in doing so reduce the time for a more experienced doctor to review the patient.

However, little research has been conducted to determine the effect of early warning scores on patient outcome. One study demonstrated a significant improvement in hospital mortality (Pittard, 2003) with the use of early warning scores but is a small before and after study and the results difficult to interpret in light of the risk of regression to the mean (Moran et al., 2005). One other study failed to demonstrate a difference in hospital mortality with the introduction of early warning scores (Subbe et al., 2003).

The reasons for early warning scores not impacting upon hospital patient mortality appreciably are multiple. An early warning score necessitates the measurement and documentation of a full set of observations, a task that has already been identified as vulnerable. Superimposed on this task is the correct assignment of the score for each individual sign and subsequent summation of the scores to reach a correct total early warning score. Indeed, some staff claim that this work is too onerous. Evidence suggests that early warning scores are frequently inaccurate (Prytherch et al., 2006; Smith et al., 2006) but that the accuracy improves with recording the vital sign values into a personal hand held device for the computer calculation of the score (Prytherch et al., 2006). Interestingly, a recent analysis of whether it was nurses' assignment of the individual scores or the ability to summate the individual scores found that it was the assignment of the individual scores not their ability to summate the individual scores (Edwards et al., 2010). This may be amenable to further education and training.

All the early warning scoring systems appear to lack sensitivity; thereby patients who are likely to be at risk of critical illness are not detected (Cuthbertson et al., 2007; Gao et al., 2007; Smith et al., 2008). An example of this lack of sensitivity is a review of 2568 medical patients, where 26 patients underwent a cardiac arrest, but only 6 (23.1%) had early warning criteria (Rothschild et al., 2010). This may explain why early warning scores have not improved outcome of ward patients as they are not either identifying deteriorating patients early enough, or at all. New early warning score systems have been developed to try to improve their sensitivity and specificity (Cuthbertson et al., 2007; Cuthbertson et al., 2010) but are probably not suitable as bedside tools unless used with a personal hand held device, as they are too complex and time consuming. More recently, simplification of an early warning score

(ViEWS™) has been successfully undertaken by reducing the number of variables and has both high sensitivity and specificity for determining those patients likely to die (Prytherch et al., 2010).

Despite the inadequate data for or against early warning scores, there have been calls for caution over their general use (Cuthbertson et al., 2007; Fletcher et al., 2010) in the face of national calls for their widespread introduction in some countries (National Confidential Enquiry into Patient Outcome and Death, 2005). The risk of using early warning scores is that staff may be further deskilled in their interpretation of vital signs by relying on a summative score of vital sign derangements rather than interpreting each individual sign. Equally, early warning scores may not necessarily imply an early appropriate response.

2.2.6.3.2 Rapid Response Teams

A different approach to the early warning score track and trigger system, which depends upon ward staff triggering a "parent team" medical review to ensure adequate management of the deteriorating patient, is bringing a critically care trained rapid response team to the ward patient (Lee et al., 1995; Goldhill et al., 1999; DeVita et al., 2004; Priestley et al., 2004; Daly et al., 2007). This approach, developed in the late 1980s, was in response to inadequately trained, inexperienced ward staff caring for the acutely unwell patient. Rapid response teams are called to the ward following a specific single physiological criterion being met or if ward staff are worried about a patient that does not fulfil specific criteria. Of the many systems used (Goldhill et al., 1999; Bristow et al., 2000; Parr et al., 2001; Buist et al., 2002; Bellomo et al., 2003; Bellomo et al., 2004; DeVita et al., 2004; MERIT Study Investigators, 2005; Buist et al., 2007; Santamaria et al., 2010) most have based their triggers on those used by Lee et al (Lee et al., 1995) (Appendix B).

These triggers, like the early warning scores, have a low sensitivity and may not provide adequate confidence for all deteriorating patients to be identified (Smith et al., 2008).

The philosophy behind a rapid response team is to provide early critical care intervention in response to a physiological abnormality, which might prevent further deterioration (MERIT Study Investigators, 2005) and improve functional outcome or mortality rate of ward patients (Garcea et al., 2004). The rapid response team may also provide other roles, including education of ward staff, review of the management of deteriorating patients in institutions, and feedback through review systems to advance patient care and end of life decisions (Parr et al., 2001).

Similar to the early warning score, the introduction of a trigger system, albeit a single trigger, removes the need for ward staff to understand the reasoning behind the derangement of the vital sign(s) and whether or not further intervention is required. It also provides a mechanism to override the ward medical hierarchy to ensure experienced medical and nursing staff review and manage the patient at risk of critical illness. However, ward staff probably under call for a MET review (MERIT Study Investigators, 2005) because of the perceived fear of retribution from the medical staff (Cioffi, 2000) and inadequate education (Jones et al., 2006). These cultural barriers have probably been underestimated and need to be addressed if a rapid response team system is to be installed into an institution (DeVita et al., 2004) with a positive outcome.

Early studies of the rapid response teams on clinically meaningful outcomes (unexpected cardiac arrests, hospital deaths and unplanned admissions to intensive care) demonstrated significant reductions in these events (Lee et al., 1995; Buist et al., 2002; Bellomo et al., 2003; Bellomo et al., 2004). These studies were often criticised for being single centre, before-and-after studies (Moran et al., 2005) and to answer critics multi centre studies were conducted (Bristow et al., 2000; MERIT Study Investigators, 2005). These failed to demonstrate a significant difference in their primary measure, namely the number of hospital deaths or a composite measure of unexpected cardiac arrests, hospital deaths and unplanned admissions to intensive care. In the largest trial, the MERIT study (MERIT Study Investigators, 2005), a cluster randomised controlled trial of hospitals randomised to establishing a MET or delivering care as usual, failed to identify a significant difference in the primary outcome (a composite number of the incidence of cardiac arrests without a pre-existing do not resuscitate order, unplanned intensive care admissions and unexpected deaths defined as deaths without a pre-existing do not resuscitate order. The reasons for this include an under calling of MET and the fact that the study was underpowered. There is now a number of longitudinal studies of METs installed into hospitals, which are able to demonstrate over time, an improved outcome for deteriorating patients (Buist et al., 2007; Jones et al., 2007; Santamaria et al., 2010). These results have been supported by a recent systematic review of the randomised trials (Chan et al., 2010). However, the longitudinal studies, stress the importance of on-going teaching and education on the utilisation of the MET (Buist et al., 2007; Jones et al., 2007; Santamaria et al., 2010) and it may also be important to develop triggers specific to institutions to improve the outcome of patients at risk (Konrad et al., 2010).

The instalment of rapid response systems into institutions undoubtedly improves the understanding of deteriorating patients (Bellomo et al., 2003), the documentation of vital signs (Chen et al., 2009) and not for resuscitation status (Chen et al., 2008). Rapid response systems also provide a means for ward staff to engage experienced medical practitioners to care for the deteriorating patients that they might otherwise feel reluctant in doing (Cioffi, 2000; Cooper, 2001). The success of a rapid response system resides in changing the culture of an institution to ensure an adequate number of calls to achieve the best from the system as it is recognised a critical number of calls made per 1000 hospital admissions provides most benefit to patients (Chen et al., 2009).

The major challenge for rapid response systems is to have a political, legal and an economic climate to allow intensive care providers to direct the care of patients on medical and surgical wards independently and effectively (Szalados, 2004). If all these were a given, the sustainability for these systems is through good governance and expert leadership (Daly et al., 2007; Hillman, 2008; Santamaria et al., 2010).

2.2.6.3.3 Other Patient Deterioration Trigger Systems

A neural network signal for patient deterioration using continuous monitoring of vital signs (heart rate, blood pressure, respiratory rate and arterial saturation) has detected deteriorating patients on average 6.3 hours earlier than standard MET trigger criteria (Hravnak et al., 2008). Whilst this is important information, continuous monitoring is not standard practice on general wards.

2.2.7 Summary

Despite the lack of an agreed definition of the deteriorating patient, much work has been done over the last twenty years to improve the process of care delivered to deteriorating patients in general. These changes include the development of human factor designed observation charts, specific deteriorating patient education and the introduction of systems to facilitate the interpretation of abnormal vital signs and bringing about a more timely medical review. Some of these developments have eventuated since the commencement of the work in this thesis and some have been picked up in the Interventional Study. The identification of the interventions needed for improving the management of patient deterioration at the Canberra Hospital was elucidated from performing a small observational study of deteriorating patients, which picked out the major deficiencies in the clinical processes. This Observational Study is described in Chapter 4.

CHAPTER 3: METHODS

3.2 Purpose of the Project

1. To improve the understanding of the processes involved in the care of the deteriorating patient
2. To examine the effect of a deteriorating patient intervention on clinical processes and patient outcome
3. To determine if the effects of a deteriorating patient intervention are sustainable

3.3 Project Structure

This chapter describes the methods used in examining the human behaviour of healthcare professionals managing patient deterioration and measuring the outcome of adult patients who were admitted to acute general hospital wards following the initial and subsequent introduction of a deteriorating patient solution. It explains the experimental design, using both qualitative and quantitative methodology, to understand the three foundations of the thesis (improve the understanding of the clinical processes and influences involved in managing patient deterioration, examining the effect of a deteriorating patient intervention on clinical processes and patient outcome and determining if the effects of a deteriorating patient intervention are sustainable) and is answered by undertaking five projects.

i. An observational study of patient deterioration: "The Observational Study"
ii. A prospective, before and after multifaceted intervention study for recognising and responding to patient deterioration: "The Interventional Study"
iii. A qualitative study to understand behavioural changes with the multifaceted intervention: "The Behavioural Study"
iv. Are changes to behaviour and patient outcome sustainable in everyday clinical practice? "The Sustainability Study"
v. The human element of managing patient deterioration: "The Human Element Study"

Details of the specific methods used for each project are contained at the beginning of each relevant chapter.

3.3.1 An Observational Study of Patient Deterioration: "The Observational Study"

The aim of this study was to provide a baseline of which clinical processes were undertaken at The Canberra Hospital in the Australian Capital Territory (ACT) for recognising and responding to patient deterioration. To establish baseline data, a retrospective observational study was undertaken on all patients undergoing a medical emergency team (MET) review in one month at the Canberra Hospital. The MET review identifies a deteriorating patient and the study investigated the management of a

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Details of the specific methods used for each project are contained at the beginning of each relevant chapter.

3.3.1 An Observational Study of Patient Deterioration: "The Observational Study"

The aim of this study was to provide a baseline of which clinical processes were undertaken at The Canberra Hospital in the Australian Capital Territory (ACT) for recognising and responding to patient deterioration. To establish baseline data, a retrospective observational study was undertaken on all patients undergoing a medical emergency team (MET) review in one month at the Canberra Hospital. The MET review identifies a deteriorating patient and the study investigated the management of a deteriorating patient up to the moment a patient deteriorated. Data collected included the frequency of documentation of vital signs, the communication processes and hospital outcome.

3.3.2 A Prospective Controlled, Before and After Multifaceted Intervention Trial for Recognising and Responding to Patient Deterioration: "The Interventional Study"

In assimilating baseline data for patient deterioration from the observational study a multifaceted intervention was chosen that encapsulated all the available solutions from the literature at the time and trialled at the Canberra Hospital and Calvary Healthcare ACT. The study undertaken was a prospective before and after multifaceted intervention trial in two wards at The Canberra Hospital and two wards at Calvary Hospital in the ACT. Data collected included the frequency of documentation of vital signs, the timeliness of communication following patient deterioration and clinically meaningful outcomes such as unexpected admissions to intensive care, unexpected hospital deaths and unexpected cardiac arrests. This study differs from previously published studies by encapsulating all elements of the available deteriorating patient solutions into its intervention.

3.3.3 A Qualitative Study to Understand Behavioural Changes with the Multifaceted Intervention: "The Behavioural Study"

In any multifaceted interventional study aimed at changing the behaviour of healthcare workers, it is difficult to determine which element(s) of the multifaceted intervention is believed by the healthcare workers to have influenced their behaviour. The study involved the interviewing of healthcare workers who had experienced the multifaceted intervention. In-depth, semi structured interviews were conducted using open-ended, one-on-one interviews using a semi flexible interview guide. The transcripts were analysed for emergent themes using the grounded theory method whereby progressive coding phases (open and axial) occurred. The final coding structure was applied to the datasets and a model of why behaviour changed following the implementation of the multifaceted intervention was generated.

3.3.4 Are Changes to Behaviour and Patient Outcomes Sustainable?

Engaging clinicians and embedding patient safety strategies into everyday practice has proved to be extremely difficult and is now the focus of a number of patient safety agencies (Reinertsen et al., 2007; Improvement4Health, 2008; Healthcare Improvement Scotland, 2012). The aim of this study was to determine whether the improvement in behaviour and patient outcome seen immediately following the multifaceted intervention for patient deterioration were sustained two years later. The study was a retrospective observational study in the two original pilot wards at the Canberra Hospital in ACT. Data collected included the frequency of documentation of vital signs, the timeliness of communication following patient deterioration and clinically meaningful outcomes such as unexpected admissions to intensive care, unexpected hospital deaths and unexpected cardiac arrests. This study differs from previously published longitudinal studies as all elements of the process of managing patient deterioration are included.

3.3.5 The Human Element of Managing Patient Deterioration: "The Human Element Study"

Whilst systems have been designed to improve patient care in the healthcare workplace, it is unknown whether the healthcare workers can use these systems to deliver what was intended. The deteriorating patient literature suggests that well intentioned systems have not always been taken up by the healthcare workers. If deteriorating patient care is to improve it is essential to try and get a better understanding of why healthcare workers act and behave in the way that they do when confronted with a deteriorating patient. This study engaged four focus groups (nursing, senior medical officers, junior medical officers, combined group) to explore and understand what affects healthcare professionals to manage deteriorating patients appropriately. I used Alice's mother's story as the springboard for free flowing discussion to try and understand why the child was allowed to deteriorate to the extent an unplanned admission to the ICU was required. The focus groups were allowed to continue their discussions until there was no new information forthcoming. Grounded theory was utilised to analyse the data. Interviews were analysed for emergent themes using the grounded theory method whereby progressive coding phases (open and axial) occurred. The final coding structure was applied to the datasets and a model of the influences on healthcare professionals in managing patient deterioration was generated.

3.4 Statistical Analyses

All statistical tests were two-tailed. P-values <0.05 were used to indicate statistical significance. Descriptive statistics are presented using medians and interquartile ranges where data were skewed or as means standard deviations, counts and percentages. Comparisons of binomial proportions between two nominal periods were performed using the Pearson Chi squared statistic or Fisher's Exact Test where the numbers were small. Odds-ratios for each pre- to- post intervention comparison and their 95% confidence interval (CI) are reported. Adjusted analysis for sensitivity purposes was undertaken using multivariate logistic regression analysis adjusted for strata used in minimization, i.e. age. Hospital length of stay between the two periods was compared using a log rank test. The relationships between hospital outcome, the multifaceted intervention and other variables were determined using a multiple logistic regression analysis model using hospital outcome as the response variable. Patients who died were censored at the time of death. For comparing three time period group ordinals, one way analysis of variance (ANOVA) with post hoc Bonferroni correction was used. If the overall three sample log-rank test was statistically significant post-hoc comparisons between the pre- and each post-intervention period were compared using a two sample log rank test and analyses were adjusted for the same predictors as the primary outcome and were based on a linear, logistic or Cox regression as appropriate. STATA/IC 10 and SPSS v19.0.1 computer statistical packages were used in the analyses.

Each of the five projects was approved by ACT Health Human Research Ethics Committee. Patient consent was waived, in accordance with National Health and Medical Research Council (NMHMRC)

Audit Guidelines but consent was gained from healthcare workers who were interviewed for the qualitative studies.

CHAPTER 4: AN OBSERVATIONAL STUDY OF PATIENT DETERIORATION

4.1 Introduction

The key to understanding the clinical processes of managing a deteriorating patient was to determine the key elements of the clinical processes occurring in the environment at Canberra Hospital in which potential solutions for improving deteriorating patient care would be tested.

4.2 Aim

To delineate the key clinical processes occurring prior to patient deterioration as detected by the patient undergoing a MET review.

4.3 Method

A retrospective, observational inception cohort study was performed on patients undergoing a MET review during a one month period.

4.3.1 Setting

The Canberra Hospital.

4.3.2 Clinical Processes for the Recognition and Response to Patient Deterioration

4.3.2.1 The Ward Observation Chart

Vital signs were documented graphically with up to three variables being superimposed on the y-axis with different scales for each variable. They were placed without reference to relationships to each other on the ward observation chart (Appendix C). There were no hospital policies relating to frequency of measurement and documentation of vital signs other than for patients with an epidural catheter in-situ (hourly), patients receiving patient controlled analgesia (hourly) and patients undergoing recent surgery (hourly for six hours following the intervention).

4.3.2.2 Medical Review and Management

There was an informal two tiered medical response to patient deterioration. In the first response, ward nursing staff requested review by the patient's team of doctors. In the second response, a MET was activated once the patient fulfilled specific calling criteria (MERIT Study Investigators, 2005). After the MET review, if the patient was not admitted to a critical care area, the care was handed back to the patient's team of doctors with an appropriate verbal and written handover and suggestions on further care.

4.3.3 Study Period and Subjects

An apriori decision was made to undertake the observational study during a one month period. All adult patients who were admitted to The Canberra Hospital and underwent a MET review were studied.

4.3.4 Data Collection

Data collected included patient demographic data and whether they were admitted as a medical or surgical patient. All study patients were followed up until death or hospital discharge. Unexpected deaths were determined by the absence of a limitation order for resuscitation. During follow up length of hospital stay was recorded. Data collection also included all vital sign measurements, communication episodes between nursing and medical staff and whether the patient had triggered specific physiological MET criteria in the 24 hours prior to the MET review. Physiological triggers reached prior to the actual MET being called were deemed "delayed MET reviews". The physiological trigger type and the MET review outcome were also collected.

4.4 Results

4.4.1 Patient Demographics

During the study period, 34 patients underwent 45 MET reviews. Patients were predominantly male (19/34, 55.9%) and most usually admitted as a medical patient (20/34, 58.8%) and as an emergency admission (27/34, 79.4%). Their median length of stay was 7.3 days (IQR 1.8 to 27.1 days) and the hospital mortality rate was 26.5% (9/34), including three were unexpected deaths, Table 3.

Table 3: Patient Demographics of 34 Patients undergoing a MET Review

Total Number of Patients	34
Total Number of Hospital Deaths	9 (26.5%)
Unexpected Hospital Deaths	3 (8.8%)
Gender: Male	19 (55.9%)
Age, years (IQR)	70 (50.3, 77.0)
Median Length of Hospital Stay (IQR)	7.3 days (1.8, 27.1)
Elective Admission Emergency Admission	7 (20.6%) 27 (79.4%)
Medical Admission Surgical Admission	20 (58.8) 14 (41.2%)

Table 4: Vital Sign Measurements of 34 Patients undergoing a MET Review

Vital Sign	Measurement per Day
Blood Pressure	9.2 (4.8, 18.3)
Heart Rate	9.1 (4.3, 31.6)
Temperature	2.8 (0.1, 7.2)
SpO_2	8.5 (1.4, 15.1)
Respiratory Rate	1.6 (0.0, 7.1)

4.4.2 Documentation of Frequency of Observations

Differences in the frequency of documentation for different vital signs in the 24 hours prior to a MET review were found. The most frequently documented vital sign measurement was blood pressure (9.2 [IQR 4.3 to 18.3] measurements/day) and the least documented vital sign measurement was respiratory rate (1.6 [IQR 0.0 to 7.1] measurements/day), Table 4.

4.4.3 MET Reviews

Of the 45 MET reviews, the commonest trigger was a fall in the GCS of more than two points (13/45, 28.9%) followed by a systolic blood pressure of < 90 mmHg (8/45, 7.8%), Table 5. The majority of MET reviews occurred out of hours (31/45, 68.9%). The death of a patient occurred during the time of four MET reviews (8.9%) but a further five patients died subsequently and prior to hospital discharge of which three were unexpected deaths, Table 3. In over half of the MET reviews, the patient remained on the ward (26/45, 57.7%) but 15 patients were transferred to critical care areas (11 to the coronary care unit, 4 to the ICU), Table 5. Eight patients underwent multiple MET reviews, the majority occurring out of hours (15/19, 79%). An increase in the number of MET reviews was associated with increased hospital mortality (One Review: hospital mortality 5/26, 19.2% [1 unexpected]; Two reviews: hospital mortality 2/5, 40% [2 unexpected]; Three reviews: hospital mortality 2/3, 66.7% [none unexpected]), Table 6.

Table 5: Medical Emergency Team Reviews of 34 Patients

	Number of MET Reviews
Total Number of MET Reviews	45
Incidence of Triggers for MET Call	
Fall in GCS >2	13 (28.9%)
Systolic Blood Pressure < 90 mmHg	8 (17.8%)
Worried	6 (13.3%)
Cardiac arrest	6 (13.3%)
Airway threatened	6 (13.3%)
Heart rate <40 beats per minute	2 (4.4%)
Respiratory rate >36 breaths per minute	1 (2.2%)
Respiratory arrest	3 (6.7%)
Outcome of MET review	
Remained on ward	26 (57.8%)
Transferred to coronary care unit	11 (24.4%)
Transferred to ICU	4 (8.9%)
Died at MET calls	4 (8.9%)

Table 6: Number of Medical Emergency Team Reviews of 34 Patients and Hospital Outcome

MET reviews/patient	Number of Patients	Hospital Deaths	Unexpected Deaths
One	26	5 (19.2%)	1
Two	5	2 (40%)	2
Three	3	2 (66.7%)	0

4.4.4 Delayed MET Review

Twelve of the 45 MET reviews (26.7%) were delayed with a median delay of 4.77 hours and 10 (83%) of these occurred out of hours. The most commonly "ignored" trigger was a systolic blood pressure of <90 mmHg (8/12, 66.7%). Prior communication between the patient's doctors, including the patient's consultant on two occasions, and the patient's ward nursing staff was associated with a delayed MET review (prior communication episodes: delayed METs 11/12, 91.7% and non-delayed METs 18/33, 54.5%, p=0.03). The hospital mortality for patients undergoing a delayed MET review was high (5/11, 45.5%) and two were unexpected deaths, Table 7.

Table 7: Delayed MET Reviews of 34 Patients Undergoing 45 MET Reviews

	Delayed MET Review	Non Delayed MET Review
Number of MET Reviews (No. of Patients)	12 (11)	33 (23)
Out of Hours MET Review	9 (75%)	21 (63.6%)
Number of Patients Died	5 (45.6%)	4 (17.4%)
Number of Unexpected Deaths	2 (18.2%)	1 (4.3%)
Median Delay (hours)	4.77 (0.91, 8.47)	Not Applicable
Prior Communication	11 (91.7%)	18 (54.5%)*
Median Number of Communications	2 (1, 3)	1 (0, 2)
Consultant Communication	3 (25%)	5 (15.2%)

*p<0.05

4.4.5 Communication Prior to MET Review

In 16 of the 45 MET reviews (35.6%), there was no documented communication between the patient's doctors and nurses prior to a MET review but only one was a delayed MET review, Table 8. In the remaining 29 MET reviews, the most frequent communicator was the nurse (37 calls prior to 22 MET reviews) and the most frequent recipient of communication was the intern or resident (24 calls prior to 13 MET reviews), Table 9. The consultant caring for the patient prior to a MET review was consulted on the telephone on only eight (17.8%) occasions (Table 8). This did not appear to be related to the day or the time of day or whether the patient died, or if the death was unexpected.

Table 8: Documented Evidence of Communication 24 hours prior to a Medical Emergency Team Review in 34 patients undergoing 45 MET reviews

	No Communication	Communication
Number of MET Reviews (No. Patients)	16 (16)	29 (18)
Number of Deaths	3 (18.8%)	6 (33.3%)
Number of Unexpected Deaths	0	3 (16.7%)
Delayed MET Review	1 (6.3%)	11 (24.4%)*
Out of Hours MET review	9 (56.3%)	22 (75.9%)
Home Consultant Communication	0	8 (17.8%)

*p<0.05

Table 9: Communication between Hospital Staff 24 hours Prior to Medical Emergency Team Review in 34 patients undergoing 45 MET reviews

Source of Communication	Nurse	JMO	Ward Registrar	ICU Registrar	Specialist	Total Episodes
Recipient of Communication						
Nurse	5	0	1	0	0	6
JMO	20	6	0	1	0	27
Ward Registrar	8	4	1	0	0	13
ICU Registrar	2	1	2	1	0	6
Specialist (Other)	1	2	2	2	0	7
Specialist (Home)	1	6	2	0	0	9
Other	3	3	0	1	0	7
Total Episodes	37	24	8	5	0	74
No. MET Reviews	22	13	7	3	0	29

4.4.6 Out of Hours MET review

Over two thirds of the MET reviews occurred out of normal working hours of the week (31/45, 68.9%) and were more likely to contain the delayed MET reviews (9/12, 75%), or repeat MET reviews (7/8, 87.5%) and had a higher hospital mortality (7/23, 30.4%), two being unexpected deaths, Table 10.

Table 10: Out of Hours MET Reviews in 34 Patients undergoing 45 MET Reviews

	0800 – 1759 hours	1800-0759 hours
Number of MET Reviews	14	31
(No. patients)	13	23
No. Hospital Deaths	2	7
No. Unexpected Deaths	2	2
Consultant Communication	2	6
No Communication	7	9
Delayed MET Review	3	9
Multiple MET Reviews/Patient	1	7

4.5 Discussion

A retrospective observational study was conducted detailing the clinical processes occurring prior to a MET review, a marker of patient deterioration. The principal findings were that MET reviews were associated with a high hospital mortality rate and there was a trend to increased hospital mortality with an increasing number of MET reviews. The majority of MET reviews occurred out of hours, which were more likely to include the delayed and multiple MET reviews. Those MET reviews with prior parent team communication were more likely to be delayed and documented consultant involvement prior to a MET review was minimal. There was also a deficiency in the documentation of vital signs, particularly the respiratory rate. These findings have potential implications for developing processes that might improve the care and outcome of deteriorating patients.

4.5.1 Documentation of Vital Signs

In this small study, the frequency of documentation of many of the vital signs was higher than standard protocols (Zeitz et al., 2006) and may reflect an underlying concern, the "gut feeling" (Kruse et al., 1988; Cioffi, 2000), that the nursing staff had about the patient. However, despite the nurses' apparent concern regarding the patient, the documentation of respiratory rate was still significantly lower than the other vital signs and reflects that found in other studies (Nurmi et al., 2005; Van Leuvan et al., 2008). This finding is disappointing given the potential usefulness of respiratory rate in identifying deteriorating patients (McBride et al., 2005; Rothschild et al., 2010).

4.5.2 Communication and Medical Review

Appropriate and timely treatment for a deteriorating patient is important (Pinsky, 2007) and requires the engagement of a suitable medical review with senior medical input (McQuillan et al., 1998). This study demonstrates there was prior communication with the consultant caring for the patient in only eight MET reviews. The low engagement of consultants prior to a medical emergency is not new. Researchers have found low involvement of consultants prior to unplanned intensive care admissions (McQuillan et al., 1998) and other researchers have found that nursing staff are more likely to seek a junior rather than senior medical opinion regarding a deteriorating patient (Crispin et al., 1998; Buist, 2008). Reasons why consultants are not called are complex but given that the majority of the METs called were out of hours, it is likely that the consultant caring for the patient was not present in the hospital. This is known to reduce the likelihood of calling a consultant about patient care (Kennedy et al., 2009). Other reasons for junior doctors not calling consultants include the lack of approachability of their consultant, their desire for independence and a belief that their credibility was under threat if they chose to seek advice (Kennedy et al., 2009).

Another finding of this study is the apparent ineffectiveness of communication, decision making and response between the ward doctors and ward nurses, reflected by the relationship between delayed METs and prior communication and associated high patient mortality. This "clinically futile cycle" is well intended clinical activity but does not allow for appropriate management of the deteriorating patient (Buist, 2008) with failure to recognise the clinical urgency of the situation (Day, 2003). The MET reviews with no documented evidence of prior communication were more likely to be in hours, less likely to be delayed and were associated with no unexpected deaths. The lack of delay for METs with no prior communication could be explained by the presence of more senior and more experienced nurses during these "in hours" who are more likely to recognise the seriousness of the patient's condition (Kruse et al., 1988; Cioffi, 2000; Day, 2003) and are more willing to call for help.

4.5.3 Patient Related Outcomes

The hospital mortality following a MET review in this study was significantly higher than that found in the general hospital (MERIT Study Investigators, 2005). The hospital mortality appeared to be higher if the patient underwent more than one MET review or if the MET review was delayed. This was in keeping with other studies (Downey et al., 2008; Quach et al., 2008; Calzavacca et al., 2010). Of concern, in this study population, none of the patients who underwent a MET review had a treatment limitation order at the time of the MET review despite six patients having expected deaths. This emphasises the need for improved end of life care (General Medical Council, 2010), which may involve the MET(Parr et al., 2001) as well as the patient's doctors.

Although this was a small observational study in a single tertiary hospital, the low consultant engagement and delay in calling for appropriate help triangulates well with previous qualitative studies (Cioffi, 2000; Day, 2003) and suggests that the findings can be generalised. The findings also provide innovative opportunities for new models of healthcare to try and breakdown some of these communication barriers and low engagement of consultants in the care of their patient during a medical emergency. The retrospective nature of the study, whilst avoiding the influence of the Hawthorne effect, may have underestimated the number of communication episodes as the data collection was reliant upon the healthcare professionals to write in the clinical record. Whilst this study was meant to reflect clinical processes leading up to all deteriorating hospital patients, it is likely, to have only captured a proportion of deteriorating patients as the sensitivity of MET criteria for detecting all deteriorating patients is not ideal (Smith et al., 2008).

Despite the shortcomings of the study, it does identify that there are a number of deficiencies in the clinical processes of caring for a deteriorating patient. An improvement in the care delivered to deteriorating patients necessitates a multifaceted approach. This would need to be aimed at improving the documentation of vital signs particularly the respiratory rate (McBride et al., 2005) and communication processes. Improvements in the communication process would need to overcome medical hierarchy (Kennedy et al., 2009), provide an understanding of the usefulness of the communication (Leonard et al., 2004) and a specific communication structure (Thompson et al., 2011). The apparent lack of the ward consultant caring for the patient requires harder decisions that are likely to driven by politics, resources (Szalados, 2004), contactablity and willingness to be contacted.

First and foremost, whichever model of care is adopted for appropriate care for the deteriorating patient, it needs to be available at all times, including out of hours and weekends so that the patient is at the focus of care rather than suiting the needs of healthcare workers. Once the new model of care has been adopted it would be important to review patient care and outcome to ensure that patients are receiving timely, appropriate care and this will require good governance and leadership (Santamaria et al., 2010).

4.6 Conclusion

Through this small observational study it was possible to determine that there were significant deficiencies in the management of the deteriorating patient at the Canberra Hospital, particularly in the arena of documentation of vital signs, communicating with senior doctors and delaying appropriate intervention despite engaging junior medical officers in the initial medical review.

Despite the shortcomings of this study it is likely is that any improvements in the care of the deteriorating patients would need a trial of a multifaceted intervention. This is "The Interventional Study".

CHAPTER 5: A PROSPECTIVE CONTROLLED BEFORE AND AFTER MULTI FACETED INTERVENTION FOR RECOGNISING AND RESPONDING TO PATIENT DETERIORATION

5.1 Introduction

It is evident that if earlier intervention is to prevent further patient deterioration and improve patient outcomes, a series of steps are required including:

- i. Timely measurement and documentation of vital signs
- ii. Accurate interpretation of vital signs and any derangements
- iii. Timely and appropriate communication of vital sign derangements
- iv. Timely and appropriate management of the deteriorating patient

The definition of timely cannot be quantified as every patient needs will be different but it is the time in which there are physical signs of deterioration, namely physiological sequelae of inadequate oxygen delivery, but prior to irreversible organ damage from inadequate oxygen delivery. Appropriate communication of the vital sign derangements requires the engagement of a senior, experienced clinician who is able to provide advice on the clinical management of the deteriorating patient, which will halt and improve the condition of the deteriorating patient.

From the observational study, reported in the previous chapter, it was possible to identify the following deficiencies in the clinical processes of recognising and responding to patient deterioration at The Canberra Hospital prior to calling for a medical emergency team review namely:

- i. Low documentation rate of vital signs, particularly respiratory rate, despite its probable relevance in recognising a deteriorating patient
- ii. Poor communication content prior to activation of a MET between nurses and doctors caring for the patient given the significant relationship between MET delays and prior communication
- iii. Lack of timely communication with senior doctors caring for the patient
- iv. Inappropriate clinical management of deteriorating patients by junior medical staff given that patients who fulfilled MET criteria but had a delayed MET review underwent clinical management during this time period, which in the end did not prevent the patient from continuing to fulfil MET criteria.

In recognising that the deficiencies cut across a number of clinical processes, the observational study informed the need to develop and trial a multifaceted intervention to improve the delivery of care of the deteriorating patient, "The Interventional Study".

It was hypothesised that by applying a multifaceted intervention for the management of patient deterioration this would increase the frequency of documentation of vital signs and the frequency of a skilled, experienced medical review of a deteriorating patient and also decrease the number of unplanned admissions to ICU and hospital deaths. The multifaceted intervention included three important strategies to improve the management of the deteriorating patient:-

1. A newly designed ward observation chart
2. Installation of a track and trigger system, which used a modified early warning score (MEWS) adapted from Morgan et al (Morgan et al., 1997) to detect deteriorating patients and to trigger communication by the bedside nursing staff to request a medical review at specific trigger points
3. Introduction of an associated education program, COMPASS© (ACT Health, 2007)

This hypothesis was tested by conducting a prospective before-and-after controlled trial comparing the outcome measures with the introduction of the multifaceted intervention.

5.2 Aim

To determine the effect of a multifaceted intervention on the number of unplanned admissions to intensive care from four hospital wards.

5.3 Methods

5.3.1 The Hospitals

Four study wards were identified (two from the Canberra Hospital and two from Calvary Hospital) and were chosen for their varied medical and surgical case mix and their high acuity reflected by receiving the highest number of MET reviews pre-intervention in each institution.

5.3.2 The Multifaceted Intervention for Managing Patient Deterioration:

5.3.2.1 Development of a New Ward Observation Chart

The observational study, reported in the previous chapter, highlighted the need to develop new ward observation chart to facilitate the recognition of abnormal vital signs and consequently patient deterioration.

5.3.2.1.1 Current Ward Observation Chart

In collecting the data for analysis for the observational study, it became apparent that interpretation of the ward general observation chart (Appendix C) was made more challenging by superimposed variables, different scale usage, and the placement of variables, each of which is discussed below.

- Superimposed Variables

  Variables being superimposed upon one another, e.g. temperature, heart rate and blood pressure made it difficult to discern which pen mark applied to which variable and so it was hard to establish the physiological status of the patient.

- Different Scale for Variables on Same Axis

Three variables on the same axis were superimposed upon each other: blood pressure and heart rate had the same scale (each small square represented 5 units) and temperature had a different scale (each small square represented 0.5 units). This made documentation and interpretation potentially confusing.

- Placement of Vital Signs on the Chart

  The respiratory rate was placed at the bottom of the chart adjacent to bowel action and did not allow for immediate focus on abnormalities in the frequency of respiratory rate or for easy association with other respiratory function markers, e.g.: arterial oxygen saturation or inspired oxygen concentration.

- Digital Display

  The small box for writing the respiratory rate frequency made the number hard to read and therefore difficult to interpret. Being placed in a horizontal line there was also no ability to visually trend the value, reducing the ability to recognise increasing or decreasing respiratory rates.

To try and address these deficiencies, I led the working group for the deteriorating patient project to change the ward observation chart. At the time of development there was little in the literature but there had been some work reported on developing a chart to detect patient deterioration (Chatterjee et al., 2005). The key features of their chart was to record an early warning score, a measure of physiological deterioration, on the reverse of the chart, to record digitally and graphically the respiratory rate and heart rate and to increase the spread of the temperature graph.

Taking Chaterjee's comments and what had been learned from findings in Chapter 4 into account, the following themes were adopted into the new chart. Although there was no formal attempt to engage experts in human factors, our ward observation chart changes were largely adopted by a human factor research team at the University of Queensland (Horswill et al., 2010) for the Australian Commission for Quality and Safety in Health Care.

5.3.2.1.2 Features in the New Observation Chart

5.3.2.1.2.1 Clarity

The aim of designing this new observation chart was to increase the clarity of the observation chart to facilitate interpretation of abnormal vital signs by allowing for clear trending of data. This was done by removing variables that had a different scales yet were superimposed upon each other (temperature and HR) but keeping those that were related physiologically on the same scale (HR and BP). It was also considered that clear trending of data would also improve the handing on of information between shifts.

5.3.2.1.2.2 Graphical and Numeric Trending

To facilitate the interpretation of vital signs, it was decided that some variables should be recorded numerically and recorded graphically by using the number as the trending item, e.g. respiratory rate.

5.3.2.1.2.3 Placement of Variables

The vital sign variables would be placed on the chart in a systematic manner so that they would be grouped according to which organ system they were measuring, e.g. arterial oxygen saturation and respiratory rate, heart rate and blood pressure. This would allow for organ systems measurements to be more easily linked physiologically and interpreted.

Previously poorly documented but important predictive vital signs for recognising the deteriorating patient would be moved to a more prominent position on the chart and have the ability to be trended, e.g. respiratory rate. By placing respiratory rate at the top of the chart, it was believed that the measurement and documentation would be harder to omit, as it would be obvious to those reading the chart that it was missing. It was hoped that this would change the behaviour of those documenting vital signs onto the observation chart to include the documentation of respiratory rate.

5.3.2.1.2.4 Embedding of the MEWS

Using the available literature, a decision was made to use a multivariable Modified Early Warning Score (MEWS) additionally to track patient deterioration and trigger a nursing team leader to call for appropriate medical help over and above the pre-existing MET system. A total of seven variables could be assigned a pre-determined score (respiratory rate, arterial oxygen saturation, blood pressure, heart rate, urine output, conscious level, temperature) according to its degree of derangement. The expectation was that every time a set of observations was performed, all seven would be measured, documented ad assigned an individual score. Once the individual scores were completed, a total score would be calculated and recorded on the front of the chart. The actions (Appendix D) following the summation of the MEWS would be dictated by a hospital policy that had been developed in parallel to the development of the new ward observation chart (Appendix E). The policy (Appendix F) stated that if a patient scored a MEWS of four or more, the nurse had to call for a medical review.

5.3.2.1.2.5 Embedding of the Colour Coding of Vital Sign Derangement

All the vital sign variables, except blood pressure, were colour coded according to the level of their MEWS. The colours were chosen to minimise the impact of those workers that were colour blind and to use a colour (pink) in the most severely deranged range that might enhance the concern of the person filling in the observation chart. The use of colour coding for each MEWS would ease the calculation of each individual vital sign, which in turn would help the total summation of the total MEWS.

The new chart (Appendix E) was reviewed by two of the wards that were going to be part of the pilot study for the multifaceted intervention. The nursing staff were asked to comment on the chart and to trial the chart to determine if there were any practical issues with its use. Comments were received, and following consideration the chart was redesigned to accommodate the points raised. The predominant comment related to increasing the number of temperature ranges to allow greater trending.

5.3.2.2 A Specific Deteriorating Patient Education Package "COMPASS©"

As part of delivering the intern orientation program, there was a suggestion that newly qualified doctors' knowledge of basic physiology and how it related to the deteriorating patient was extremely limited, confirming previously published findings (Harrison et al., 1999). This deficit in knowledge is not necessarily limited to junior doctors. In setting up of the new ANU Medical School and developing the new curriculum, 15 senior medical academics were asked if they understood the reasons for measuring blood pressure so regularly in the ward environment. Their responses suggested that they too had a poor understanding of why blood pressure was measured as often as it was in the ward environment. With this in mind, education of why vital signs were being measured was going to be important to underpin the new ward observation chart. It was also realised that the education package would need to be for all healthcare professionals, both senior and junior.

The elements of the education package would provide a reason as to why it was relevant to the everyday work of the study participants. It would also provide a physiological explanation as to why vital signs were important to collect and interpret and the reasons for their derangement. Information would be provided on how to determine the MEWS and how to structure communication between one healthcare professional and another.

Although the education package aimed to encourage deep learning, the time allowed for both the development of the package and the time to deliver the education face to face limited its capacity to do so. The package comprised of four elements:

i. The manual
ii. The DVD
iii. The quiz and
iv. A three hour face to face low fidelity simulation session

Another deteriorating patient education package was available on the market (Smith, 2000; Smith et al., 2002) but it was deemed to be orientated toward medical education and to be too time consuming for a busy hospital environment under tight fiscal and time restraints. Under my editorial control the COMPASS© package (ACT Health, 2007) was developed and its objectives were to provide:

- a physiological basis of the generation of vital signs
- a link between oxygen delivery, vital signs and the deteriorating patient
- the basic tools to recognise and respond to the deteriorating patient, including:
    - use of rapid response systems
    - patient management, and
    - a communication structure

5.3.2.2.1 The Manual

The manual was divided into eight chapters and was aimed at helping healthcare professionals gain an understanding of the physiological principles behind the generation of vital signs, the physiological reasons for deranged vital signs and the possible implications of vital sign derangement. It provided an explanation why vital sign measurement was important to patient care and provided information both on how to calculate a total MEWS and a chapter on how to structure communication when faced with a deteriorating patient. It was likely that the manual would impart declarative knowledge (Biggs et al., 2007) and provide the readers with an opportunity to know about the important facts in recognising and responding to patient deterioration. A subsequent quiz was used to test participants understanding of the physiological elements of the manual. The quiz was mandatory prior to undertaking the face to face low fidelity simulation session.

5.3.2.2.2 The DVD

It was envisaged that there would be time to deliver face to face lectures on the physiology behind vital signs but the time allotted to teaching was too limited to do so. As a way of obviating the need for lectures on physiology, a script was developed to underpin simple moving pictures of the physiology involved in the deteriorating patient and recorded onto DVD. The DVD lasted 15 minutes and was interactive to facilitate the understanding of the physiology behind cardiovascular and respiratory vital signs. The interactive DVD allowed participants to draw upon their declarative knowledge in a simulated context by asking the participants to answer questions that were related to physiology, which was embedded into the observation chart on the screen.

5.3.2.2.3 The Quiz

As it was going to be difficult to mandate staff to read the manual and watch the DVD, it was thought that if people had to gain 100% in an associated quiz prior to undertaking the face to face session, it would encourage them to do the prior-learning for the face to face teaching. The quiz would largely be physiologically based and a testing of declarative knowledge. As the quiz was on line, the participants could take the test anywhere, including at home and the trainers could track the participants' scores. A philosophy of open access to the questions was also established, as it was believed that it was important for the participant to read the relevant parts of the manual. However, this would have the disadvantage that the participant might only review the parts of the manual relevant to the quiz.

5.3.2.2.4 The Face to Face Learning

The face to face learning was delivered as an interactive lecture summarising the physiology, the method for calculating the MEWS and the communication strategy. This was then followed by low fidelity simulation case scenarios provided by COMPASS© trainers. It consisted of four clinical cases relevant to ward care and patient deterioration. Each case was role played by participants in the group, which was no larger than six participants. During the low fidelity simulation participants would act out the skills needed to recognise and respond to patient deterioration. This would test their knowledge and allow them to put it into a simulated clinical context. It was anticipated that this low fidelity simulation education session would provide functioning knowledge (Biggs et al., 2007) and would allow the student to operate at the ward level, where situations are complex and wide ranging, allowing them to recognise and respond to patient deterioration. Initially, the groups were multidisciplinary but it became impossible to get the professional groups in the same classroom at the same time. However, the multidisciplinary teaching principles remained whereby the structured learning provided opportunities for "shared learning" and enabled learners to acquire knowledge, skills and importantly professional attitudes.

5.3.2.3 The Track and Trigger System

Both the Canberra Hospital and Calvary Hospital already had a MET system for managing patient deterioration following participation in the MERIT trial (MERIT Study Investigators, 2005). The MET system, a single track and trigger system (Lee et al., 1995), was designed originally at Liverpool Hospital, Sydney. The MET system could be triggered by either a predetermined single physiological criterion or if the staff were worried enough to call for a MET. Despite the presence of the MET system in both hospitals, repeated episodes of failure to recognise patient deterioration were identified by the newly established Clinical Review Committee (Mitchell et al., 2008). Thus, ACT Health deemed that another system was needed to facilitate the recognition and response to a deteriorating patient. Following in the footsteps of the United Kingdom's recommendation from the National Confidential Enquiry into Patient Outcome and Death "An Acute Problem?" (National Confidential Enquiry into Patient Outcome and Death, 2005), a multi parameter track and trigger system (Morgan et al., 1997) was chosen to be part of the pilot intervention for improving the recognition and response to the deteriorating patient. It was thought that this multi parameter system might identify deteriorating patients earlier than the single parameter system and might encourage the ward medical staff to engage in the early care of their acutely unwell patients having been called by the nursing staff caring for their patients.

5.3.3 Study Design

The study design was a prospective, controlled before and after multi-faceted intervention trial. All adult patients admitted to the four wards were considered for participation.

5.3.4 Study Principles

The principle underlying the multifaceted intervention was that physiological instability identifies patients at risk of adverse events. The provision of a framework for nurses and doctors for the rapid identification, assessment and treatment of patients with physiological instability should prevent further deterioration and reduce adverse events.

5.3.5 Study Periods

The duration of the control period was four months during which outcome measures were studied under normal operating conditions. This was followed by an eight month preparation and education period during which a new ward observation chart, new hospital policy (Appendix F) for vital sign measurement and new education program, COMPASS©, were developed. This eight month period allowed for development of the new strategies and provided a period for new learning and a washout period to reduce false negatives. Ward focus groups and information sessions for all hospital staff were held to minimise problems during the intervention period. The duration of the intervention period was four months during which the outcome measures were studied under the new operating conditions.

5.3.6 Subjects

Analysis included all adult subjects who had been admitted to the four wards during the two study periods. Subjects excluded from the study were those who were specifically admitted to the four wards for palliation, aged less than 18 years of age and those being readmitted to the four wards during the study periods to minimise contamination between periods and allow accurate calculation of unexpected deaths. Approximately 25% of patients were randomly selected by a computer program as a subgroup for an in depth analysis of vital sign measurements and associated communications.

5.3.7 Data Collection

Data collected on admission to the ward included demographic data, admission diagnosis and whether they were medical or surgical patients. All study patients were followed up to either death or hospital discharge. During follow up data on length of hospital stay and predefined adverse events were obtained. In a randomly selected subgroup of patients data collection included all the vital sign measurements documented, the MEWS recorded during the intervention period and any communication documented between nursing and medical staff following clinical instability, defined as a MEWS of four or more and subsequent medical review.

5.3.8 Outcome Measures

The primary outcome measure was the incidence of unplanned admissions to ICU. The secondary outcome measure for the whole cohort was the incidence of adverse events. In the subgroup of patients, the secondary outcome measures were the daily documented frequency of vital sign measurements, the incidence of documented communication and documented medical review following clinical instability.

This study was registered, number ACTRN12609000808246.

5.4 Results

5.4.1 Study Processes

The COMPASS© program was undertaken by 177 of the 195 (90.8%) ward nursing staff, 28 of the 34 (82.3%) ward junior medical officers and all of the five physiotherapists prior to the intervention period. However despite being invited, no senior medical officers undertook the COMPASS© program.

5.4.2 Patient Demographics

During the control period, 1157 patients were studied compared with 985 patients during the intervention period (97 and 44 readmissions were excluded, respectively). The demographics were similar between the two periods (Table 11) but there was a significant increase in the proportion of patients from the Canberra Hospital during the intervention period (820/1157 [70.9%] and 747/985 [75.8%] $p = 0.01$) and significantly more medical admissions during the intervention period (418/1157 [36.1%] and 397/985 [40.3%] $p = 0.05$). The demographics of the randomly selected subgroup of patients were similar to the whole patient cohort (Table 11).

Table 11: Baseline Demographics of Study Patients in a Multifaceted Intervention for Managing Patient Deterioration

	All Patients		Randomly Selected Patients	
Period	Control	Intervention	Control	Intervention
Numbers	1157	985	427	320
Hospital A (%)	820 (70.9)	747 (75.8)**	233 (56.3)	191 (60.3)
Hospital B (%)	337 (29.1)	238 (24.2)	190 (44.5)	129 (40.3)
Male (%)	644 (55.7)	540 (54.8)	243 (56.9)	168 (52.5)
Age, yrs, (SD)	58.6 +/- 19.7	57.4 +/-19.8	60.4 +/-20.4	59.4 +/-19.8
Type of Admission				
Medical (%)	418 (36.1)	397 (40.3)	183 (42.9)	158 (49.4)
Surgical (%)	604 (52.2)	498 (50.6)	187 (43.8)	137 (42.8)
Other (%)	135 (11.7)	90 (9.1)*	57 (13.3)	25 (11.0)*
Surgical Admissions (%)				
General	176 (29.1)	131 (26.3)	61 (32.6)	34 (24.8)
Orthopaedic	62 (10.3)	49 (9.8)	12 (6.4)	7 (5.1)
Vascular	55 (9.1)	45 (9.0)	15 (8.0)	17 (12.4)
Hepatobiliary	35 (5.8)	57 (11.5) *	10 (5.4)	19 (13.9)*
Urology	56 (9.4)	33 (6.6)	19 (10.2)	12 (8.8)
Medical Admissions (%)				
Gastroenterology	91 (21.8)	91 (22.9)	32 (17.5)	29 (18.4)
Renal	55 (13.2)	58 (14.6)	19 (10.4)	14 (9.8)
Hepatology	35 (8.4)	59 (14.9) *	14 (7.7)	21 (13.3)
Rheumatology	28 (6.7)	18 (4.5)	12 (6.6)	7 (4.4)
Respiratory	26 (6.2)	21 (5.3)	19 (10.4)	17 (10.8)

*p < 0.05, ***p=0.01

5.4.3 Patient Outcomes

During the intervention period there was a significant reduction in the number of patients requiring an unplanned admission to ICU (21/1157 [1.8%] vs. 5/985 [0.5%] relative risk ratio 0.28 [0.11–0.74], p = 0.005) and unexpected deaths (11/1157 [1.0%] vs. 2/985 [0.2%] rate risk ratio 1.57 [1.24–1.99] p =

0.03). There was a significant increase in the number of patients receiving one or more MET reviews (25/1157 [2.2%] vs. 38/985 [3.8%], Relative Risk Ratio 1.79 [1.09–2.94], p = 0.03). There was also an increase in hospital length of stay during the intervention period (4.0 [1.8–8.3] vs. 4.8 [2.2–9.8] p = 0.03) but no other significant changes in patient related outcomes (Table 12).

Table 12: Comparing Patient Outcomes and Incidence of Adverse Events between Control and Interventional Groups in a Multifaceted Intervention for Managing Patient Deterioration

Number of Patients (%)	Control Period	Intervention Period	RRR (95% CI)	*p* value
Patients	1157	985		
Unplanned ICU Admissions	21 (1.9)	5 (0.5)	0.28 (0.11–0.74)	0.005
Unexpected Hospital Deaths	11 (1.0)	2 (0.2)	1.57 (1.24–1.99)	0.03
All Hospital Deaths	30 (2.6)	6 (0.6)	1.56 (1.34–1.81)	<0.001
Hospital length of stay (days) *	4.0 (1.8, 8.3)	4.8 (2.2, 9.8)		0.02
Acute Myocardial Infarction	1 (0.1)	2 (0.2)		0.6
Pulmonary Embolus	4 (0.4)	2 (0.2)		0.69
Respiratory Failure	7 (0.6)	1 (0.1)		0.08
Acute Renal Failure	1 (0.1)	0 (0.0)		1.00
Cardiac Arrest	4 (0.4)	0 (0.0)		0.13
MET Referrals	25 (2.2)	38 (3.9)	1.79, (1.09- 2.94)	0.03

p-values for comparing frequencies were based upon Pearson Chi-squared tests or Fisher's Exact Test. p-value for hospital length of stay was based upon a log rank test. Patients who died were censored at the time of death.

*Median (interquartile range).

5.4.4 Vital Sign Measurements

The average daily frequency of documentation of all the vital sign measurements (blood pressure, heart rate, respiratory rate, oxygen saturation and temperature) significantly increased during the intervention period (3.4 [SE 0.22] vs. 4.5 [SE 0.17], p = 0.001) including respiratory rate (2.3 [SE0.21] vs. 4.7 [SE 0.20], p < 0.001).

5.4.5 Communication and Medical Review following Clinical Instability

There was no significant difference in the number of documented communication episodes between nursing staff and medical officers following an episode of clinical instability (133/297 [44.8%] vs. 79/191 [41.4%], p=0.38). However, there was a significant increase in the number of medical reviews following communication (58/133 [43.6%] vs. 55/79 [69.6%], p<0.001).

5.4.6 MET Review following fulfilment of MET Criteria

In the pre-determined subgroup, the number of times MET criteria were fulfilled was greater in the control period (166 vs. 138) but there was no difference in the number of times the MET was activated (11/166 [6.6%] vs. 10/138 [7.2%]).

5.5 Discussion

A two centre before and after study of the introduction of a multifaceted ward based intervention to improve the detection of patients with clinical instability and timely and appropriate intervention to improve their acute care was conducted. A decrease in unexpected admissions to ICU and a decrease in hospital mortality was found. This was associated with an increase in medical review (patient parent team or MET) on a background of increased documentation of vital signs. These findings have potential implications for attempts aimed at improving the quality of care for clinically unstable hospital patients.

5.5.1 Documentation of Vital Signs

This study found a significant increase in the frequency of documentation of all vital sign measurements including respiratory rate, which is often poorly recorded despite its significance (Fieselmann et al., 1993; Goldhill et al., 1999). The potential reasons for this finding are numerous. The provision of vital sign education (Franklin et al., 1994) within a clinical context (Ramritu et al., 2001) may have provided more reason to document vital signs. The hospital policy mandating the calculation of a total MEWS every time a set of observations was performed (McBride et al., 2005) may have provided nurses with personal consequences if they did not follow the policy. The need to perform a complete vital sign set for a MEWS may have increased the documentation of the vital signs (McGain et al., 2008). Lastly, the Hawthorne effect during the intervention period may have increased vital sign documentation. Minimisation of the Hawthorne effect through a blinded randomised controlled study would have been impossible in this setting given the inability to blind the observation charts. Furthermore, a cluster randomised controlled study would probably have been contaminated by "educated" staff rotating from the intervention wards.

5.5.2 Communication and Medical Review

The monitoring of a clinically unstable patient must be associated with an appropriate treatment to improve care, which can only occur following an appropriate medical review triggered by a meaningful communication by the bedside nurse to medical officer. During the intervention period although there was no change in the rates of contacting the patient's parent team, there was an improvement in the number of times a medical officer came to review a clinically unstable patient. Although there was an increase in the number of times a MET review was activated during the intervention period, there was still a significant number of episodes when the MET was not activated in the control subgroup (n=155) and in the intervention subgroup (n=128). The reasons for such failures include inability to think appropriately for the clinical scenario (Daffurn et al., 1994), inability to prioritise patient care (Cioffi, 2000), and the patient being deemed suitable for palliation by the nurses but not by the doctors.

The improvement in the frequency of a medical review (MET or parent team) may have occurred by the provision of a framework for the nurses, which not only mandated the reporting of a physiological deterioration and a request for medical review, but also provided a methodology and structure for communicating the clinical instability (Andrews et al., 2005). Other possible reasons for the increase in MET reviews include the additional documentation of vital signs providing more MET trigger points (MERIT Study Investigators, 2005), the empowerment of nurses and junior doctors through improved education and the underutilisation of the MET prior to the intervention. However, improvements in number of medical reviews may reflect an improvement in medical documentation, although MET data were collected independently pre and post intervention.

5.5.3 Patient Related Outcomes

The introduction of the multifaceted intervention for the detection of the clinically unstable patient led to a 72% relative reduction (21/1157 [1.8%] vs. 5/985 [0.5%]) in unexpected admissions to the ICU and an 82% relative reduction in unexpected deaths in a general medical and surgical population (11/1157 [1.0%] vs. 2/985 [0.2%], risk ratio 0.42 [0.19, 0.95] p=-.037, adjusted for age, gender and hospital). This was the first ward based intervention and rapid response system that has decreased unplanned admissions to an ICU without any adverse effect on the unexpected hospital deaths. An important limitation to the interpretation of patient related outcomes is the absence of a concurrent control group and the increased likelihood that the observed improvements merely reflect a regression to the mean (Moran et al., 2005), given that the control group had a higher rate of unplanned admissions to the ICU compared with other studies (Chen et al., 2009). Similarly, data were not collected to determine whether decisions were made to limit patients' admission to the ICU. Another limitation to the understanding of the patient related outcomes is whether the two patient cohorts were matched. There were a higher proportion of medical patients in the intervention group but these patients are more likely to have a higher not lower incidence of unexpected admissions to the ICU and have a higher mortality (Hillman et al., 2002). Moreover, multivariable regression analysis did not detect any differences between the two groups to account for the differences in hospital outcome.

The reasons for the reduction in hospital mortality cannot be explained by a reduction in individual patient adverse events. However, the increased medical review (parent team and MET) or increasing dose response may explain some of the positive differences seen in patient outcome, which has been similarly seen in other studies (Buist et al., 2002; Bellomo et al., 2004; Priestley et al., 2004). The usefulness of the track and trigger system for inexperienced junior medical officers and nurses may have aided their early identification of clinical deterioration. Given the MET is likely to have been underutilised or delayed; it is possible that a further improvement in patient outcome could have been realised if each trigger had led to appropriate activation. Generalisability of the study may be limited due to the small sample size, number of centres and the exclusion of readmissions into the study.

5.6 Conclusion

This prospective study of a simple, practical ward based intervention that has included the majority of current solutions aimed at recognising and treating adult deteriorating ward patients from a tertiary and metropolitan institution had a positive impact on patient outcome. It had also had a significant impact on the behaviour of both doctors and nurses managing patient deterioration. What is unknown is which of the interventions instituted had the greatest impact on the healthcare workers and whether these behaviours could be maintained once the project moved from research mode to program mode. The former is explored in "The Behavioural Study" and the latter explored in "The Sustainability Study".

CHAPTER 6: A QUALITATIVE STUDY TO UNDERSTAND BEHAVIOURAL CHANGES WITH THE MULTIFACETED INTERVENTION

6.1 Introduction

The results from the multifaceted intervention for the recognition and response to patient deterioration suggested that there was a significant improvement in the documentation of vital signs and also an improvement in the number of medical review episodes following the intervention. These changes in behaviour were associated with a significant reduction in the number of delayed activations of the MET, unplanned admissions to the ICU and unexpected hospital deaths. However, the study was not able to determine why the healthcare professionals' behaviour changed.

The behaviours that were investigated were associated with multifaceted intervention for managing patient deterioration, both during the interventional study and following the hospital wide roll out. The behavioural components to timely recognition and appropriate response to a deteriorating patient can be broken down into:

i. Accurate measurement of vital signs
ii. Documentation of vital signs
iii. Accurate documentation of vital signs
iv. Interpretation of vital signs and any derangements
v. Timely and appropriate communication of vital sign derangements
vi. Timely and appropriate management of the deteriorating patient

From the observational study performed prior to the interventional study, it was determined that a number of the components were not occurring (documentation of vital signs, timely and appropriate communication, timely and appropriate management) whilst others were not investigated (accuracy of measurement of vital signs, accuracy of documentation of vital signs). A number of these findings concurred with the literature including poor documentation of vital signs, particularly respiratory rate (MERIT Study Investigators, 2005; Van Leuvan et al., 2008) reasons for which included poor observation chart design (Oakey et al., 2006) and a deficiency in the understanding of why vital signs are measured (Smith et al., 2002). Additionally there appeared to be a failure to communicate adequately (Franklin et al., 1994), which delayed appropriate medical management (Jacques et al., 2006).

In appreciating that the process of timely recognition and timely and appropriate response to a deteriorating patient was complex, the solutions needed to address many of the bedside behaviours.

In the literature, the strategies to improve the behaviours required for recognising and responding to patient deterioration that had been reported were limited. These included increasing respiratory rate documentation (McBride et al., 2005) by embedding a multi parameter track and trigger system into a ward observation chart and improving the timeliness of medical review by installing a single parameter track and trigger system (Lee et al., 1995). However, in these studies there was not an explanation of why behaviour changed. Through a multidisciplinary group discussion, a number of potential solutions were identified to improve the recognition and response to a deteriorating patient, based on the literature review and the clinical experience of the clinicians. Nevertheless, it was unclear whether the following solutions listed would change the behaviour of those caring for deteriorating patients:

a. A modified observation chart; removing any ambiguity in the interpretation of the observation chart.
b. The installation of a track and trigger system; providing objective evidence for determining that a patient was deteriorating and providing a trigger to communicating for help.
c. An education package (COMPASS©) addressing the perceived knowledge deficit for the recognition and response to the deteriorating patient.
d. The development of a policy framework to ensure that vital signs were completed, which then generated a MEWS to provide a forcing function to make the nurses communicate with the doctor and the doctor to come to the bedside within a specified time frame, when a predetermined MEWS was reached.

Through the outcome of the interventional study, it was possible to identify that some of the behaviours required to recognise and respond to a deteriorating patient did change namely increased documentation of vital signs and increased medical review, similar to the experience of other groups (Lee et al., 1995; McBride et al., 2005). However, what was not clear from the literature or the interventional study was why behaviour changed.

6.2 Aim

To determine which factors influenced the change of behaviour observed following the introduction of a multifaceted intervention to improve the management of patient deterioration. In examining the positive behavioural influences on the care of the deteriorating patient, the findings could be utilised in further studies of patient deterioration.

6.3 Method

6.3.1 The Setting

The multifaceted intervention, described earlier was introduced into two pilot wards at the Canberra Hospital under research conditions for four months and subsequently continued in a "business as usual" process. Following the success of the pilot study, a hospital wide roll out of the intervention occurred.

A a theory which explained why behaviour had changed in the face of patient deterioration could not be identified and so developing a theory following analysis of interview data was required. This ground-up or data driven theory making, the grounded theory methodology of data analysis (Strauss et al., 1998), is a research method intended to develop a theoretical explanation of a social phenomenon that is "grounded in" naturalistic data (Strauss et al., 1998). The exploratory study reported below used interviews to investigate the experiences of nurses and junior doctors involved in the original pilot study and the hospital wide roll out of the intervention. The source of these healthcare professionals, were two wards, a mixed medical/surgical ward chosen to reflect the research environment and the haematology/oncology ward, chosen to reflect "business as usual" conditions.

6.3.2 Data Sources

Sampling of the healthcare professionals was purposeful (Strauss et al., 1998) to achieve a sample of participants within each clinical craft group including those that had had enough experience with the intervention to describe their experiences in enough depth to construct a theory. Registered nurses and junior doctors from wards in the hospital who had experienced the new multifaceted intervention for patient deterioration and likely to have been exposed to significant numbers of deteriorating patients (gastroenterology/general surgical/haematology patients) received study information sheets inviting them to participate in the study (Appendix G). Informed consent (Appendix H) was obtained from seven nurses and five junior doctors who volunteered to join the study. Participants were coded numerically to maintain their anonymity.

6.3.3 Collection of Data and Analysis

In depth, semi structured interviews were conducted using open ended, one on one interviews with the use of a semi flexible interview guide (Appendix I). Domains of the interview guide were based on the introduction of the multi-faceted intervention and each element of the multi-faceted intervention (observation chart, education package including the communication strategy and the track and trigger system). Interviews were conducted until no new information was forthcoming (Strauss et al., 1998).

Interviews were transcribed verbatim for five nurses (N1-5) whereas for the five doctors (D1-5) and the remaining two nurses (N6 and 7) key points were transcribed during the interviews. The transcripts were analysed for emergent themes using the grounded theory method whereby progressive coding phases (open and axial) occurred. Datasets were read recursively to develop a preliminary coding structure (Strauss et al., 1998). My supervisor and I discussed, refined and confirmed this coding structure. The final coding structure was applied to the datasets, using NVivo software (QSR International, Cambridge, MA) to facilitate cross-referencing. A model of why behaviour changed following the implementation of the multifaceted intervention for recognising and responding to patient deterioration was generated by repeatedly going back to the data to clarify the theory generated.

6.4 Results

The 12 health care workers who volunteered to join the study (seven nurses and five junior doctors) were interviewed and all their data were used in the analysis. The median number of years of experience as a registered nurse was 18 (4.5, 18) and the median number of years of experienced as a medical practitioner was 1 (IQR 1-1) (Table 13).

Table 13: Demographics of Participants in the Behavioural Study

	Gender	Years Post Graduation	Ward
N1	Male	29	Haematology
N2	Female	28	Haematology
N3	Female	38	Haematology
N4	Female	3	Haematology
N5	Female	6	Haematology
EN1	Female	27	Haematology
N6	Female	2	Haematology
D1	Female	1	Mixed Medical/Surgical
D2	Male	1	Surgical
D3	Male	1	Mixed Medical/Surgical
D4	Female	1	Mixed Medical/Surgical
D5	Female	1	Mixed Medical/Surgical

N Registered Nurse

EN Enrolled Nurse

D Medical Practitioner

From the data it was possible to extract four key influences on the change of behaviour by the healthcare professionals:

i. The sense of being obligated to behave in a certain manner following patient deterioration
ii. Being provided with objective evidence of patient deterioration
iii. A sense of confidence for the nurses to communicate with doctors following patient deterioration
iv. Being provided with a structure of care for managing patient deterioration

6.4.2 A Sense of Obligation

A sense of obligation appeared to have influenced many of the actual and perceived changes by the healthcare workers in behaviour including:

i. Nurses communicating to the doctors regarding patient deteriorations

ii. Nurses completing the ward observation chart

iii. Medical review of the patient occurring

6.4.2.1 Nurses Communicating to the Doctors regarding Patient Deterioration

6.4.2.1.1 Pre Instalment of the Intervention

The data revealed a sense of reluctance by the nurses to call the doctor regarding patient deterioration, which was often related to previous negative experiences with communication. The reasons for this were complex but revolved around the perceived hierarchy between doctors and nurses whereby doctors assumed that nurses neither had the knowledge nor the understanding of when a patient was deteriorating. In the event that the nurse did call the doctor, the doctor was often unreceptive to their concerns:

> N1: "We have had no choice but to call the consultant and they get very annoyed with both you and the registrar because they have been called at home"

Or forthcoming in coming to see the deteriorating patient:

> N3: "..because often in after hours there was a frustration that if the patient was deteriorating they [the nurses] would be ringing people, ringing people and nothing would be happening"

It is not surprising these negative experiences sometimes led nursing staff to delay calling for appropriate help although this appeared to be related to the individual person as there were some doctors that nurses would be happy to call:

> N2: "Oh yes, I find its different who calls, it's different who's on doctor wise, and its difficult because I work nights and you just don't have them [our own ward doctor]."

And the quality of the response was dependent upon whether the call was in hours or out of hours reinforcing the idea that the model of care delivered is centred around the staff and not the patient:

> N1: "It depends on the time of the day in a lot of the cases. Like at night time you have your evening RMO on and they can be young and tied up and not really know especially in haematology you know the whole circuit, but during the day Monday to Friday its pretty good because you have your registrars around, you've got everyone on board"

From the negative experiences before the installation of the multifaceted intervention, the need for improvements in calling for the doctor were evident from the data from this qualitative study. However, it is interesting, that the quantitative data in the interventional study revealed no change in the incidence of communication episodes related to patient deterioration following its introduction.

6.4.2.1.2 Post Instalment of the Intervention

The intervention provided the nurses with a sense of obligation to do something including calling the doctors in the event of a patient deterioration:

> N1: "Once you have a figure you know you have to do something"

In response to the sentiments that the nurse had to "do something"; the doctors felt the pressure from the nurses to call the doctor:

> D1: "Nurses pressured more [by CNCs] to call the doctor"

However, despite the intervention there continued to be some reluctance among nurses to call for appropriate help. At times it seemed it was not until the arrival of a more senior, experienced nurse that appropriate action would be taken:

> N3: "Some people .... didn't follow the algorithm and there has been times ... I would say you call a MET now and they would say but, but and I would say no buts call one now."

This reluctance of nurses to call for further medical help from either the parent medical team or the MET may explain why there were no changes in the instances of nurse to doctor communication episodes following the introduction of the multifaceted intervention. What is not explained is why nurses were reluctant to call for help. This is explored further in "The Human Element Study".

The trigger for the nurses to call for medical help necessitated the nurses to complete observation charts to generate a MEWS (Morgan et al., 1997), which, when the score was high enough (four or more) the hospital policy dictated that the nurses had to call for medical help. From the data reported in "The Observational Study" and "The Interventional Study" it was evident that observations, particularly respiratory rate, were not documented frequently enough prior to the intervention and reasons why observations were so poorly documented were unclear.

6.4.2.2 Nurses Completing the Ward Observation Chart

6.4.2.2.1 Pre-instalment of the Intervention

From the data, it was clear that the old ward observation chart was difficult to complete because of its confusing layout:

> N3: "Some people found it hard whether to put the 100 on that line or the line above it, so they would write it in"

It was also confusing to interpret the vital signs:

> N3: "[The old chart] was sort of all over the shop sometimes you had your temp and your heart rates in the same colours, you had to study it closely to look at whether you were reading a heart rate or a temperature, the blood pressure lines you still had to put arrows in"

Observations did not appear to be an important part of the role of the nurse because whilst the observation chart was populated, the actual observations were not necessarily performed:

> N4: "with the old ones [charts] some people didn't even bother do the obs and just fill them in"

Through these data it was evident that there were not only issues with performing the observations and documenting the observations but also with interpretation of the observations entered on the old ward observation chart.

6.4.2.2.2 Post-instalment of the Intervention

In contrast to the old ward observation chart, the new ward observation chart installed with the multifaceted intervention was greeted more favourably and the new ward observation charts were filled in with greater due diligence:

> N3: "I think they have been a little bit more careful now, they actually document them, they don't just throw a little dot somewhere they have to actually make sure the obs are reasonably accurate"

Perhaps this was due to the need to end up with a total MEWS, which necessitated that all vital signs had to be completed:

> N2: "[I] do it [completing the ward observation chart] more diligently because it's all there to be done because you have to end up with a score that should reflect all of them."

The data suggest that the reasons for the greater diligence in completing the observation charts probably was not as a result of a greater understanding of the importance of measuring and documenting vital signs but more that if they did not complete the chart there were negative consequences:

> N3: "Because they have to score it, I mean if you are going to fudge it once you don't want to make a whole big fool of yourself on your scoring do you because if you make it up and the next person and further down and the score was dramatic you could actually get caught out and I suppose there is a bit of that"

A higher completion rate of the ward observation chart seemed to be driven not only by the different design and the need to arrive at a total MEWS, necessitating all vital signs to be measured, but also because the nurses had a sense of accountability for their actions.

> N1: "Yeah…., we are more accountable now and I sort of like that and for me when I don't do some obs the next lot I do."

The reason for the latter is unclear but unlike the old ward observation chart there was now an obligation for the nurses to sign for their observation set. Alongside the nursing staff changing their behaviour in documenting vital signs, the junior doctors who were being contacted by the nursing staff to review deteriorating patients appear to have realised the change in nursing behaviour following the introduction of the multifaceted intervention, which in turn changed their way of dealing with the information and the feeling of the need to review patients.

6.4.2.3 Medical review of the patient

With the introduction of the intervention there was a greater sense that the junior doctor was obligated to review the patient:

> D3: "Forces [me] to review the patient"

and that they could no longer ignore the calls from the nurses regarding patient deterioration:

> D3: "Could not ignore it [call from nurses]"

The provision of a framework for recognising and responding to patient deterioration that became embedded in a hospital policy appeared to obligate the nurses to complete the observation chart, to generate a MEWS, and to call a doctor who, in turn, felt obliged to review the patient. The generation of an objective score for measuring patient deterioration appeared to provide supporting evidence for the nurse to call the doctor.

6.4.3 Provision of Objective Evidence of Patient Deterioration

Nurses reported that they often felt the need to provide supporting information to highlight the urgency or the importance of the clinical situation to justify their reasons for calling a doctor to review a patient. The instalment of a MEWS provided the nurses with objective, supporting evidence that a patient was deteriorating and warranted further medical intervention. This score could neither be challenged or refuted by the doctor and given the policy underpinning the intervention, which stated that a doctor had to review the patient within 30 minutes following the first telephone call, the call could no longer be ignored by the doctor.

> N5: "I think the new MEWS score has been absolutely wonderful in getting doctors to understand because now there is a concrete score and they have to do something about it and we can ring"

Again the empiric nature of the score facilitated the nurse calling for the doctor:

> N5: "I think it is a really good tool as I have said to it allows the junior nurse to get an empiric score of what is happening and be able to communicate that to the doctor that are then all aware of what needs to be done"

The limited clinical exposure of the junior doctors interviewed in managing patient deterioration might have meant that deteriorating patients were not detected nor managed appropriately. By being given objective evidence for patient deterioration, the MEWS provided the doctor with an appreciation that they were now caring for a sick patient:

> D4: "MEWS was good at night if you could not think or were scared, it helped me realise that I had a sick patient"

For some of the junior doctors the request to review a patient with a high MEWS created confusion, given their limited clinical experience. They were still unable to prioritise acute medical emergencies that did not necessarily trigger a review from a deranged MEWS:

> D2: "Worries me that I have to prioritise between MEWS and chest pain"

There were also some comments that the nurses would not provide any information as to why the MEWS was elevated such that they would be unable to formulate a plan of action prior to arriving to review the patient:

> D3: "Communication worsened because only MEWS was handed over but not with an explanation of what the problem was"

Of note, at the time of interview the junior medical staff did not appear to use the MEWS as a foundation for building a case for more senior doctors to come and help care for their deteriorating patients:

> D1: "Never used MEWS communicating with my consultant or registrar"

These data suggest that nurses and doctors appreciated having some form of objective evidence and as the following section outlines, and therefore, one of the benefits of this evidence was increased confidence in calling the MET.

6.4.4 A Sense of Confidence by the Nurses to Communicate with Doctors

The interaction between medical and nursing staff regarding deteriorating patients has not necessarily been a positive experience as highlighted in the commentary above. The introduction of the intervention provided confidence particularly to nursing staff in their day to day activities in a number of ways.

The education package, COMPASS©, provided background knowledge to the recognition and response to the deteriorating patient but it was difficult to tease out the effect of the education package had on behaviour from the algorithm that they were provided with to call the doctor:

> N3: "Because you have done the course, they have been taught. They have been part of COMPASS© training, that has reinforced it all for them and they feel far more confident and you have given them algorithm and that says you call a MET and they don't feel they have to run out and find somebody to tell somebody"

The MEWS also provided confidence to some of the nurses that they were now "allowed" to call for a medical review

> N1: "It (the MEWS) provided me with more confidence to call the doctors and more responsibility on my part to call one especially a sudden hike up the scale or nothing has happened and I can say 'look they have been running, what are we doing here?'"

The confidence that was perceived by the nurses appeared to override the issues with medical hierarchy, which were reflected as negative interaction experiences when they spoke with their junior and medical colleagues, allowing the nurses to call for help.

6.4.5 Provision of a Structure of Care for Managing Patient Deterioration

As hospitals care for increasingly complex patients, it has become more challenging for them to prioritise the care of their patients. Following the installation of the intervention, the nursing staff used the MEWS to prioritise and structure the care of their patients. This prioritisation, in turn, allowed staff to prioritise their care to deteriorating patients in preference to other patients that were being cared for at the same time:

> N5: "It definitely reorganises your day plan and your time management. I came onto the ward and found a high MEWS score that wasn't handed over or had happened since they went to hand over and it definitely more orientates you to that particular patient so as in charge you have to say 'I'm really sorry but someone is going to have to pick up on my other three patients because I have this picture'"

It also allowed medical staff to prioritise the care of the patients too:

> D2: "Does allow me to see the patient in a more timely fashion"

The provision of a framework for recognising and responding to clinical deterioration influenced behaviour by allowing the nurses and doctors to feel obligated to perform the various tasks required.

This was underpinned by a feeling of confidence by using an objective number for determining the extent of patient deterioration and providing a structure and certainty in the ensuing actions.

6.5 Discussion

In this qualitative study, ward nurses and doctors described changes in behaviour in relation to the introduction of the multifaceted intervention to recognise and respond to patient deterioration. The main behavioural changes that were confirmed by the quantitative data included the nurse completing and documenting a set of patient observations and the doctor coming to see a deteriorating patient. In this study, there was also a perceived increase in the bedside nurse calling the doctor with the installation of the multifaceted intervention but this was not corroborated by the quantitative data in the interventional study. Underpinning these changes in behaviour were four major influences: a sense of being obligated to perform various components of the task of recognising and responding to patients' deterioration, providing objective evidence to the doctor that the patient was deteriorating, and providing the nurse with confidence to call the doctor and the new policy framework in which management of the deteriorating patient operated under.

Few interventions for patient deterioration have included a multi-pronged approach specifically designed to improve the management of a deteriorating patient from a ward perspective. The approach included a dedicated education program for patient deterioration with the introduction of a track and trigger system and a new ward observation chart. However, some other studies have introduced some of these elements to improve care of the deteriorating patient including a single parameter track and trigger system (MERIT Study Investigators, 2005; Chen et al., 2009), a multi parameter track and trigger system (Odell et al., 2007) or a ward observation chart with an embedded multi-parameter track and trigger system (McBride et al., 2005). All these studies have noted an increase in the documentation of vital signs particularly respiratory rate although none appeared to have designed their study to specifically increase the documentation of vital signs. Examination of the reasons for increased completion rates has not been well described and so an important finding from our study was the sense of increased obligation to complete the observation chart. This may have been driven by the introduction of the policy stating the responsibilities of both the nurse and the doctor when a patient is noted to be deteriorating. The introduction of this policy for the recognition and response to patient deterioration could be described as an extrinsic motivational factor with negative consequences (Sherman et al., 1984) for not completing the observation chart.

As previously noted, the interventional study demonstrated a significant improvement in calling for a MET review rather than calling the parent team, although according to the data from this study, the nurses perceived that there been an improvement in calling for the doctor. Reasons for the nurses calling for a MET review could be due to a feeling of confidence in calling for further medical help. This increase in confidence may be due to the removal of uncertainty around whether they should be calling a doctor or not, through the new deteriorating patient policy framework and the provision of objective evidence that their patient was sick, confirmed by the MEWS, which could not be ignored by the doctor. Reasons why there may not have been quantitative evidence of improving the calling of the parent team doctor may be similar to the results of a study which examined why nurses did not call for a MET (Cioffi, 2000) and found that the reasons included being too afraid (Cioffi, 2000). However, this finding was in the absence of supporting evidence such as MEWS. So, it may be that the nurse at the bedside is either reluctant to call for a parent team doctor due to their lack of knowledge (McQuillan et al., 1998) compared with a dedicated medical team specialising in acutely unwell patients (Lee et al., 1995) or that they needed further evidence of patient deterioration to give them greater confidence to call for the parent team doctor.

One finding from the interventional study was the increase in medical reviews occurring once the doctors had been contacted by the nurses on the wards. The doctors in this study confirmed that they felt a change in pressure from the ward staff to review these patients, which may have been due to the desire to comply with policy framework, rather than the desire to ensure the patient was safe.

During the interventional study the attendance at an education program specific to patient deterioration was deemed mandatory in association with the instalment of the track and trigger system and new ward observation chart. However, attendance at the educational program was incomplete (8/12, 75% read the education manual but only 4/12, 25% had attended the face to face teaching sessions) by the healthcare professionals. Those that did attend the education program, in part or in whole, viewed it positively but with some qualifying factors:

> EN1: "Education was useful in that it re-educated me and reminded me of the basics"
>
> N2: "I thought the manual was good. It was very comprehensive and very good because it went through all the different systems that we required"
>
> D2: "I did not mind doing it [education package] and resolved questions but did not help improve my understanding and importance of observations"

Reasons for non-attendance at the sessions were not examined in detail due to time constraints but may have reflected inadequate time to attend the sessions or undertake the pre-learning, poor programming by the COMPASS© organisers with respect to shift work (although a number of night sessions were delivered to night staff) and participant disinterest.

It was not possible to discern clearly whether the education package had influenced behaviour, or not due to the absence of comments relating to the education package. Being taught about the algorithm for contacting the doctor in the event of patient deterioration did appear to influence behaviour and provided an element of confidence for the nurses to call the doctor. Further reference to the education program for patient deterioration was minimal and may be as a result of the method in which the education information was conveyed. The education package was designed to promote functional knowledge but the limited amount of time available to teach interactive face-to-face sessions reduced its capacity to encourage deep learning and development of a functional knowledge. The interactive DVD and the clinically relevant quiz questions were an attempt to overcome these limitations.

The use of low fidelity simulation was aimed to provide an educational immersive, safe environment to allow participants to integrate and apply their prior COMPASS© knowledge to inform their clinical decision making. Low fidelity simulation was chosen as a compromise on both time to develop the scenarios and cost to the institution recognising that high fidelity simulation sessions have been extensively used in the healthcare environment with demonstrated favourable outcomes on patient outcomes (Wayne et al., 2008). However, they are prohibitively expensive (Beaubien et al., 2004). Given the large scale training that was required, low fidelity simulation was selected and has been used in health extensively (Morey et al., 2003) but it did minimise the opportunities for developing behavioural skills. The limitations of the low fidelity simulation and the other limiting modes of delivery of information may have been the reason why education did not appear to influence behaviour.

A somewhat surprising finding from this study was the absence of discussion about the patient and their welfare during the interviews with the healthcare workers. The semi structured interview questions did not specifically ask about patients, which may have influenced the answers. Nevertheless, the fact that no participant considered the patient during their interviews was odd particularly when patients are central to all their work. Although there is no evidence from the data, it perhaps reflects the inability of healthcare professionals' inability to step into the shoes of patients and their relatives to appreciate the impact of failing to recognise and respond to clinical deterioration both upon the patient and their relatives. A mechanism of trying to overcome this deficiency has been the use of patient stories (Lamont et al., 2009) and may minimise errors in health care.

6.5.2 Implications for Managing Deteriorating Patients

This study demonstrates that nurses and doctors do change their behaviour when provided with a tool and a framework for when to communicate and review deteriorating patients, underpinned by a dedicated education program. Future improvements in communication are still required to encourage communication between nurses and doctors but the data do support the concept that providing frameworks for care can change behaviour.

Future studies need to include a wider range of healthcare professionals, including senior doctors, pharmacists and physiotherapists, who are all part of the team to recognise and respond to deteriorating patients. They also need to include questions about how the patient may or may not be benefitting from the new system. This raises the question of whether patient deterioration programs should include patient stories to allow healthcare professionals to hear from patients and relatives who have experienced patient deterioration and understand what it is like to be on the "otherside", which may be more powerful in changing behaviour. This technique is explored when a patient story is used to trigger discussion on patient deterioration in "The Human Element Study".

6.5.3 Limitations

This study was exploratory with a small group of healthcare professionals interviewed from one hospital. The findings of this study were not intended to be representative of all healthcare professionals on all the wards in this hospital, or from the other hospitals. Although the nurses were both junior and senior, only very junior doctors were interviewed. This did not allow for exploration as to whether the behaviour of senior doctors had changed over time following the intervention. This is unfortunate as it is likely that senior doctors are more capable of managing patient deterioration by virtue of their clinical experience and pivotal to ensuring that appropriate care is delivered when they are engaged. Exploration of the influences of "out of hours" behaviour was not undertaken, but this would have provided information on any differences of behaviour between "in hours" and "out of hours" and is certainly a future study to be undertaken.

The interviewer was also conflicted by virtue of the fact that she was the leader of the development team for the introduction of the multifaceted intervention and this may have influenced the interview discussion or interpretation of the data, although this has been minimised by conducting duplicate coding for the more complex themes and using a semi structured interview technique.

6.6 Conclusions

This qualitative study was undertaken to understand why the changes in behaviour occurred. It was important to examine critically the process of recognising and responding to patient deterioration following the installation of the multifaceted intervention. The major changes in behaviour reported were the improved completion of observation charts by the nurses and the improved review of patients following deterioration by doctors. The major influences included a sense of being obligated to undertake appropriate actions for managing deteriorating patients and feeling confident to perform these actions. From the data it was possible to suggest that within the multifaceted intervention, an objective measure for patient deterioration provided participants with a sense of confidence, and at the same time provided a sense of obligation. Further study would allow elaboration of these dual outcomes that is, confidence and at the same time obligation. Of note, future work would include trying to tease out the influence of education including the relevant policies and the sense of obligation

Future interventions for the management of deteriorating patients need to consider the conceptual framework identified but probably also need to address the question as to why nurses were still not calling the doctor in the advent of patient deterioration. This is explored further in "The Human Element Study".

An increasingly important component of research today is whether changes in behaviour such as seen in "The Interventional Study" and confirmed in this behavioural study can be translated into every day clinical practice (National Health and Medical Research Council., 2010). This is examined in "The Sustainability Study" in the next chapter.

CHAPTER 7: ARE CHANGES TO BEHAVIOUR AND PATIENT OUTCOMES SUSTAINABLE IN EVERYDAY CLINICAL PRACTICE?

7.1 Introduction

The use of track and trigger systems to help manage deteriorating patients has been demonstrated to improve patient outcome in single centres (Buist et al., 2002; Bellomo et al., 2003; Bellomo et al., 2004; Priestley et al., 2004). Although longitudinal studies of track and trigger systems have demonstrated on going improvement in patient outcome (Buist et al., 2007; Santamaria et al., 2010), none has examined whether the specific behavioural steps required to manage patient deterioration are maintained over time.

Following the implementation of the multifaceted intervention program for patient deterioration to the remaining wards in the two ACT public hospitals, it was hypothesised that with on going clinical leadership, governance and auditing of the utilisation of the system, the increase in frequency of the documentation of vital signs and frequency of a medical review of a deteriorating patient would be sustained and these would lead to a reduction in the number of unplanned admissions to ICU and hospital deaths.

This hypothesis was tested by conducting a retrospective, observational study in all consecutive adult patients admitted to two medical and surgical wards in the Canberra Hospital. The study was performed during three four-month periods; one prior to the intervention ([820 patients) and two following the intervention (immediate [750 patients] and two years later [819 patients]).

7.2 Aim

To determine if the positive effect of the multifaceted intervention for managing patient deterioration on behaviour and patient outcome was maintained two years after it had been introduced as part of everyday care on two hospital wards.

7.3 Methods

7.3.1 The Setting

The two wards at the Canberra Hospital used for the original interventional study were used for this sustainability study.

7.3.2 Pre and Post Intervention Systems for Managing Deteriorating Patients

The pre and post intervention systems for recognising and responding to patient deterioration have been described in detail previously, in Chapter 5. However, post introduction of the multifaceted intervention to the two wards, a governance structure, as suggested now by the Australian Commission for Quality and Safety in Health Care (Australian Commission for Quality and Safety in Healthcare, 2010), was implemented to ensure clinical leadership, up to date policy development, dissemination of relevant information, and comprehensive, timely data collection to determine if patient deterioration processes were still being followed. The Rapid Response Committee oversaw all these activities including providing monthly reports on patient deterioration trend data to the peak clinical governance committee in the hospital. These reports are able to identify any areas of concern that required a response by the rapid response unit, the ward or the peak clinical governance committee. Responses are then monitored to ensure appropriate action has been taken.

7.3.3 Study Design

The study design was a retrospective, observational study in all consecutive adult patients aged 18 years and over, admitted to one combined medical and surgical study ward and one surgical study ward at The Canberra Hospital during three four-month periods, one before the intervention and two following the intervention.

7.3.4 Study Principle

The principle underlying the multifaceted intervention was that physiological instability identifies patients who are at risk of adverse events. The addition of a framework for nurses and doctors to help them identify, assess and treat deteriorating patients should prevent further deterioration and reduce adverse events.

7.3.5 Study Periods

The duration of the control period was four months during which outcome measures were studied during pre-intervention normal ward conditions. This was followed by an eight month preparation and education period during which a new ward observation chart, new hospital policy for vital sign measurement and a new education program (COMPASS©) were developed. The duration of the two post-intervention study periods was four months, one immediately post the introduction of the intervention and one two years after the introduction of the intervention.

7.3.6 Subjects

Analysis included all adult patients who had been admitted to the two study wards during the three study periods. Patients excluded from the study were those readmitted to the two wards during the study periods to minimise contamination between the periods and to allow accurate calculation of unexpected deaths. 14-25% of patients from each study cohort were randomly selected by a computer program as a subgroup for an in depth analysis of vital sign measurements and associated communications.

7.3.7 Data Collection

Data collected on admission to the ward included demographic data, admission diagnosis and whether they were medical or surgical patients. All study patients were followed up until to hospital discharge or death. During follow up, details of length of hospital stay, unplanned admissions to intensive care and MET referrals were collected. In the randomly selected sub group of patients, data collection included all the vital sign measurements documented, MEWS recorded during the intervention period and any communication documented between nursing and medical staff following clinical instability, defined as a MEWS of four or more and subsequent medical review (Attachment D).

7.3.8 Outcome Measures

The primary outcome measure was the incidence of unplanned admissions to ICU. The secondary outcome measure for the whole cohort was the incidence of expected and unexpected deaths. In the predetermined subgroup of patients, the secondary outcome measures were the daily documented frequency of vital sign measurements, the incidence of documented communication and incidence of documented medical review.

7.4 Results

7.4.1 Patient Demographics

During the pre-intervention period, 820 patients were studied compared with 750 patients immediately post-intervention and 819 patients two years following the introduction of the intervention (97, 44 and 57 readmissions were excluded, respectively). The mean age of patients two years following the introduction of the intervention was significantly higher than for patients in the pre-intervention and immediately post-intervention periods (60.1 years [SD 19.0], 57.9 years [SD 19.6] and 57.3 [SD 19.6] respectively p=0.006) but other patient demographics were similar, (Table 14).

Table 14: Baseline Demographics of 2389 Study Patients before and after a Multi-Faceted Intervention for Managing Patient Deterioration

	Pre-Intervention	Immediate Post-Intervention	2 Years Later	p value^
Number of Patients	820	750	819	
Male (%)	479 (58.4)	440 (58.9)	485 (59.2)**	
Mean Age, Years (±SD)	57.9 (19.6)	57.3 (19.6)	60.1 (19.0)	0.006
Type of Admission				
Medical (%)	189 (23.0)	205 (27.3)	222 (27.10)	
Surgical (%)	631 (77)	545 (72.7)	597(72.9)	
Medical Admissions				
Total (%)	189 (23.1)	205 (27.4)	222 (27.1)	
Gastro-Intestinal	88 (10.7)	89 (11.9)	79 (9.6)	
Cardiovascular	7(0.01)	0	16 (2.0)	
Hepatobiliary	35(4.3)	76 (10.2)	60 (7.3)	
Renal	3 (0)	6 (0.8)	12 (1.5)	
Male Reproductive	1 (0.5)	0	1 (0)	
Surgical Admissions				
Total (%)	631 (77.0)	545 (73)	597 (72.9)	
Gastro-Intestinal	170 (20.7)	139 (18.6)	149 (18.2)	
Cardiovascular	60 (7.3)	46(6.2)	93 (11.4)	
Hepatobiliary	33 (4.0)	40 (5.4)	48 (5.9)	
Renal	112 (13.7)	67 (9.0)	90 (11.0)	
Male Reproductive	34 (4.2)	37 (5.0)	48 (5.9)	

^ Differences between the three groups

**p<0.001

7.4.2 Patient Related Outcomes

Although there was a significant reduction in the number of patients requiring unplanned ICU admissions from the pre-intervention to the immediate post-intervention period (14/820 [1.7%] vs.

3/747 [0.4%], p=0.024, relative risk ratio 0.23 [0.05–0.86]), there was no difference in unplanned ICU admissions between pre-intervention and two years following the intervention roll out (14/820 [1.7%] vs. 15/819 [1.8%], p=0.997, relative risk ratio 1.04 [0.71–1.52]). Similarly, although there was a significant reduction in the number of deaths from the pre-intervention and the immediate post-intervention period (23/820 [2.8%] vs. 8/747 [1.1%], odds ratio 0.37 [0.15–0.88], p=0.022), there was no significant difference in the number of deaths between the pre-intervention period and two years following the intervention roll out (23/820 [2.8%] vs. 28/819 [3.4%], odds ratio 1.23 [0.86–2.23], p = 0.566,) and there was no difference even when adjusted for age (odds ratio 1.16 [0.662, 2.041] p=0.6). This finding was mirrored in the number of unexpected hospital deaths (pre-intervention: 9/820 [1.1%], two years following the hospital-wide roll out of the intervention: 8/819 [1.0], odds ratio 1.04 [0.50-2.17]). There was no change in the number of MET referrals between all three years. The median length of stay in the immediate post-intervention period was significantly higher (5.7 days [2.9, 10.9] than that seen in the pre-intervention period (4.7 [2.3, 9.4], p<0.008 (Table 15).

Table 15: Patient Outcomes of 2389 Study Patients before and after a Multi-Faceted Intervention for Managing Patient Deterioration

	Pre-Intervention	Immediate Post-Intervention	2 Years Later	^p value
Number of Patients	820	750	819	
Unplanned ICU Admissions	14 (1.7)	3 (0.4)	15 (1.8)	0.025
Unexpected Hospital Deaths	9 (1.1)	1 (0.1)	8 (1.0)	0.058
Hospital Deaths	23 (2.8)	8 (1.1)	28 (3.4)	0.008
Hospital Length of Stay (days)*	4.7 (2.3-9.4)	5.7 (2.9-10.9)	4.6 (1.9-8.8)	<0.001
Patients with MET referrals	22 (2.7%)	34 (4.6%)	30 (3.7%)	0.144

* Median (Interquartile Range)

^ Differences between the three groups

7.4.3 Vital Sign Measurements

The average daily frequency of documentation of all the vital signs (blood pressure, heart rate, respiratory rate, oxygen saturation and temperature) measurements increased significantly between the pre-intervention and the immediate post-intervention periods (4.6 [SE 0.28] vs. 5.3 [SE 0.24], p = 0.04, rate ratio 1.12 [1.02, 1.23],) and although appeared to be an increased in the daily frequency of documentation of vital signs two years following the intervention roll out (5.0 [SE 0.20]) it was not significantly different to the pre-intervention period (4.6 [SE 0.28]), rate ratio 1.03 [0.92, 1.14]). This was in contrast to respiratory rate documentation where there was a significant increase in the average daily frequency of documentation between the pre-intervention and the immediate post-intervention period (3.5 [0.31] vs. 5.7 [0.3] odds ratio 1.5 [1.33, 1.69], p<0.001), and the significant increase was maintained between the pre-intervention period and two years following the intervention roll out (3.5 [SE 0.31] vs. 5.0 [SE 0.21], odds ratio 1.3 [1.14, 1.50], p<0.001), Table 16 albeit the numbers of patients were smaller in the period two years following the intervention roll out.

Table 16: Mean Daily Frequency of Documentation Vital Signs Measurements in the Subgroup of Study Patients

	Pre-Intervention	Immediate Post Intervention	2 Years Later	p value
	237	188	114	
Blood Pressure	5.1 (0.30)	5.3 (0.22)	5.0 (0.21)	0.47
Heart Rate	4.9 (0.29)	5.1 (0.23)	4.9 (0.21)	0.46
Respiratory Rate	3.5 (0.31)	5.7 (0.30)	5.0(0.21)	<0.001
SaO_2	4.6 (0.28)	5.5 (0.26)	4.9 (0.20)	0.02
Temperature	4.7 (0.27)	5.0 (0.22)	4.9 (0.20)	0.36
Overall	4.6 (0.28)	5.3 (0.24)	5.0 (0.20)	0.04

7.4.4 Communication and Medical Review following Clinical Instability

There was a significant increase in the total number of instances when a junior medical officer reviewed a patient with clinical instability (MEWS 4 or more) over the sequential three study periods (49/122 [40.1%], 42/63 [66.67%] and 52/61 [85.2%], p<0.0001). However, there was a significant decrease in the total number of calls from the bed side nurse to the medical officer when a patient was clinically unstable (MEWS 4 or more) over the three study periods (122/238 [51.3%], 63/147 [42.9%] and 61/207 [29.5%], p<0.0001). The percentage of nursing calls made to doctors regarding a MEWS of four or more made per patient was maintained from pre-intervention to two years following its intervention ([122/237 [51.5%], 63/188 [33.5%], 61/114 [53.5%[).

Thus, although the nurses were not calling the doctors as often as they should have been, according to the hospital policy, there was an overall increase in the number of times the doctors were being called per patient. Behaviour by the nurses, defined as the percentage of nursing calls made to doctors per patient regarding patient deterioration was maintained at pre-intervention levels but it was inappropriate for the patient's clinical condition. Tthe data did not capture whether the doctor was already at the bedside when a further observation set was recorded, showing a high MEWS.

7.5 Discussion

This study investigated whether changes seen in a research setting with the installation of a multifaceted intervention for patient deterioration are sustained when put into every day clinical practice. Two years after the introduction of the intervention, there was no on going benefit to patient outcome but there was a sustained increase in the instances of medical review (patient parent team) found following the introduction of the multifaceted intervention as well as an increase in documentation of respiratory rate. These continued improvements in behaviour that are relevant to the improved care of the deteriorating patient, might have had a positive impact on patient outcome, if the study population had been larger.

7.5.1 Patient Related Outcomes

As in some other deteriorating patient studies (Bristow et al., 2000; MERIT Study Investigators, 2005), in this study it was not possible to demonstrate any on going positive effect of a patient deterioration system on patient outcome. The reasons for this are complex and multi-factorial but include the possibility that the results were merely regressing back to the mean of the pre intervention conditions, which complicates the interpretation of before and after intervention trials (Moran et al., 2005). Another possibility is that in this study, similar to others (MERIT Study Investigators, 2005), it was underpowered to detect changes in adverse event rates, given that the incidence of adverse events, such as unexpected deaths were very low. Detecting small changes will require a larger patient sample or a study that extends over a much greater length of time. Such studies have tended to detect changes at least in single institutions (Buist et al., 2007; Santamaria et al., 2010).

The lack of an effect on hospital mortality of the intervention seen in the period two years following the hospital-wide roll out of the intervention, even when adjusted for age, could be explained by the cohort of patients two years following the intervention roll out having significant comorbidities, which increases their risk of clinical deterioration. Data were not collected to determine whether or not these patients were objectively sicker than the other two cohorts. However in the sub groups the mean incidence of MEWS of four or more was greater in the cohort of patients two years following the intervention roll out (1.0: Pre-Intervention, 0.78: Immediate Post Intervention and 1.8: Two Years Following), which may infer that the cohort of patients two years following the roll out of the intervention were more at risk of clinical deterioration than those in immediately post intervention and therefore more likely to have a worse outcome.

An additional reason for the lack of effect of the patient deterioration multifaceted intervention on hospital outcome was the relative recency of the introduction of the intervention. Patient deterioration systems such as the MET system have often taken years to demonstrate changes both in behaviour and patient outcome (DeVita et al., 2004; Jones et al., 2007; Santamaria et al., 2010). Since the introduction of the multifaceted intervention into the tertiary hospital studied, the MET call out rate has gone from 400 per year (2005) to 1800 per year (2012) and there is a trend for a reduction in the hospital's standardised mortality ratio.

Although patients in this study had access to two track and trigger systems to trigger a medical review, both the MEWS and MET trigger points are relatively insensitive in detecting all deteriorating patients (Smith et al., 2008; Smith et al., 2008) and so despite the two systems appropriate timely care to improve patient outcome was not necessarily engaged. More recently, track and trigger systems have been developed and subsequently validated in large patient populations with have a much greater sensitivity for detecting those at risk of hospital death, which may provide patients with more timely and appropriate treatment (Prytherch et al., 2010; Bleyer et al., 2011).

7.5.2 Documentation of Vital Signs

This study is one of the first to demonstrate a sustained positive effect on the behaviour of nurses documenting respiratory rate on observation charts outside of a research study. Reasons for the continued improvement in documentation of respiratory rate have already been explored in "The Behavioural Study", (Chapter 6) including the sense of feeling obligated to fill in the ward observation chart by the need to complete a total MEWS, which requires all vital signs to be measured and documented. This has also been found by other researchers (McBride et al., 2005). There was also the feeling of accountability and that there would be negative consequences if the nurses did not complete the chart. Other influences are possible and include an on going monthly audit of documentation of respiratory rate providing a feedback loop for the two wards, an essential component of any patient safety initiative (Agency for Healthcare Research and Quality, 2001). Other possible reasons for the increased documentation of respiratory rate is the Hawthorne effect but this is less likely given that two years following the intervention, this study was performed under normal operating conditions.

7.5.3 Communication and Medical Review

The success of any track and trigger system for managing patient deterioration is dependent on whether there is timely and effective medical care, which necessitates the doctors being aware, through effective communication, of a deteriorating patient. Although there was a trend to increasing the referrals to the MET compared with the first cohort period, it was not significant. More worryingly is in the sub groups of patients studied for communication, there was a significant decrease in the percentage of instances of when the nurse should have called the doctor in relation to a significant MEWS over the three years examined. This may have contributed to the lack of effect of the track and trigger system on patient outcome in this study. Reasons for the reduction in documented communication from the nurse to the doctor include that nurses may have experienced a negative interaction with a doctor previously, which was expressed in "The Behavioural Study", which made them reluctant to call for help in a similar scenario. This has been seen by other researchers (Cioffi, 2000). Also, the doctor may have been at the bedside when subsequent high MEWS were recorded so that there was no need to call them to the bedside again. An additional reason why the nurses may have not called for the doctor in the face of patient deterioration is lack of education and training regarding patient deterioration. Although, this is less likely given that the COMPASS program with yearly refreshers had become mandatory for all hospital employees during "The Sustainability Study".

As in both "The Observational Study" and "The Interventional Study", the nurses may not have documented all conversations with doctors to the same degree that they had done previously, thereby under estimating communication with doctors. Reassuringly, when the parent team doctor was called, there was a sustained improvement in the doctor reviewing the patient, which concurs with what the doctors said in "The Behavioural Study".

This study measured many of the patient deterioration clinical processes pre and post the installation of a multifaceted intervention and is unique in allowing the detailed examination of the activation of a medical review for patient deterioration. Whilst there was no improvement in patient outcome, there was a sustained improvement in some of the clinical processes necessary for managing patient deterioration, which if undertaken in a larger patient cohort study may be of benefit to patients.

This study also poses an important question as to why, despite two recognition and response systems for patient deterioration, behaviour was still suboptimal, which may have a negative impact on patient outcome. In the next study, there is exploration as to why some of the clinical processes for managing patient deterioration are still not followed despite the installation of a multifaceted intervention for patient deterioration.

7.6 Conclusion

The multifaceted intervention for improving the management of patient deterioration in every day clinical practice did achieve a sustained effect on two important behaviours including increased documentation of respiratory rate, a marker of patient deterioration, and an increased frequency of medical review following patient deterioration. These behaviours are important for managing patient deterioration as deteriorating patients can be identified through changes in respiratory rate. The medical review is a significant part of the clinical process that can make a difference to patient management. However, there were some previous improvements in the management of the deteriorating patient that were not sustained and the influences on such behaviour are examined in "The Human Element Study".

CHAPTER 8: THE HUMAN ELEMENT OF MANAGING PATIENT DETERIORATION

8.1 Introduction

Despite two deteriorating patient systems (MEWS and MET), as outlined earlier, to improve both timeliness of recognition and response to patient deterioration, there continued to be deficiencies in the care of patient deterioration. These have been highlighted previously in this thesis but included nursing staff not always communicating patient deterioration to both the parent team doctors and the MET and also junior doctors not communicating with their senior decision maker, leading to delays in appropriate treatment. The immediate question is "why is this so?" The behavioural study, reported in Chapter 6, was informative of some of the influences on the behaviour of both nurses and doctors but its primary aim was to establish why behaviour had changed with the new multifaceted intervention for patient deterioration. However, through the work done during this project, it became increasingly apparent that the management of the deteriorating patient is more complex than originally thought. The previous chapter identified a patient deterioration system can help change some behaviours to affect patient outcome but there were still some important behaviours including the reporting of clinical deterioration that were not impacted upon by the introduction of a multifaceted intervention for patient deterioration.

8.2 Aim

To understand the behaviour of healthcare professionals in managing patient deterioration to inform any future projects on patient deterioration to increase their likelihood of improving patient outcome.

This would be determined by exploring the practices of acute hospital healthcare workers with respect to, recognising and responding to, patient deterioration.

8.3 Method

8.3.1 The Hospital

Since 2008 The Canberra Hospital has had both a multi and single parameter track and trigger system for managing patient deterioration. Governance has been provided to these systems to ensure that there was clinical leadership and feedback loops to all wards for suggestions aimed at improving the ability of staff to comply with the systems.

Due to the lack of literature in this area, a theory which explained the behaviours in managing patient deterioration could not be identified and so developing a theory, through grounded theory methodology of data analysis (Strauss et al., 1998), was required. The exploratory study reported below used focus groups to investigate the experiences of nurses, senior and junior doctors involved in the management of patient deterioration by asking them about their perceptions, opinions, beliefs, and attitudes towards managing patient deterioration.

8.3.2 Data Sources

Three focus groups, initially, were convened to investigate the experiences of nurses, senior, and junior doctors involved in managing patient deterioration. The choice of the focus group participants attempted to be purposeful (Strauss et al., 1998) so that there was representation from each clinical craft group. Theparticipants had had a range of clinical experience to enable each person to contribute their experiences in enough depth to help elucidate a theory. Registered nurses, senior and junior doctors known to the author and the interventional study project officer were approached and asked if they would consider taking part in the study. Theywere provided with study information sheets (Appendix J) formallyinviting them to participate in this study. Informed consent (Appendix K) was obtained from three senior doctors, six junior doctors and six nurses who volunteered to join the study. In the nursing group all were female with a median clinical experience of 3.5 years (IQR 3-7). The junior doctors' group had a higher proportion of male participants with a median clinical experience of 3 years (2-6) and with the senior doctors group, two thirds were female with a median clinical experience of 18 years (18,-23.5), Table 17. The senior doctors although with varied backgrounds had all participated extensively in the management of clinical adverse events in the hospital, including patient deterioration.

Once the three focus groups had been held a fourth focus group was established, including representatives of the first three focus groups. Within the representative group there was one senior doctor, two nurses and two junior medical officers.

Table 17: Focus Groups Demographics of 16 Healthcare Professionals Exploring the Behaviours in Managing Patient Deterioration

	Gender	Years Post Graduation	Ward/Speciality
Nurses			
	Female*	3	Haematology
	Female	3	Orthopaedics
	Female	8	Infectious Diseases
	Female	4	Renal
	Female*	18	General Surgical
	Female	1	Vascular
Junior Doctors			
	Male	9	Orthopaedic Trainee
	Male	10	Physician's Advanced Trainee
	Male*	1	Intern
	Female	3	Basic Physician's Trainee
	Male*	3	Basic Physician's Trainee
	Female	3	Basic Physician's Trainee
	Female	1	Intern
Senior Doctors			
	Female*	18	Neonatology
	Female	18	Immunology
	Male	29	Gastroenterology

* Denotes participation in fourth representative focus group

8.3.3 Collection of Data and Analysis

Between December 2009 and April 2010 the four focus groups (nurses, junior doctors, senior doctors and a representative group of the previous three groups) were held with an external facilitator to explore and understand what affects healthcare professionals to manage deteriorating patients appropriately. As a spring board for the focus groups' discussion was a mother's description of her 16 year old daughter clinical deterioration without an appropriate response from the healthcare professionals at the hospital, the hospital in which all the healthcare professionals in the focus groups worked. The case had been de-identified for use in this study (Appendix L). Verbal consent from the mother and patient had been obtained following consultation and in the hope that the patient's experience might help avoid similar experiences. The case description was provided to participants 14 days before the focus group meetings.

Discussion was unstructured, free flowing with occasional attempts made both by the external facilitator, and the researcher to try and understand why the 16 year old in the case study was allowed to deteriorate to the extent she did, which resulted in an unplanned admission to the intensive care unit. The focus groups were allowed to continue their discussions until no new information forthcoming. A fourth representative group was provided with a document that provided extracts from the three transcripts (transcribed verbatim) that were representative of the three transcripts combined together from the three craft groups (nursing, junior and senior doctors). The external facilitator assisted the researcher to work with the representative group using the compiled document as a trigger for further in-depth discussion and interpretation to find patterns in the data to reveal further why healthcare professionals seemingly struggle with managing patient deterioration despite patient deterioration systems in place.

Interviews were transcribed verbatim for all four focus groups and analysed for emergent themes using the grounded theory method whereby progressive coding phases (open and axial) occurred. Datasets were recursively read to develop a preliminary coding structure (Strauss et al., 1998). In discussion with my supervisor the coding structure was refined and confirmed. The final coding structure was applied to the datasets, using NVivo software (QSR International, Cambridge, MA) to facilitate cross-referencing. Participants were coded into their craft group to maintain their anonymity. A model of the influences on healthcare professionals in managing patient deterioration was generated.

8.4 Results

From the focus groups, the overriding influence on healthcare professionals' management of patient deterioration appeared to be the ability to make the right decision and at the right time; these influences operated both directly and indirectly at the time of decision making. The major influential categories included the characteristic of the:

i. patient

ii. junior doctor or nurse caring for the patient

iii. patient's consultant

iv. healthcare institution rostering

Within each of these key influences there were subcategories of influence, which are explained below:

8.4.1 Characteristics of the Patient

The patient's presenting condition influenced the timing of decision making, even for the inexperienced healthcare worker, and this is expanded upon in the following pages.

8.4.1.1 Acute Nature of Deterioration

A healthcare professional's ability to make a decision about an acutely deteriorating patient is not always supported by their clinical ability or previous clinical experience. It is sometimes driven by being confronted by an acutely deteriorating patient and the inexperienced doctor having the feeling of needing "to do something" for fear that the consequences of not doing something would be even worse:

> Junior Doctor (JD): "Yes if they are an acutely unwell patient, you think: 'Okay I need to do something'"

If there was no one available who had the appropriate clinical experience to ask for help them in making a decision, such as out of hours, the doctors were more likely to do things that they may not have done during daylight hours:

> Senior Doctor (SD): "[As a junior doctor] I've had to handle patients on my own without other support I had to be able to put central lines into anyone, I could do arterial punctures, I could do things in the middle of the night if I had to"

From the data, it also appeared that some remote healthcare institutions provided experiences for doctors, which forced them into making decisions by being the only medical officer on duty:

> JD: "In Scotland where I worked, as well as the teaching hospital in rural Scotland, you are it, you're the only MO overnight and you treat everything"

However, other institutions, for whatever reason, did not encourage decision making and this was reflected in the focus groups' hospital:

> SD: "You have to work in hospitals where you actually have control that you're put in the situation where you have to make decisions about whether a patient is sick or not and what you do with them and if you've got a registrar that has been trained from internship right through [the] Canberra Hospital they don't work in those sorts of units"

However despite the acute nature of deterioration of the patient out of hours, from the data there continued to be a sense of reluctance, predominantly by the junior doctors, to intervene in a patient's management plan as devised by the parent team, unless there was a crisis, such as a cardiac arrest.

> JD: "Overnight you really have to be extremely worried overnight to change course"

This sense of the junior doctor's reluctance to "do something" did not appear to be helped even by being presented with objective evidence that the patient had significantly deteriorated, such as fulfilling the physiological criteria to call for a MET review:

> N: "We've had interns that have felt way out of their depth when they could not get hold of their registrar and okay they will agree to call a MET but there's a reluctance obviously, a perceived reluctance, of the interns to call a MET and that's seen as a secondary choice"

The junior doctors had to confirm or seek approval from their consultant before calling for a MET review:

> N: "If you can't get hold of them that will be the way to call a MET but rather than calling a MET it's 'hang on I'd better ask my boss first'"

So even when there was a crisis the junior doctor still did not feel able to change a patient's management and so by default left decisions to others thereby delaying the patient from receiving appropriate treatment:

> SD: "They [junior doctors] are just leaving it to someone else to make that decision whether that be another junior doctor or another senior consultant"

So when a patient was clearly in need of intervention, some of the healthcare professionals in the study reported that they did not feel confident to make decisions that would be in the patient's best interests. The reason for junior doctors needing to seek confirmation before they could call for help, such as the MET, is explored in the following section.

8.4.2 Junior Doctor or Nurse Attributes

There were two attributes of the junior doctors and nurses that influenced behaviour.

8.4.2.1 Clinical Experience

From the data it became apparent that healthcare workers (doctors and nurses) reported that they were neither comfortable managing nor recognising acute patient deterioration through their perceived or actual lack of clinical experience and adequate training, which was seen as an important component of recognising deteriorating patients:

> SD: "I think it's something [skill to recognise sick patients] you get with time"

In the case of a senior doctor it was the lack of recently caring for acutely deteriorating patients that made her feel uncomfortable, which in turn would reduce her ability to advise her junior medical staff appropriately:

> SD: "People don't feel comfortable managing sick patients and I don't really know if they know how to recognise a sick patient anymore"

The lack of clinical experience of managing patient deterioration also meant that nurses felt uncertain as to whether they should be seeking further help such as a MET review, despite the objective physiological criteria being reached by the patient triggering decision rules on what to do next, which was supported by a hospital policy:

> N: "Yes [my inexperience doubted my decision making], the initial MET that I called I thought 'Oh I was an EN for about 10 years before I became an RN but I was still inexperienced in that scenario and yes it was my inexperience and I thought am I right am I wrong, should or shouldn't I?' and eventually I said 'okay that's it I'm calling it'"

In addition, health care workers' difficulties in managing patient deterioration was thought to be due to a lack of exposure to patients brought about by the reduction in weekly working hours from the "safe working hours" (Australian Medical Association, 2003) initiative, intended to improve patient safety:

> SD: "These days there are a lot of doctors ....so their experience is much less than it ever used to be. So instead of working 120 hours a week now it's 40. So you can see the experience is extremely small"

Healthcare institutions' fiscal drive to reduce the working hours in the week and its impact on exposure to clinical experiences is discussed further on in this chapter. However, from the data, the senior doctors felt that the junior doctors did not get adequately exposed to patient deterioration to be in a position to care for these patients:

> SD: "Certainly our registrars don't get trained to recognise sick patients they are not ever put in situations where for any length of time where they actually manage sick patients"

The lack of consistent clinical exposure, driven by the frequent rotation of junior medical staff between specialities, which although allowed them to have a breadth of specialist experience did not provide a depth of clinical experience to facilitate decision making:

> JD: "And especially in medicine you change over probably every week, the registrar is changes... a renal registrar today and tomorrow you are a haematology registrar"

An unintended consequence of the frequent rotations of junior medical officers to different wards and specialties was the reduction in the time to build team-work amongst the doctors and nurses on particular wards. The relationship between the nurses and doctors was felt to be important as it appeared to facilitate the care of the patient by understanding their respective limitations and also allowed for exchange of knowledge between doctors and nurses providing opportunities to improve patient care:

> JD: "But you think they [the experienced nurses] probably know how this ward works and the sort of patients that are on this ward and let's see what they have to say"

A common and recurring theme was that it appeared that junior doctors, through their uncertainty from clinical inexperience, delayed their decision making in the hope that the patient would improve:

> JD: "It may even be a situation where people just think: 'She'll be right just give her some time and everything will be fine' and I think there's a degree of that too"

However, this delay, as suggested before, would leave the decision making to others including the nurses and whilst in some cases the nurses hesitated in calling for a MET review, in most cases, the nurses did not have as much difficulty as the doctors in calling for a MET review once the patient fulfilled the appropriate criterion. Reasons for this include nurses taking more note of hospital policies, being supported by further objective evidence that the patient was deteriorating such as the MEWS and realising that the patient needed more help than the doctors were delivering to the patient:

> N: "When doctors sit back and say: 'Well let's just sit on it', is there an element of the nurses might know and hopefully they will call a MET anyway?"

In addition the nurse did not feel personally affronted that "their" management had failed although the junior doctors appreciated that calling for a MET review was likely to benefit the patient:

> JD: "I've often thought that sometimes although it's kind of like embarrassing getting the MET"

At times, there was inadvertent delay for help when previous carers of the patient had not acted upon deranged vital signs. So instead of the doctors and nurses seeing the abnormal physiological parameters as triggers for help, they assumed that if others before them had not acted upon them then there was no need for them to call for help. Calling for help only occurred when someone felt able to question the abnormality:

> N: "You readjust your own headsets to accept abnormality as normal. The longer deterioration goes on for the more acceptable [for] the patient [it] would seem"

Whatever the reason for the doctor's delay in decision making, it created a sense of frustration in the nursing staff who then felt powerless to manage the increasingly deteriorating patient.

> N: "There is the sense of frustration that as you were experiencing you could not get a decision out of your junior doctors"

An important and repeated feature of what resulted from gaining clinical experience was the development of a "gut feeling" that the patient was sick, which appeared to facilitate decision

> SD: "Recognition of a deteriorating patient, apart from this numbers thing, is a gut feeling, just this gut feeling thinking about Mrs Smith I'd better go in and make sure everything is okay"

This sixth sense did not seem to appear to come from being taught about managing the deteriorating patient

> SD: "It's just this gut feeling, I don't know how you teach that to somebody who only works eight hours a day, I don't think that person can be taught this"

Although unaware of these data at the time, "The Interventional Study" described the installation of a system to recognise and respond to patient deterioration which relied on objective patient data and not the healthcare workers' "gut feelings", so that even the less experienced healthcare worker should have been able to recognise and respond to patient deterioration:

> N: "So again we give the system a tool such as a modified early warning tool that is you add up your observations and the greater the number the greater the derangement you've got of the patient. It's just another way of confirming that you've got a problem"

However, the potential negative impact of such a patient deterioration system is that healthcare workers would rarely develop their thinking processes and skills around actual patient deterioration but rely solely on the patient deterioration system to recognise patient deterioration:

> SD: "The system was put in place because people don't have the experience and then because the system is there people don't develop the experience"

But utilising the "gut instinct" and an objective scoring system for recognising and responding to patient deterioration should not be seen as mutually exclusive.

In summary, respondents suggested that adequate clinical experience was needed to make appropriate decisions for managing a deteriorating patient, often with the development of a gut feeling or intuition (Hodgkinson et al., 2008) that the patient was unwell and in need of further intervention. However, doctors, in particular, with inadequate clinical experience and therefore less able to manage patient deterioration did not seek help from their supervisor or the MET. This failure to call for help was either because they were not aware that they needed to seek help or that they did not want to appear deficient to their supervisor. An important component of seeking help from a supervisor is the need for adequate skills to collate and interrogate the information to allow the junior doctor to communicate comprehensively and meaningfully to their supervisor about patient deterioration.

8.4.2.2 Communication Skills

Historically, communication skills taught at medical schools (Simpson et al., 1991; Makoul, 2001) have predominantly focussed on the doctor-patient relationship so that the doctor can gain as much information to gain an understanding of the patient's history. Until recently, little focus has been placed upon the doctor to doctor communication in medical schools (Solet et al., 2005) despite communication between healthcare workers being a significant source of clinical errors in hospitals (Wilson et al., 1995).

The junior doctors in the focus groups appreciated that the decision making made by the senior doctor over the telephone would be influenced by the content of their conversation to them:

> JD: "If you were the registrar on call for the night or the weekend the consultant's decision over the phone is probably to a certain extent more…probably the vast majority of it is based on your presentation of your recap of the story"

The senior doctor's response was not only dependent on the content of the conversation but also the way, in which conversations were commenced, phrased and the information presented:

> JD: "I think generally they are quite concerned. It might depend on the words you use but I tend to start off always and start with what I write in the chart. I'm concerned about this patient just to get their attention up front"

If the junior doctors were direct in their request for advice from their consultant, the consultant usually responded to their requests for help:

> JD: "Some of them might have a bit of a different idea but most of them they do come [when called] and if you make them and say: 'This [patient] is sick and you need to come', they have to come and most of them do"

An added complexity to communication between the junior and senior doctors in managing patient deterioration was the perception by the focus group senior doctors that the junior doctors did not want to admit that their patient was sick to their senior doctors. One interpretation of this perceived reluctance was that the junior doctor feared that they would be seen as having failed to manage the patient:

> SD: "[Discussions should] not [be] registrar to registrar [but] consultant to consultant because registrars you often find their messages get turned around and downgraded because they [the junior doctor] see it as a failure"

A further challenge for the junior doctors was that, depending upon the situation they were in (face to face ward round, presenting cases for examination purposes, over the telephone), would dictate the format of the information to be delivered. It was not apparent that the different formats of information were ever explicitly articulated prior to the commencement of each job:

> JD: "In ED [I] tried to work the patient up as we do in other parts of the world and then I was almost criticised in the handover or by the consultant: 'No, no, no, no cut to the chase, is the patient coming in or not, medical, surgical?'"

There were also some areas in the hospital that actively discouraged junior doctors from providing significant amounts of information about patients at times of handover:

> JD: "I think unless it's very urgent it [handovers] wasn't a priority for me because the priorities were these people waiting"

This inadequacy of information passed from one shift to another shift was not an isolated issue and seemed to lead to confusion of the information, the so-called "lost in translation" (Solet et al., 2005), when accurate information was necessary for making appropriate decisions:

> JD: "Shift work means that if you're the first person to see the patient then you have to hand it on to the second person and then the third person so if you don't hear it first-hand it's not quite the same because Chinese whispers kind of changes it and the meaning of the history starts to lessen"

An additional issue that arose from the inadequate transfer of information was the need to take further histories from the patient to gain better information, which for the patient was tiring, frustrating and repetitive:

> JD: "The patient is presented to you and your assessment is different so you wonder 'has [the patient] changed or did that person get it wrong?' so I think that's why everyone likes to start from scratch [taking the patient's history]"

The junior doctor's knowledge of their patients appeared to be worse at the weekends. Perhaps this is because they were covering a large number of patients that they were unlikely to know personally and yet would still need to pass on information about their patients to other junior doctors, who were also unlikely to know the patients:

> JD: "Unfortunately it was a weekend and there was a terrible handover thing like one person will come and he will handover to another person so everyone asks the same story which is very frustrating to tell"

Added to the complexity of communication of patient information is the interpretation of the information by the receiver so that even if the content of information is inadequate, the receiver is in the position to interrogate the provider of information for more information. It appeared from the data that this was not always forthcoming reducing the chances of the receiver picking up an issue:

> N: "EN might just say to the RN: 'I've done the obs' and the RN might say: 'Oh good' and not actually question: 'Well were they okay what was the blood pressure and these are okay?' What's okay? They don't ask the in depth questions"

In summary, it was recognised by both the junior doctors and nurses that the adequacy of communication, particularly to senior doctors from the junior doctors, would determine the effectiveness of advice to manage a patient. However, there appeared to be a reluctance to speak with senior doctors and this is explored below.

8.4.3 The Patient's Consultant

The hospital consultant or specialist in a healthcare environment has two major roles; supervising the patient's care, which historically has allowed them to "own" their patient, and supervising the care delivered by their junior doctors, which often affords them the role of "supervisor of training". These two attributes influenced the management of patient deterioration.

8.4.3.1 Patient Ownership

The historical model of care for patients in hospitals is for a patient to be admitted under the care of a specific consultant. The decision for a specific consultant to care for a patient is often based around the need to fulfil the following three criteria:

1. The consultant is on call at the time the patient presents to the hospital and the patient's presenting condition falls into the consultant's speciality
2. The consultant has the specific training to care for the patient with a particular disease, which assumes that the junior doctor requesting for the patient to be cared for by a specific consultant has diagnosed the patient correctly
3. The consultant has accepted the responsibility to care for the patient

Once the consultant has accepted the care of the patient, the consultant oversees and takes responsibility for the care of the patient and in a traditional model, no other consultant can provide on going management without the responsible consultant providing permission for another consultant to do so.

During normal working hours (Monday to Friday, 0800 hours until 1800 hours), the junior doctors often work with specific consultants and thus the junior doctors are responsible for the patients that are under the care of their consultant. However, out of hours, the junior doctor will often cover other consultants' patients. The challenge for patient care is that consultants can become possessive of their own patients and not allow others to make decisions on their patients:

> JD: "I mean you are not allowed to step into that boundary [of ownership] without permission even if the patient is dying"

Nevertheless some senior doctors did not appear to be restricted to the boundaries demarcated by consultant ownership:

> SD: "I won't accept boundaries where other people feel that they have to but I think at that point you are then not caring for the patient. I think we're quite happy to accept the wrath of outside or the parent team"

To make matters more complicated, if there was more than one consultant involved in the care of the patient, it became unclear who was taking responsibility for making the final decision on the care of the patient:

> SD: "And maybe it was this so called shared responsibility that there was no one person [taking charge of the patient]"

Whilst there was a strong sense of ownership and decision making by the junior doctors if they owned the patient, the junior doctors struggled to feel a sense of ownership or responsibility for making decisions if the patient did not belong to their team, sometimes delineated by colours:

> N: "There is a team within the hospital that has different coloured teams within their team and: 'No I won't look at that patient, I'm the blue team. 'No I won't look at that patient, see the red team'"

This reluctance to make decisions for patients that the junior doctors did not "own" was even more common outside of normal working hours when they were covering large numbers of patients, which were not their own. This was reflected in comments by the junior doctors and reinforced by comments from the senior doctors in the focus groups:

> SD: "At weekends, out of hours it's all about ownership of the patient. 'It's not my patient'"
>
> SD: "Certain treatments aren't followed through or instigated especially during the night time or at the weekends because again it's the parent team that's responsible for the patient"

As described previously, if the patient was suddenly deteriorating out of hours, the junior doctor's hand was forced into owning the patient and making decisions:

> JD: "It's interesting because [when there are] sick patients you become their parent team when you're doing nights"

In some areas such as the Emergency Department, the junior doctor felt a sense of ownership of emergency patients both in and out of hours and probably reflected the different model of care where all the patients belonged to the Emergency Department at all hours. However, this sense of ownership disappeared as soon as the patient had been accepted by a ward team although the Emergency Department continued to be responsible for patient care (Australian College of Emergency Medicine, 2005), until the patient was transferred out of the Emergency Department. This lack of feeling ownership by the Emergency Department medical staff meant that management decisions were not made and defaulted to the ward medical staff, who had accepted to care for the patient but were not physically present all the time in the emergency department:

> JD: "She was pigeonholed [admitted] and so she was sort of babysat in ED well that's the feeling I got rather than anyone [in ED] taking responsibility"

This lack of ownership and lack of acceptance of responsibility for decision making for patients physically in the emergency department but accepted by a parent team changed when the patient became acutely unwell. The sense of ownership and decision making reappeared similar to what was described earlier (Page 107) about the nature of the patient's acute deterioration forcing the hand of the junior medical staff present to manage acute patient deterioration:

> JD: "Once they are referred [from ED] it's not my problem unless he's dying or he's nearly dead"

In contrast to the tight ownership of the patient and decision making experienced by many of the doctors in the focus groups, there were occasions when consultants or their team had relinquished the responsibility for decision making on "their" patient so that other teams would make decisions for them.

The reason for this was not clear but may have been because the consultant or team believed that the expertise lay elsewhere and they had no need or desire to expand their knowledge or that they believed that they were not qualified to make such decisions.

> JD: "You have a patient who is in with haematological problem and has chest pain they will refer to a cardiologist it's almost like a standard of care but they are also passing it on."

This relinquishing of responsibility for decision making was not restricted to specific areas of clinical expertise but included the management of patient deterioration. At times, it appeared that patient deterioration deliberately ignored by teams. This may reflect a number of issues; such as inexperience to manage these scenarios as described above, resulting in them being too scared and too fearful of showing themselves up, or that there was inadequate structure of the working day that took them to other places in the hospital. These consultants or junior doctors also knew that eventually the MET would pick up the pieces:

> JD: "I know they're part of the team but their first priority is always: 'We've seen them in the morning and if they go downhill well you can call a MET call'"

Although the impact of the sense of patient ownership on timely decision for managing patient deterioration was significant, an even greater challenge on decision making was having to seek advice from a senior decision maker.

8.4.3.2 The Consultant Supervising Care

In Australia, consultants are either be employed directly by a public hospital as a staff specialist or are contracted to provide specialist services as a Visiting Medical Officer (VMO). Both these positions require a specialist qualification but the VMO is usually based out of the hospital, in private rooms. The traditional model of public hospital care dictates that consultants caring for a patient will have a team of junior doctors delivering the care to the patient. Although the care delivered to the patient is not always under the consultant's direction as his/her team or others may make decisions without consulting with them first, the consultant is still responsible for the patient from time of the hospital admission to time of hospital discharge and ultimately is responsible for the overall care delivered to the patient.

From the data it has been possible to identify six key components of consultants supervising the care delivered to their patients that can impact upon decision making and ultimately the care of the patient:

1. The role and expectations of healthcare professionals
2. Decision making and their consequences
3. Decision challenging and their consequences
4. Admission of knowledge deficits and their consequences
5. Peer review and personal reflection related to learning
6. Individual performance feedback

8.4.3.2.1 The Role and Expectations of Healthcare Professionals

The healthcare professionals in the focus groups were of the view that the role of the consultant was to be overall in charge of patient management and the consultant was assumed to have the knowledge to be able to care for the patient in its entirety.

> SD: "It is the senior people who should take responsibility"

However, there appeared to be differences in the role, presence, responsibility and commitment between the VMOs and staff specialists over the care of their patients, as alluded to by the nursing staff:

> N: "You can have a MET going on and ring a staff specialist and they will be straight over. You can have a MET go ring a consultant [VMO] and you will be lucky if they pick up the phone because they're too busy in surgery or in rooms"

In general, there was an expectation that consultant decisions about managing patient deterioration would not be questioned and in this was because the consultants did not expect to be questioned:

> SD: "The expectation is that unless you do what I [the consultant] say and I expect that they don't question it"

The staff around them assumed that the consultants would have the knowledge to manage patient deterioration whether or not that they had the expertise to do so:

> N: "It's very difficult to actually stand there and go 'no I want to do something'. You just assumed the consultant, and especially when I started, I had no idea what the consultant does you can say now that they're not seeing acute patients but I've got no clue so when they say: 'No don't MET them' I go: 'Okay, you know what you're talking about', you take it for granted that they do [know] and off I go"

However the expectation of the doctor having superior knowledge to manage patients was not limited to the consultant level of doctor:

> SD: "I think there's a certain expectation amongst everyone that a doctor is the authority, doesn't matter what level of doctor but probably the doctor has the most knowledge, the most experience, the most skills in the healthcare environment but unfortunately they are not realised particularly in this setting"

This concept of the doctor, at any level, knowing best would be more likely if the nurse was junior and inexperienced:

> N: "If you don't have that support [from senior nurses] then you just don't do it and you take on board whatever the intern says and you just follow that plan without thinking 'hang on what's that going to do and why are we doing this and what's the rationale for that? I think it's that underlying culture, the culture that they're the doctor and we're the nurses and therefore they know more."

In contrast, if there were senior, experienced nurses available to help the inexperienced junior doctor, the junior doctors would look to these nurses for guidance as opposed to their consultant, confusing the traditional role between nurses and doctors:

> N: "And they're saying: 'What do you think' and I say: 'This is what I think but you're the one whose calling the shots here and you need to think about it too'"

However, the decisions made by the junior doctors often did not significantly change the course of patient management and were either due to the expectation that their role was to leave significant decision making to their senior medical staff or that they appreciated that in their role they were too inexperienced to make the decision. The distinction between these two was not evident from the data:

> JD: "Refer to someone higher than you to make any fairly substantial decision I think like what [another JD] says it's kind of probably bad in a way because it prolongs everything you have to talk to the registrar and then if your registrar is not certain they should really talk to the consultant before you can go ahead with anything"

Although there was the acknowledgement by the junior doctors that they should force themselves to make decisions to gain more experience knowing that they had more experienced doctors around for advice if need be:

> JD: "We all need out of our experience to test the waters a bit and make decisions on our own and have backup when it's required"

Sometimes, the junior doctor appeared incapable of making a decision even when it was evident that the patient needed help and had to ask for help from their consultant first:

> N: "If you can't get hold of them that will be the way to call a MET but rather than calling a MET it's 'hang on I'd better ask my boss first'"

However, the view of the junior doctors in the focus groups was that the advice provided to them by their consultants had allowed them to feel confident in their consultant's decision making ability. In contrast, the nurses in the focus group expressed some doubt in their senior nursing decisions despite the expectation that they should be in a position to make the right decision:

> N: "If I'm not a hundred per cent confident in my team leader I might not be a hundred per cent confident in their call which means I'm not confident in my call"

Not only did the junior doctors feel confident in the advice being given to them by their consultants but also that most consultants fulfilled their role of being the ultimate decision maker and were supportive of the junior medical staff through this role:

> JD: "I think if you're genuinely worried about a patient and you if you tell them the necessary facts about how sick the patients were then I'm sure they would be interested"

Decisions to call consultant staff were often made from their perceived approachability and not always based on clinical reasons:

> N: "I don't know why that is but you do feel more comfortable ringing some consultants over others"

In summary, there was a consensus that the consultant's role in managing a deteriorating patient was to provide over-sight of and guidance to decision making. However there was a mixed response from the focus groups as to whether their consultants fulfilled this role or not, which may influence whether the junior doctor reports clinical deterioration and seek advice. The reasons for not seeking advice was, amongst other things, because of lack of approachability, which may have been preceded by a previous negative interactions between the junior and senior doctor described in the data below.

8.4.3.2.2 Decision Making and its Consequences

Decision making requires knowledge, often from previous experience, confidence and the support from those not only carrying out the orders from the decision makers, but also from the consultant who is ultimately responsible for patient care.

> SD: "[Senior Doctors] have to be giving people confidence to do the right thing and it starts with the nursing staff, the intern and resident registrar"

However, from the data it was evident that there were occasions when decisions required the junior doctor to seek advice from the consultant resulted in a negative experience:

> JD: "I think if you call up the consultant and you go: 'I'm very worried about this patient because of blah blah blah' they tend to go humph and often you get an expletive"
>
> JD: "To actually bother a consultant to get told: 'You should be knowing this [already]'"

These negative interactions with consultant staff did not provide for a suitable environment for either the junior doctors or nurses to engage in helpful exchanges for advice on patient management. What also transpired was that there was fear from the junior doctors particularly of looking stupid if they made the wrong decision or of looking inadequate:

> JD: "Again the fear, fear of looking stupid, fear of defeat, or fear of looking inadequate [if they make the wrong decision]. Doctors, they want to look like they know what they're doing"

Although not explicitly stated, the fear that seemed to pervade the junior doctors could have resulted in delays in them seeking advice for making decisions on managing patient deterioration. There was also fear from nurses about doctors that someone was going to "check" their work, thereby delaying medical opinion and management:

> N: "There are [nurses] actually scared to tell the doctor because they'll get it checked by somebody else and again and again"

There were negative responses from the MET itself for making the decision to call for a MET review:

> JD: "I don't think I've ever seen the MET get up anyone. And yet we had this discussion in M and M the other day and the RMOs were saying I've seen people get told off [and so] 'why would you call a MET what a waste of time', which I've never seen"

The unintended consequence of the negative response from the MET was that staff would then question the need to call for a MET review, which in turn would delay appropriate care.

> N: "Yes I think because they [MET] were great I thought yes I've made the right decision. Had they [MET] ripped my head off the next time around I might be thinking 'oh my God will I do this or wont I do it'"

However, there were some nursing staff who believed that if their patient was so desperately unwell that their consultants could not be in a position to respond negatively to their decision making for calling for a MET review. It was merely enacting out the MET policy, which effectively was a system that overrode the historical dominance of medical hierarchal decision making to ensure patient deterioration was adequately managed:

> N: "You challenge them [consultants] and because they have a policy to back them up so 'oh well I am required to call the MET', then you just wear it later"

Whilst the nurses felt supported by the existence of a hospital policy to justify calling a MET, the junior doctors continued to fear calling the MET. The reason cited was the fear that they had failed in their role as a junior doctor and would be perceived poorly by their consultant and consequently receive a poor end of term report from their consultant.

> SD: "They're [JMOs] allowed to call the MET but there's a lot of unhappiness then from the consulting staff down to resident registrar, remember they are the ones who assess them and give them a little grade at the end of the term"

This fear of calling for a MET may also have been seen as challenging the management decisions made by their consultant and may explain some of the reasons delayed METs were seen in 'The Observational Study". The consequences of challenging decisions are explored further.

8.4.3.2.3 Decision Challenging and its Consequences

Traditionally, doctors have dominated the medical scene by virtue of their social positions and monopoly of knowledge (Freidson, 1970). This hierarchy has not allowed for open communication and so for decades it has been the nurses role to merely inform and advise the doctor without challenging the position of the doctor (Stein, 1967). Although this traditional model is probably undergoing transformation (Allen, 1997), the difficulty of challenging a medical decision remains ever present even today:

> N: "If he [the registrar] says to me 'I don't want you to' well no then maybe I would be a little bit more apprehensive [about calling a MET]"

Added into the traditional model of medical decision making is the influence of the consultant, the ultimate decision maker, who also writes the reports and references for the junior doctors under their supervision, which in turn often influences the junior doctor's success or failure in their career destination (Kennedy et al., 2009) and as quoted previously:

> SD: "They're [JMOs] allowed to call the MET but there's a lot of unhappiness then from the consulting staff down to resident registrar, remember they are the ones who assess them and give them a little grade at the end of the term"

This deferential powerbase could reduce the junior doctor's willingness to make or challenge decisions of their consultants for fear of reprisals in their report although it was not possible to tease this concept out from the data. In general the reluctance to challenge care was not restricted to nurses or junior medical staff but also felt by consultants who perceived that a junior doctor from a particular speciality would have a greater expertise in an area that they had not specialised in, e.g. intensive care:

> SD: "I mean why would a [non intensive care] consultant not question an intensive care registrar?"

Sometimes challenging care was purely limited by practical issues, e.g. limited time to question the care:

> N: "No time to question, you've got four, five, six patients. You could have eight if you are doing intravenous drugs"

Sometimes nurses sought more senior and experienced nurses outside of their own hierarchy to provide them with the courage to carry out the action that they wished originally to perform:

> N: "[New grads] would ring me [as Clinical Development Nurse] and say 'this is my situation this is what my T[eam] L[eader] is telling me can you come down' and like I said I had to call the MET"

However, there were also negative experiences expressed by nurses when they challenged the consultant decision making:

> N: "I've had a consultant say: 'Why have you called a MET they're not for resuscitation this is ridiculous and I've said: 'They're still for MET calls they're still according to the medical manual' and this was a senior consultant who yelled"

Which in turn made the nurses question their confidence in clinical decision making ability?

> N: "I was the one that was yelled at [by a senior consultant] and that's fine for me because I know that I did the right thing and I had to get a management plan because this patient was ready for MET calls. It makes you question your judgement"

The ability to challenge care often resided in confidence, derived from having had the experience and hence the knowledge to know that care needed to be challenged, to ensure that the patient received appropriate care. However, as a junior doctor's experience is limited there is a need to seek advice and help but as the data indicated sometimes this deficiency in knowledge was neither appreciated nor articulated.

8.4.3.2.4 Admission of Knowledge Deficits and its Consequence

There were limitations in decision making by some junior doctors because it appeared from the data that either the nurses assumed that the junior doctors had the knowledge to manage patient deterioration or the junior doctors believed that they did not need help managing patient deterioration. It is very likely that the junior doctors did not have the knowledge and that it was a case of "you don't know what you don't know":

> JD: "They [doctors] have the knowledge to not require a MET"

However, the junior doctors in the focus groups who were still very inexperienced (less than two years since graduation) and seemed to recognise their lack of knowledge and believed that it was still acceptable for them to admit that they did not have enough knowledge or experience, inferring that at some time point it would not be acceptable for them not to know:

> JD: "And I think I'm still quite junior so I definitely feel like I'm in the space where I can readily admit that I don't know. And if I don't do that then something is wrong"

This ability and ease of junior doctors to admit their knowledge deficiency seemed to disappear as they climbed higher up the medical hierarchy, where there appeared to be an increasing expectation by them and others around them, that they should know what to do, which in turn was likely to reduce their calling for help, including a MET review, in their decision making:

> SD: "If a nurse calls a MET it's a call for help 'it's a very sick patient I need some care' but for the doctor to call a MET it's to admit that your skills are not good enough and you need more help. There's a reluctance for doctors to call the MET and say 'I can't do anything further'"

The anxiety of calling for help from others reduces once the doctor becomes a consultant and was expressed by several of the senior doctors in the focus groups:

> SD: "I'm happy to admit that to myself, to the patient's family to the people around. Some people might think you're a lesser individual because you don't know so you must be a lesser doctor but some people say at least you admit that you don't know"

The inability to admit one's deficiencies is not only related to the rank reached but also to the ethnic culture of healthcare professional and this varied from consultant to consultant:

> JD: "And certainly certain [ethnic] cultures don't like to admit that they're wrong in fact they will do anything to cover up that they were in the wrong. It is not accepted that you can admit that you're wrong as a doctor I can't speak for the nurses"
>
> SD: "But it's much better than it was 30 years ago. The surgeons 30 years ago, every surgeon was his own man he could never ask anybody else, would never be asked by anybody else. He had to make his way through alone"

Although the junior doctors in the focus groups did not disclose when they might have been out of their depth, the nurses in the focus groups, having observed junior doctors on the wards, were able to confirm that there were times when junior doctors, reluctantly, admitted that they were out of their depth.

> N: "I have seen [junior] doctors call the MET when after a while they say 'we're not winning here yes they need help'"

When the junior doctors did eventually seek help because of their uncertainty as to what to do next, they often sought the expertise from someone other than their registrar or consultant, such as the ward nurses they were working with:

> JD: "Because they've [the nurses] got the clinical experience that registrars might not have the same on the ground experience"
>
> N: "Interns feel a little but more reliant on nurses [when making decisions]"

Their seeking of help from someone other than their registrar or consultant suggests that the junior doctors did not want to reveal their own inadequacies to their consultant and so would actively seek out other sources of help:

> JD: "But it's also them not letting the consultant know so they then also see it as defeat"

There were multiple reasons for doctors being unable to admit that they had inadequate knowledge to manage and make decisions on patient care and included having to accept that they had failed the patient, fear of being ridiculed (although it was unclear by whom) or that their consultant would become aware of their deficiency in knowledge at a time in their career when they should have known what to do:

> JD: "I think it's more to do with the admission of defeat and that you've failed your patient"
>
> JD: "Again the fear, fear of looking stupid, fear of defeat, or fear of looking inadequate and it affects my pride"
>
> SD: "But it's also the [registrar] not letting the consultant know, [if they did] [the consultants] see it as defeat"

There were specific situations when doctors appeared more comfortable to admit their deficiencies and often it was when they were with people who do not directly affect their career.

> JD: "But...[you] can admit to a nurse that you do not know"
>
> JD: "It's okay to admit to nurses than to actually bother a consultant"
>
> SD: "But he [the surgeon] feels much more comfortable admitting it to you [as a physician]. I suppose because you can't threaten him"

However, in some of the hospital units the ability to acknowledge one's deficiencies in knowledge were more likely to have been applauded rather than apprehended:

> SD: "I'll tell you [if] registrars come to my unit [and] they don't know [something] and [then] they don't ring the consultant, [they are] in big trouble."

In summary, even though junior doctors may be aware of their deficiencies in knowledge, they appeared to be reluctant to admit this to senior medical staff, other than those recently graduated. Reasons for this include the previous negative responses from their seniors that they did not know something, a reluctance to seek help and admit their lack of knowledge to their consultants for fear that the consultants would become aware of their deficiencies, which might impact negatively on them either in an end of term report or career promotion.

Mechanism for decreasing knowledge deficiencies and improving the ability to make decisions may be through personal reflection and peer review. Indeed, being a professional requires lifelong learning and this can be done through personal reflection on how patient care can be improved as well as learning from doctors open to acknowledging their knowledge deficiencies, peer review, and individual feedback on performance.

8.4.3.2.5 Personal Reflection and Peer Review

The focus groups agreed that an important component of improving patient care was to reflect personally upon the care delivered. The consultants in the focus groups viewed personal reflection as essential to personal development given that no one formally over-saw the delivery of their care on a daily basis. As one senior doctor argued on behalf of the group:

> SD: "Instead of learning from mistakes and saying' look guys I've made this mistake, I hope you don't ever make this mistake, but this is what happened and for those reasons I've chosen to do this and it backfired'"

He went on to suggest that doctors that could not reflect would be dangerous to patient care:

> SD: "If you don't have the insight having looked at this [adverse event] then you are dangerous"

Alongside personal reflection to increase a consultant's ability to make the right decision was the peer review of care delivered by another consultant. Peer review from one's own craft group was seen as a mechanism for not only improving one's knowledge and decision making ability but also improving patient care both current and future:

> SD: "Peer review and that can actually create a positive outcome for future patients"
>
> N: "[I] take the time to spend the time to try and explain to them 'well if you do it like this and look at your patient today isn't he better' and stuff like that, regular feedback"

However, creating the appropriate environment for people to feel comfortable in discussing their cases was seen as essential and it was suggested that the more involvement of all the healthcare professions, the better the peer review process. This concurs with suggestions on how to conduct a useful clinical peer review process (Johnston et al., 2000):

> SD: "I think it is a matter of trying to develop an environment where people will recognise the fact that not only they but everyone else is going to have the problems and if you look at things in an honest way, you can be critical without attacking"

Not all peer review environments were positive and would lead either to blaming others for their mistakes or minimising and curtailing the discussion, thereby decreasing the usefulness of the potential learning experience:

> SD: "Our meetings are like an egotistical meeting and so I often won't talk about my patients in that meeting because I don't want to be put down so what I'll do is I'll talk to consultants privately"

Further commentary is made on appropriate approaches for constructive peer review process later on in this chapter. A more immediate mechanism of receiving feedback, particularly for junior doctors, is receiving commentary from their consultant on the way in which the patient was managed.

8.4.3.2.6 Individual Performance Feedback

The literature argues that performance feedback can be an excellent learning opportunity for understanding whether the junior doctor had engaged in the correct clinical decision making (Mann et al., 2009). However from the data, the feedback either occurred infrequently:

> SD: "I don't think you'd have any idea [about performance]. And I think that goes right across the board from registrars through to consultants"

Or the feedback was not useful:

> JD: "You get eyebrows raised [from a consultant] in the morning and you only saw five patients "
>
> JD: "I have jokes made about my seven page admissions. People roll their eyes at me"

Or the feedback provided was only negative feedback:

> JD: "I think continually you're being told how bad you are"
>
> JD: I do not get much feedback about the way I've managed patients. A lot of feedback but mostly negative. Not a lot of appreciation or anything"
>
> JD: "There's not constructive criticism [by a consultant]"

Sometimes, the only mechanism for receiving feedback was either from personal reflection or from the patients themselves:

> SD: "You know if you've done a bad job you know if you've done an okay job"
>
> SD: "A lot of patients have told me I've done a great job and some of them I've done a really shocking job but fortunately they're very kind"

In conclusion, although personal reflection, peer review and performance feedback have the potential to provide avenues for personal development, increasing knowledge and ability to make decisions, from the data it was either not done or performed poorly thereby minimising its usefulness.

Whilst the ability to make decisions largely rests with the personnel directly involved at the time, there are also systemic reasons for why decision making may not be optimised including the manner in which the institution rosters personnel as discussed below.

8.4.4 Healthcare Institution Rostering

Over the last ten years, there has been both a significant increase in the number of doctors graduating and the numbers of doctors employed. This has allowed for a predominance of shift work, which often reduces the numbers of hours the doctors' work and allows compliance with the safe working hours ruling. However, the rostering of junior doctors continues to see the majority of junior doctors working during the working week, which both minimises cost to the institution with the absence of overtime payments and caters for the elective work in hospitals, which predominantly occurs during the working week. Despite the increase in number and acuity of patients, leading to sicker patients throughout the 24 hour period all week long, there has been little focus on increasing the numbers of doctors outside of normal working hours. Reasons for this include financial limitations, limiting working anti-social hours and failure to review the historical manner of rostering to address the increase in acuity of patients 24 hours per day. Inevitably, this results in a mismatch of the care required out of hours to that delivered.

Rostering of staff is a complex process but in an ideal world four domains need to be considered to maximise the potential for safe patient care, maximise patient exposure, maximise safe working hours and minimise budget expenditure:

1. Adequate clinical exposure to gain experience
2. Safe working hours and fiscal responsibility
3. Workload
4. Adequate senior support.

8.4.4.1 Adequate Clinical Exposure

The data suggest that nurses and doctors need to gain adequate clinical exposure to facilitate decision making by gaining the "gut feeling" to recognise and respond to patient deterioration, which undoubtedly speeds up the decision making process. However, the time and type of clinical exposure that nurses and doctors experience is dictated by the hours that they are employed and the manner in which they are rostered by the healthcare institution. Over time, the time and type of exposure have been limited and this was expressed earlier by both the junior and senior doctors as impacting on their ability to make decisions (page 109).

8.4.4.2 Safe working hours and fiscal responsibility

Over the last twenty years, there has been a drive to cut medical staffing costs and limit the numbers of hours that junior doctors work. This has led to keen junior doctors feeling inadequate in that they cannot complete their workload within the time allocated to them, which they believe is not due to their inefficiency:

> JD: "The parent team, which is 8 till 5 because we're not allowed to stay after 5 Monday to Friday because we're...and if we have to then that's because we've got poor time management and it's our own fault"

8.4.4.3 Workload

The workload of staff is dictated either by the growing demands of patients through their increasing acuity, coexisting comorbidities, the increasing numbers of patients, the reduction in time allowed to care for patients through the safe working hour rule and the reduction in staff to patient ratio. For whatever reason, both the junior doctors and nurses repeatedly expressed a lack of time to manage their own workloads:

> JD: "I don't have a meal break and on a night shift would rarely leave to even go to the toilet in my 13 hour shift"
>
> N: "An intern that has got a million things that they're doing, they've got so much to do you sort of think to yourself: 'Yes I can understand why you can't get here'"
>
> N: "It's eight hour shifts well I kind of scrape through and give it on to the next person"

At times the nurses' workload was driven by roles that no one else would take on and by default they undertook them, limiting their time further:

> N: "A lot of our time is consumed by doing things that are not really what we should be doing like delivering items that nobody wants to deliver, fixing things and all that kind of stuff"

The nurses were also further burdened by the Administration not replacing nurses that called in sick:

> N: "When it gets really busy and I guess in view of the budget there's times when we're not replacing sick leave on shifts then that makes it even heavier. You've got an extra patient and if you've got a sick patient and a patient with dementia it's a nightmare"

Through the lack of experienced doctors being rostered out of hours, the few experienced doctors were excessively burdened and were likely to leave patient reviews longer than they would have liked as reported by one of the medical registrars in the focus groups:

> JD: "After hours people might say: 'Oh when you have time please go and check on my patient' like I'm getting so many pages or I've got so many people that are allocated to me they are kind of really on the backburner"

For the surgical registrars it became physically impossible to see patients on time as the registrars were caught up in the operating theatre as explained by one of the surgical registrars in the focus group:

> JD: "If you are orthopaedic registrar you are on call you have to run two theatres you have to be in theatre all the time every time and you have to be with your patient all the time every time and seeing all the patients and multiply all this complication which is virtually not possible for a superman"

The physical availability of experienced staff to less experienced staff was not isolated to the doctors as the senior nurses reported:

> N: "She [the nursing team leader] is being constantly called away to deal with these other problems of other really sick patients"

Given the time limitations of the experienced junior doctor, the less experienced junior doctor was then delegated to performing tasks that were within their skill set so that they could be left unsupervised. However, by only performing rudimentary tasks, their learning experience for making more complex decisions was minimised:

> JD: "So what is your responsibility [in ED as a registrar] put in the cannula, start some fluid and take some blood, chest x-rays, and that's all. That's all you're supposed to do"
>
> JD: "During the day administrative type sort of thing. You don't actually see the patients clinically you're requesting investigations"

Similarly, with the experienced nurses, since the complex tasks took up most of their time less complex tasks had to be delegated to other workers:

> N: "As an RN you have eight patients and you're doing [the] medication [round] and so on a reciprocal sort of agreement the EN will do the observations for the RN"

Even relatives of patients were taking on some of the nurses' previous roles:

> N: "I think that's where it comes in that the mother was happy to do the saline nebs and the nurse would think: 'Great someone to help me with the load'"

Traditional aspects of nursing care were delegated to others through lack of time:

> N: "I had to get a psychologist to come in and sit with him [the patient] for an hour because nurses don't have enough time"

Reducing the time that experienced nurses spent with the patients minimised their ability to develop a rapport with the patient and thereby they missed opportunities for patients to confide in them that they did not feel very well:

> N: "This is your patient you need to talk to them because if you don't spend those few minutes with them they won't call you back to tell them when they've got a problem"

Another unintended consequence of handing over parts of patient care to other people such as AINs is that whilst they able to carry out the tasks, they are probably not as able to interpret their findings of the task. An added danger is that sometimes the supervising staff member does not then have time to ask the person who has performed the task about their findings. So, whilst information is collected, it is neither understood nor questioned or interpreted correctly and so cannot be used in any decision making process:

> N: "I don't think they process it, I think they are task orientated"

As highlighted earlier, the handing over of tasks can affect the content of communication as well as the interpretation of data:

> N: "EN might just say to the RN 'I've done the observations' and the RN might say 'oh good' and not actually question well were they okay what was the blood pressure and these are okay. What's okay? They don't ask the in depth questions"

Other consequences of excessive workload also include:

- Reduced time for understanding the patient's condition:

> N: "We're doing so much more and there's so many other problems that they have it's not just the cut and dried this person's got this you can't possibly get your head around all of it"

- Reduced time to receive education:

> N: "But [the hospital administration] won't release our staff to do it though we've been told that you've got to have three days off a week to do it and management went 'no you can't do it'"

Understanding the workload of others can result in changes to patient allocation, possibly improving patient care. One team leader explained that by seeing the patients for herself she would become aware of the workload of others and redistributed the work as needed to provide equity of workload across her nursing staff, which in turn, allowed for better nursing care delivered.

> N: "You visualise your patient and then you have an appreciation of your other colleagues' workload and you have an idea what everybody else is doing and I think that's a good thing"

Despite the repetitive nature of the comments from the junior doctors and nurses that their workload was excessive, the senior doctors in the focus group could not understand why the junior doctors and nurses struggled with their time management:

> SD: "It is amazing the amount of ...how few patients...even if you compare the number of patients admitted here under a particular team if they get five admissions a day that's a lot"
>
> SD: "Ten minutes at an observation time can that not happen? When you think about it, you see people [nurses] chatting at the nurses' desk"

This lack of understanding of the time pressures by the senior doctors may have arisen because they did not appreciate the number of patients that the junior doctors have to care for out of hours, which often exceeded 100 patients. Another factor that the senior doctors may not have appreciated was that because the majority of junior doctors after hours were inexperienced, it would undoubtedly take the junior doctors longer to perform each task, than a senior doctor. These characteristics of junior doctors were not appreciated by those rostering the junior medical staff as little has changed in rostering junior medical staff over the last decade.

8.4.4.4 Adequate Senior Support

The findings reported here suggest that junior doctors and bedside nurses are either in a stage of development or have reached a threshold where they do not have the capability to make certain decisions and need to involve those that can. However, from the data, the physical availability of these decision makers was limited because they were occupied elsewhere such as the operating theatre:

> JD: "They've got theatre and if they're going to theatre it's your problem"
>
> JD: "Trainee registrar they are just there for operations so they go to theatre and most of them never do the ward round"

Their physical availability varied from speciality to speciality:

> N: "Our consultants [X speciality] are there pretty much. Our registrars are there pretty much all the time. The [Y speciality] you don't see very often. Very rarely you might see them once"

The absences of consultants were extreme in one case:

> SD: "I know an intern who was in a ward for at least 6 weeks and eventually 10 weeks but in 6 weeks they had never seen their consultant"

For the nurses, they would often need to wait for decisions to be made on the formal consultant ward round rather than interrupt them for a senior decision maker's decision, which could delay care for the deteriorating patient:

> N: "We'll just keep going and if it [the blood pressure] drops a bit more I'll get an intern but will not question it further because you know that doctors come in on the morning rounds"

Often the consultant ward rounds would not be until the afternoon because of outpatient clinics:

> N: "…for me the team do their morning clinic here so they actually don't come to the ward until the afternoon and they do rounds when it's the afternoon or the morning shifts lunch"

As for the doctors, the nurses also had limited access to their senior nursing decision makers through their rostering practices as very few were rostered on at any one time, which meant they were excessively busy:

> N: "They [Team Leaders] do but it's just bigger than Ben Hur for the team leader particularly if there's six nurses on the ward and the TL is the most experienced and then you haven't got another level two to support her particularly in the mornings and then you've got this big drop you've got no middle range experienced staff experience level 1"
>
> N: "In my ward I actually prefer the Team Leader to have a light load so that they are free to help the other people"

At times, junior nurses were left to care for the sickest patients on the ward, through poor allocation of nursing staff:

> N: "That's an allocation problem too, someone that sick shouldn't be given a junior nurse really"

Or junior nurses were left to lead the ward team of nurses. However, they had inadequate experience and this left them feeling very negative about the experience:

> N: "I've just finished my grad year and I've been a team leader twice on my ward already. It's horrendous"

In summary, the influences on decision making are numerous, complex and interrelated and include the type and duration of clinical experience, access to a senior decision maker, ability to reflect on the care delivered and institutional impositions.

8.5 Discussion

8.5.1 Principal Findings

The findings reported above indicate that it is possible to determine that the major influence on capacity of healthcare professionals to manage patient deterioration appropriately is their ability or lack of ability, to make the right clinical decision at the right time following patient deterioration. There are multiple influential factors, including individual and environmental characteristics, which influence the manner in which clinical decisions are made or not made. Whilst clinical decision making and its influences is not a new concept (Croskerry, 2005), this has not been reported in the literature in the arena of patient deterioration.

8.5.1.1 Patient Characteristics

The deteriorating patient provides the healthcare professional with a number of cues, which are often physiological derangements (Harrison et al., 2005) but some can be more subjective (Cioffi et al., 2009), and may or may not prompt the healthcare professional to make appropriate clinical decisions. In this study, it appeared that the more dramatic the deterioration, the more it triggered the healthcare professional to feel "the need to do something quickly". These decisions are likely to be intuitive (Lyneham et al., 2008; Fulop et al., 2009), a form of cognitive short circuiting, which are said to be subconscious and normally created from extensive clinical experience. Although the exact nature of the relationship between depth of clinical experience and intuitive decision making is unclear (Hall, 2002), intuitive decision making often forms the basis of clinical reasoning, which is often beyond our understanding (Sox et al., 1988; Lyneham et al., 2008; Lyneham et al., 2009).

Given a large proportion of our focus group participants would be considered to be novices (two years or less of work experience), they would be lacking in depth of clinical experience and unable to draw on intuition to manage quickly deteriorating patients, it may be considered unusual that they described their ability "to do something" in an acutely deteriorating patient. Unlike an experienced clinician who can draw upon a well organised store of networks and rules, which allow efficient access and retrieval of information, the novice is unable to do this because of their lack of clinical experience. However, there is one situation, where the inexperienced novice need not have to draw on their clinical experience but rather can draw upon a well organised set of rules namely in a cardiopulmonary arrest, one spectrum of a deteriorating patient. In this clinical situation they can draw upon basic and advanced life support guidelines (Australian Resuscitation Council, 2010). These guidelines or rules adhere to a specific set of tasks in a specific setting, namely cardiopulmonary arrest, which is an easily identifiable cue that can then engage a rigid set of tasks that does necessitate experience other than in the training laboratory. This also may reflect a pattern recognition process for decision making often seen in clinicians (Croskerry, 2002) given that that the management of cardiac arrest is taught throughout medical and nursing school training.

8.5.1.2 Junior Doctor or Nurse Attributes

There were two attributes of the junior doctors and bedside nurses, their clinical experience and ability to communicate, that determined their ability to make appropriate decisions.

8.5.1.2.1 Clinical Experience

The natural career pathway for both junior doctors and bedside nurses involves an increasing exposure to clinical practice. A career stage will be reached when they will have seen, common clinical scenarios being managed a number of times, thereby gaining appropriate clinical experience. However, until this point is reached, it is likely they will be novices in their clinical decision making skills due to lack of clinical experience. The increasing clinical experience is often integrated with, and supported by, an increasing knowledge base often from text books, web sites, tutorials, simulation experiences and didactic teaching driven by assessment for post graduate examinations.

From the data, junior doctors and nurses in the focus groups accounted for some of their difficulties in making clinical decisions through perceived or actual lack of clinical experience. This relationship between degree of clinical experience and response to making a clinical decision has been seen in intensive care nurses whereby the more frequently nurses dealt with particular patient situations, the more confident and less stressed they felt in their decision making (Bucknall, 2003). As well as the difficulties in making clinical decisions, the junior doctors and nurses in the focus groups revealed a lack of time to perform tasks. Reasons for this include that their inexperience leads to a less focused and a more time consuming clinical assessment of deteriorating patients and the need to concentrate on a wider range of cues (Nojima et al., 2003) than an expert to help them make a decision. This leads the novice to being less able to sift out quickly what is important and what is not, and thereby decisions take longer. Equally, with reduced ability through a deficiency in clinical experience, it is likely that there will be "bounded rationality" decision making (Simon, 1991), whereby a complex scenario is reduced to a level at which it can be readily understood by the decision maker. In the case of a novice managing a complex deteriorating patient, there is the risk that only simple components of the signs and symptoms will be managed. This limited assessment and interpretation of signs and symptoms is not likely to address the underlying reason for patient deterioration, which in turn limits the treatment options and may explain a commonly seen phenomenon, the clinical futile cycle (Buist, 2008). This is when there is much clinical activity (all of it with good intention) directed at the patient, but little of this activity relieves the dire circumstances of the patient.

8.5.1.2.2 Communication Skills

Communication errors between healthcare professionals have long been identified as a significant contributor to medical errors (Leape et al., 1991; Wilson et al., 1995). The junior doctors in the focus groups appreciated the importance of communication in appropriate medical decision making, not only in terms of the content of information provided to their more senior doctors but also the construct of the information conveyed. The importance of communication, both in content and delivery, has been reflected on by other clinical researchers who have effectively used communication tools that have taken content and its construction into consideration for delivering information to others (Marshall et al., 2009; Thompson et al., 2011). The communication tools used in these studies were originally designed for the US Navy for standardising important and urgent communication in nuclear submarines. The clinical researchers found that the tools increased the transfer of key clinical information and reported that there was an improvement in the structure and consistency in the handover of information, a time when information is handed over to the next shift workers. From the data in the current study, the varied nature of requirements of information by senior doctors added an additional complexity in the delivery of clinical information.

The universal adoption of a standardised communication tool such as ISBAR (Introduction, Situation, Background, Assessment, Recommendation) by universities training doctors and nurses may eliminate the confusion and maximise the transfer of important patient information to allow appropriate clinical decisions to be made. The use of such a communication tool by healthcare professionals is likely to become mandatory in Australia by the need to comply with Standard 6 from the Australian Commission on Safety and Quality in Healthcare (Australian Commission on Safety and Quality in Healthcare, 2011), which relates to the quality of information handed from one healthcare worker to another.

8.5.1.3 Supervising Consultant

8.5.1.3.1 Patient Ownership

From the data, decision making appeared to be significantly influenced by who "owned" the patient sometimes with catastrophic, unintended consequences. These included the failure to enact appropriate decisions and actions because clinicians would be obstructed from engaging in life saving activities by the "owning" consultant, or clinicians would not engage in appropriate management activities if the patient concerned was not under their care. Obstruction to care due to possessiveness of consultants has not been reported before in the literature. However, this lack of ownership by junior doctors has been reported since the introduction of shift work (Van Eaton et al., 2005), junior doctors do not perceive patients to be "their" patients (Drazen, 2004) if their supervising consultant does not own them and this was also found amongst the focus group junior doctors. This becomes an even greater issue out of hours, which occupies 70% of the week, because junior doctors will tend not to make decisions on patients they are only "covering", delaying definitive decision making until the "owning team" are back to care for their patient. Why this should be the case is unclear but could include; the fear of exposing inadequacies to other healthcare professionals including another consultant, excessive workload affording little time to make decisions, uncertainty as to which consultant to call for advice and inadequate rapport with the patient's consultant. An important start would be a clear understanding of junior doctors' responsibilities regarding patient care needs (Van

Eaton et al., 2005) to increase the sense of the need to make decisions even when the patient does not belong to the team of the junior medical officer.

8.5.1.3.2 The Consultant Supervising Care

As the consultant supervising the care delivered by the patient's team of junior doctors and nurses, the data suggested that there were six related components that influenced patient deterioration decision making.

8.5.1.3.2.1 The Role and Expectations of Healthcare Professionals

Traditionally it is assumed that the consultant caring for the patient, from whatever speciality, is expected to care for the acutely unwell patient even though their experience may be limited given their specialisation in other areas of medicine (Hillman, 2002) and with the advent of intensive care as a speciality (Ibsen, 1954). Intensive care specialists are specifically trained to care for the critically ill patient and are increasingly caring for patients outside the walls of the ICU (Hillman, 2004), including the establishment of models of care such as the MET (Lee et al., 1995). These developments probably further diminishes healthcare professionals' experience of managing the acutely unwell patient further and so hospitals today are grappling with who has the role of managing acutely unwell patients so that they receive timely and appropriate treatment.

8.5.1.3.2.2 Decision Making and their Consequences

Decision making is an integral part of a healthcare curriculum. Two decades ago, doctors completed their medical training by being immersed for hours on end in the clinical arena so that they learned to decide which diagnostic and treatment plans to put in place to meet patients' needs (Drazen et al., 2002). However, the graded learning experience to acquire the skill base to decision making requires a delicate balance between the individual initiative and supervision by their supervisors (Gawande, 2002). This delicate balance of giving the trainee room for initiative to make decisions but being there to provide support makes clear articulation of roles and responsibilities of their trainees very difficult. Supervisors also need to balance the provision of direction and self-direction and be approachable; qualities akin to those of a PhD supervisor (Lee et al., 2007). Data from the focus groups did not universally reflect that supervisors had the pre-requisite qualities particularly in "being approachable". This lack of approachability of supervisors, particularly after hours, has been described previously (Kennedy et al., 2009) and can often hinder timely, appropriate decision making. Some of the approachability was the genuine (intended or unintended) lack of physical presence of their supervisor but an undercurrent that pervaded the focus groups was the fear of the consequences that may have resulted from calling for help to facilitate decision making. This fear of asking for help from supervisors is not new and has been previously reported by both junior doctors (Garrud, 1990) and by junior nurses (Cioffi, 2000). Culturally, this is first seen in the teaching of healthcare students where teaching is often by humiliation with the main perpetrators being male and senior medical staff (Lempp et al., 2004). In this study the fear of asking for help appeared to be in association with either previously poor interactions with their supervisor or that they were too afraid to admit their inadequacies to their supervisor. Of note, the consultants in the focus groups did not perceive that consultants could be unapproachable or reflect the extent of the fear that the junior doctors expressed in contacting consultants.

8.5.1.3.2.3 Decision Challenging and their Consequences

From the focus groups, challenging consultant decisions was uncommon and independent of whether the nurses and junior doctors believed or knew whether the consultants had the skills and knowledge of managing patient deterioration. In the case of Alice, the failure to challenge the consultant's decision led to delays in appropriate care. However, the ability to challenge decisions often depends on whether the challenger feels the confidence to do so, which is often provided either by experience or using communication techniques such as graded assertiveness (Brindley et al., 2011) or other strategies (Curtis et al., 2011). Other strategies include the fostering of communication by understanding each clinician's information needs in a mutually respectful manner, especially in the context of uncertainty.

Ideally, the ability to challenge decisions is to be aware of the barriers of communication (lack of knowledge creating lack of confidence, fear of experiencing a negative reaction from the decision maker, excessive workload and lack of time, talking to an unknown quantity, lack of physical presence of the decision maker, adhering to rigid, traditional communication hierarchies) and creating communication opportunities by addressing the communication barriers.

8.5.1.3.2.4 Admission of Knowledge Deficits and their Consequences

The ability to admit to or acknowledge deficiencies in knowledge provides a platform for openness in asking further questions to facilitate decision making and caring for deteriorating patients. The doctors in the focus groups described three phases of their ability or inability to admit their deficiencies in knowledge. The phases were temporally related to the time from graduation. The first phase was with newly qualified doctors who believed that it was still "safe" to admit that they did not know "everything" as there was a general expectation that those around them would appreciate their lack of experience in the role. This appreciation allowed for an open dialogue between the junior doctor and their consultant or between junior nurses and senior nurses without negative consequences. The second phase appeared around two years after graduation from medical school when the junior doctors were starting to perceive that it was not "safe" to admit their deficiencies to their consultant. This sense of inability to admit their deficiencies is likely to be associated with either a lack of approachability of their supervisor or the fear of upsetting their supervisor, which is perceived by the junior doctor to lead to a poor reference and reduce their ability for career progression (Kennedy et al., 2009). As acknowledged earlier in the chapter, the junior doctors preferred to seek advice from outside their traditional medical hierarchy, frequently the experienced nursing staff. This has been described as the newer negotiated modification of the nursing and medical boundary (Svensson, 1996; Allen, 1997). In contrast in ICUs (Coombs et al., 2004) the medical hierarchy has been found to be more dominating than the senior experienced nurses. The third phase was found in experienced consultants when they felt able, once more, to admit their deficiencies in knowledge and request advice to facilitate decision making. Some of the reasons for this include: the consultant position currently is almost immune from accountability with no one deriding their knowledge deficiency; attaining enough clinical experience to appreciate that it was always going to be impossible to know everything given the complex medical world (Gawande, 2009) and being able to seek advice from distant geographical peers without local peers being aware.

In being aware that junior doctors often find it difficult to seek advice from their own supervisors, strategies to either overcome this difficulty need to be pursued or it has to be accepted that it becomes the norm for seeking information outside of the normal social paradigm. If continuing with the traditional medical hierarchies of seeking advice, strategies will need to include both the encouragement of junior doctors to ask for advice and for the supervisors to understand the importance of seeking help rather than responding negatively to requests. These issues have been increasingly addressed in medical curricula (Hafferty, 1998; Montgomery et al., 2003) but serve only to inform the student leaving senior medical staff ill-informed on the issues.

8.5.1.3.2.5 Peer Review and Personal Reflection

Reflection, the purposeful critical analysis of knowledge and experience in order to achieve deeper meaning and understanding (Mann et al., 2009), has been used toas a learning tool in medicine and nursing for decades. It allows healthcare professionals to revisit experiences so that they can learn from complex problems in professional practice. Whilst reflective practice has been qualitatively demonstrated to allow new knowledge to be integrated with past experiences, there is little to guide medical educators and senior doctors how to encourage and develop reflective ability in their novices (Mann et al., 2009). There was very little evidence from the focus groups that nurses and doctors were using reflection as a tool for learning to strengthen their ability to make clinical decisions, which has been found useful by other groups of medical trainees and medical students (Branch et al., 2002). Steps to improve this include: the teacher being a good role model, gaining the trust of the learners, and having the skills to facilitate reflection (Branch et al., 2002). Indeed, receptiveness to reflection requires a willingness to learn and an acknowledgment of a deficiency in knowledge, which the junior doctors in the focus groups were unwilling to admit, whereas the senior doctors in the focus groups were much happier to admit their uncertainties. The literature (Keren, 1987) suggests that the greater the expertise the greater the readiness to admit one's deficiencies and one senior doctor in the focus group was strongly supportive of reflection and actively participated in self-reflection. However, the focus group doctors acknowledged that doctors are generally poor at reflecting on the care that they have delivered although it is recognised as an essential element of continuing professional development (General Medical Council, 2009). One reason for this may be the inadequate provision of reflection tools to medical students or junior doctors, although this is now being recognised by both universities (Law, 2011) and training programs (Berger et al., 2011). Once reflection becomes the cultural norm, learning opportunities will grow and might improve the quality of decision making.

Since the exposure of landmark medical disasters (Mitchell et al., 2008) in the mid-1990s, participation in clinical peer review and audit processes have formed part of many post graduate medical and nursing professional development programs, which are now demanded by licensing medical authorities. The premise of clinical audit and peer review is to improve the quality of patient care delivered by allowing clinicians to understand their short comings in the care that they have delivered to patients. To date, although a mandatory requirement for licensure, clinical audit and peer review is yet to demonstrate that care and outcome of patients is improved.

As experienced by some in the focus groups, peer review and clinical audit can be counterproductive and provide a potentially threatening environment for junior medical and nursing staff (Johnston et al., 2000). There are described methods of improving the usefulness of clinical audit and peer review. Conducive, confidential environments for audited are needed and ideally the problems tackled as a multidisciplinary unit with the oversight from a strong and fair facilitator. Training programmes for clinical audit are a necessity along with establishing evaluation programmes (Johnston et al., 2000). These prerequisites for clinical audit and peer review were not reflected by those in the focus group as the main aim of the focus group was to reflect upon clinical management of patient deterioration.

8.5.1.3.2.6 Individual Performance Feedback

A frequent complaint by both medical students and junior doctors is that they "never receive any feedback" (Ende, 1983; Sheehan, 1984). In the focus groups it was not only the junior doctors who expressed this opinion but also the consultants. This is disappointing given that feedback can be an effective learning tool. There are many opportunities for using feedback as a learning tool in healthcare institutions (Branch et al., 2002) and feedback can either be done informally or in a highly structured environment. Examples of how feedback can be delivered include:

i. Brief feedback

The teacher or supervisor provides feedback that is useful during a specific event.

ii. Formal feedback

The teacher or supervisor provides feedback related to a previous specific event and encourages self-feedback.

iii. Major feedback

The teacher or supervisor schedules a feedback session so that the learner will know that feedback will provided and that they will have an opportunity to reflect upon their performance.

Learners are highly appreciative of feedback as a mechanism to increase their knowledge to provide a greater capacity to make the right clinical decision. In response, hospitals and postgraduate professional development programs have developed an infrastructure for formal feedback. Accreditation requirements for both hospitals and post graduate professional development programmes include mandatory performance agreements for all healthcare professionals and for trainees to be supervised by appointed supervisors of training, which provides an opportunity for regular feedback on their performance. It is imperative that supervisors providing feedback are given the appropriate tools and techniques to provide helpful and supportive feedback as it is likely that poorly constructed feedback will have a negative impact upon the behaviour of a healthcare professional.

8.5.1.4 Healthcare Institution Rostering

8.5.1.4.1 Adequate Clinical Exposure

Unless there is a clinical situation such as a cardiopulmonary arrest, described earlier (Page 106), which has a set of strict management rules, the duration and type of clinical experience that affords intuitive decision making, is probably critical in the management of the deteriorating patient. An added strength to the experienced clinician's clinical decision making is that they can also raise diagnostic possibilities of the atypical variant (Croskerry, 2002) rather than be influenced by recent exposure to a particular disease, which often influences more inexperienced clinicians.

Although clinical exposure can be gained through a simulated environment (Maran et al., 2003; Beaubien et al., 2004), it is hard to substitute this for real life clinical experiences to aid the ability of doctors to make clinical decisions. In nursing, increasing clinical experience is associated with a reduction in the incidence of adverse events (Morrison et al., 2001) suggesting improved decision making. As a result, it is essential to consider how rostering and allocation of staff can affect clinical exposure when developing rosters for junior medical staff and allocation of nursing staff on shifts.

8.5.1.4.2 Safe Working Hours and Fiscal Responsibility

In the mid-1990s, Healthcare Institutions in Europe faced pressure from the European Working Time Directive (Spurgeon et al., 1997) and in Australia from the Australian Medical Association (Australian Medical Association, 2003) to reduce the number of hours junior doctors worked per week. This reduction in working hours was an attempt to reduce the fatigue and stress experienced by healthcare professionals, which was said to impact upon patient safety (Spurgeon et al., 1997). The experience from junior medical staff working night shifts is that whilst they report fatigue and poor performance (Ahmed-Little, 2007), a study of fatigued airline pilots suggested that if they had worked previously together, they worked better than those that had been well rested but had not worked together previously. Although individual team members made more errors, the team was able to compensate for the errors of individuals (Carter et al., 1999). In the focus groups, the shortened hours for junior doctors resulted in them being frustrated with their inability to handover completed tasks, which they felt would be interpreted as their poor time management by their supervisors.

It is unclear from healthcare institutions whether the drive for safe working hours is to benefit the delivery of safe patient care or to reduce public healthcare costs by reducing the need for overtime in both medical officers and nurses. Aside from the cost or safe working hours issues, the manner in which rosters are written need to consider carefully not only duration of clinical exposure but also the manner in which they can be taught during these clinical experiences. From the discussions in the focus groups, it would appear that rosters were infrequently written to enable maximal clinical exposure, such that junior doctors felt inadequate in the clinical areas that they had been rotated to as part of their rotational roster.

8.5.1.4.3 Workload

The reduction in working hours for junior medical staff has reduced their clinical exposure and so for their years of graduation, they are relatively less clinically experienced. Despite this relative clinical inexperience the manner in which we roster, teach, train and supervise both junior medical and nursing staff has remained largely unchanged for over a century. Clinical inexperience also increases the time to make decisions and is compounded by the increasing complexity of patients cared for in acute care hospitals leading to the sense of excessive workloads (Collins, 2010; Temple, 2010), which was reported frequently by the nurses and doctors in the focus groups. In the UK systems have been put in place (Collins, 2010) to provide a curriculum for training with an emphasis on competency based training to try and combat the deficiencies in clinical exposure. However, they have been taken up inconsistently (Collins, 2010). In Australia, a curriculum framework for junior doctors has been established (Confederation of Postgraduate Medical Education Councils., 2006), which should allow junior doctors to gain appropriate skills. Its effect on providing skills to make decisions to minimise workload was not felt by junior medical staff in the focus groups despite their hospital providing an education program that delivered the curriculum framework for junior doctors.

If safe working hours limit clinical exposure, which increases the time for junior doctors to make decisions, a greater emphasis needs to be placed on making each clinical experience a useful learning situation. This requires time and dedication to teaching from supervisors. As an alternative or as an addition, high fidelity simulation can provide useful experiences, which facilitate clinical teaching, often in a multi-disciplinary environment.

8.5.1.4.4 Adequate Senior Support

To reduce working hours per week, junior doctors and nurses work shifts, which mean that for large periods of time they work outside of "normal" working hours. For the junior doctors much of their work is not directly supervised by their designated supervisor. Instead, they have to liaise with a variety of consultants to deliver safe, effective care by seeking advice on clinical decision making. Whilst having access to other consultants through on call rosters, junior medical officers, often remain reluctant to seek advice, for a variety of reasons (Kennedy et al., 2009). These reasons include the need to determine the relative importance of the clinical question, the desire to seek independence, the belief that their credibility may be under threat if they choose to seek advice and the consultants' approachability and availability. The Visiting Medical Officers and to a lesser degree Staff Specialists are often reviewing ward patients either early or late in the day when their junior doctors are not rostered on. This reduces the ability of junior doctors and nurses to obtain timely advice and this was identified as an issue in the focus groups. The fractured nature of the parent team, either through the junior doctor working shifts or the consultant working different hours increases the risk of miscommunication and diminishes the opportunities for communication, which risks the right decisions being made and acted on in a timely manner.

8.5.2 Strengths and Limitations of the Study

The strength of this study is that it has used a de-identified and a previously unknown deteriorating patient case as the spring board for focus group discussion. It was designed to encourage the participants to appreciate that healthcare professionals are imperfect and to permit the participants to feel able to air their true feelings and perceptions of their own memories of managing patient deterioration. The use of a professional external facilitator who was not a healthcare professional for three of the four focus groups, may have allowed for more free expression and a greater degree of probing where no assumptions were made for the processes in healthcare delivery. The composition of the focus groups, including both senior and junior doctors and nurses, afforded representation of different viewpoints. The final group was a mixed group, reflecting the multidisciplinary nature of caring needed for the deteriorating patient and this multidisciplinary group provided a depth of conversation with some triangulation between nurses' and doctors' thoughts, perceptions and actions. The use of focus groups in determining why healthcare professionals struggle to recognise and respond to patient deterioration has not been previously reported.

There is a number of limitations to this study including its generalisability. This study relays thoughts and perceptions of tertiary hospital nurses and doctors where two systems run in parallel for the recognition and response to patient deterioration and may not be applicable to other healthcare settings. However, many of the findings are similar to those reported in the literature, which suggests that the findings are likely to be generalisable to other healthcare settings. The small numbers used in the focus groups may not have been an adequate representation of junior and senior doctors and nurses in the hospital. The author's recruitment of the focus groups, particularly of the doctors, may have biased the selection leading to members being more attuned to the deteriorating patient and again may not have represented the general views of nurses and doctors. Equally, with the presence of the author at all the focus groups, the groups may have been intimidated, particularly the junior doctors, thereby limiting the depth of discussion and exhibiting some of the characteristics described in inability to talk to senior doctors (Kennedy et al., 2009). On the other hand, working within an environment where participants felt comfortable, and where they closely identified with the case study provided a level of credibility to the discussion which might not have been there had the study been conducted differently

However, to gain further insights into the influences on decision making in managing patient deterioration, triangulation of the data gained from these focus groups is needed. This is likely to involve real time data collection in the clinical environment.

8.6 Conclusion

Appropriate and timely decision making is crucial to managing patient deterioration and is likely to be the limiting factor for attaining positive outcomes in interventional deteriorating patient studies. Key challenges are lack of clinical experience and access to senior decision makers through fear of calling them. Improvement in managing patient deterioration requires a review of not only the way our healthcare institutions manage, train and educate nurses and doctors but also a minimisation of the barriers to timely, appropriate communication with the senior decision makers, including the consultant medical staff.

CHAPTER 9: SUMMARY, FUTURE DIRECTIONS AND CONCLUSION

9.1 Introduction

> *".....as the hours passed, I should have insisted that she be reviewed with a view to intervention and much sooner as I most certainly had presided over copious monitoring and review but a seemingly total lack of clinical assessment and decision making affording early intervention in order that her deterioration was halted"*

The key issues that Alice's mother identified when the healthcare professionals caring for her 16 year old daughter failed to provide timely treatment are very relevant to this research. Although the work of this thesis does not directly address the specific issues raised in the case of Alice, there is now a better understanding of the key elements needed to recognise and respond to patient deterioration.

9.2 Key Findings

The key findings from this thesis that affect the management of a deteriorating patient are as follows:

1. Lack of consistent definition of a deteriorating patient;
2. Clinical processes in managing patient deterioration are deficient;
3. Patient deterioration systems only partially improve the clinical processes;
4. Decision making determines timely and effective clinical management.

9.2.1 Lack of Consistent Definition of the "Deteriorating Patient"

From the literature review, one of the significant challenges to the deteriorating patient arena is that there no agreed definition of a deteriorating patient (McQuillan et al., 1998; Hillman et al., 2001; Parr et al., 2001; Whitehead et al., 2002). Without an agreed definition, the curriculum for teaching about patient deterioration is ill defined and not systematically taught at both the undergraduate and postgraduate level. Without appropriate teaching and training, deteriorating patients are less likely to be recognised, which makes the provision of timely and appropriate care more precarious. The lack of consistent definition also means that enrolment of deteriorating patients for research studies is inconsistent and study generalisability is limited. This lack of generalisability of studies may explain the delay in the development of national programs for patient deterioration by national healthcare providers [(National Confidential Enquiry into Patient Outcome and Death, 2005; Australian Commission for Quality and Safety in Healthcare, 2010; Health Services Executive Ireland, 2010)].

For the purposes of this research , the definition of a deteriorating patient was presumed to be "a patient who is at risk of critical illness". Deteriorating patients are often at risk of developing organ failure from inadequate oxygen delivery leading to depletion of the intracellular energy, ATP. Inadequate oxygen delivery is frequently reflected in the development of abnormal vital signs and although vital signs lack sensitivity for the detection of patient deterioration, they have a better specificity to detect deteriorating patients (Fieselmann et al., 1993). This is presumably the reason that there is ubiquitous measurement and documentation of vital signs and has been the cornerstone of acute healthcare since Nightingale's days of nursing (Nightingale, 1859).

9.2.2 Clinical Processes in Managing Patient Deterioration are Deficient

"The Observational Study" revealed large gaps in the clinical processes of managing patient deterioration including infrequent documentation of respiratory rate and the delay in appropriate treatment for deteriorating patients. Importantly, the delays in appropriate care, such as calling for a MET review, were associated with multiple communications between nursing and junior medical staff. Multiple interactions that were well intentioned but did not result in meaningful management of the deteriorating patient featured strongly in Alice's care and have been described aptly as the "clinical cycle of futility" (Buist, 2008). In "The Observational Study", there was also a lack of consultant engagement in managing patient deterioration and these data triangulated well with "The Human Element Study", where the junior medical staff feared calling for help from their consultants unless it was unavoidable. Concomitantly, there were also delays seen in the healthcare workers calling for a MET review in one third of the patients who fulfilled MET criteria similar to other studies (Calzavacca et al., 2010) and this may be due to fear of calling for a MET review (Cioffi, 2000).

9.2.3 Patient Deterioration Systems only Partially Improve Clinical Processes

Patient deterioration researchers have designed systems, predominantly using vital signs, to identify deteriorating patients and alert ward staff that they are caring for a deteriorating patient. In turn, the ward staff can then call for appropriate help. These systems can track a patient's condition and if specific criteria are met then they can trigger ward staff to call for further help, the so called "track and trigger system". The single parameter track and trigger system (Lee et al., 1995) uses one vital sign measurement to prompt ward staff to call for a critical care team. The multi-parameter track and trigger system (Morgan et al., 1997) summates scores from up to eight different vital sign measurements and a pre-determined score can prompt ward staff to call for help often from the patient's own medical team. However as stated earlier, because these systems use vital signs, they have lacked sensitivity (Smith et al., 2008; Smith et al., 2008) so have been unlikely to detect all deteriorating patients. More recently, a scoring system has been developed with improved sensitivity and specificity (Prytherch et al., 2010; Bleyer et al., 2011). To avoid the reliance on vital signs on detecting patient deterioration, some systems have used subjective criteria, such as "worried", to increase their sensitivity thereby capturing more deteriorating patients. The difficulty with subjective criteria is that they rely on staff having had adequate clinical experience, often lacking in junior healthcare workers, which is generally the predominant workforce out of hours. In the light of these issues, the systems that should prompt nurses and doctors to seek more appropriate help for deteriorating patients may not necessarily instigate help any earlier than traditional models of care.

Although many deteriorating patient studies have focussed on installing tools that use vital signs and communication frameworks, researchers have not predominantly concentrated on addressing ward processes such as the documentation of vital signs and communication strategies. However, it is acknowledged that as a spin-off of these deteriorating patient studies an increase in documentation of respiratory rate has occurred (McBride et al., 2005; Chen et al., 2009) and an increase in calling for METs has been demonstrated (MERIT Study Investigators, 2005).

By providing a multifaceted system for patient deterioration in "The Interventional Study" that focussed on educating ward healthcare workers involved in patient deterioration significant changes in behaviour were found. These behavioural changes included an increase in frequency of documentation of all vital signs including respiratory rate and instances of review by the patient's junior doctor and MET. Although these changes were associated with positive patient outcomes, issues with some of the clinical processes required for managing patient deterioration remained. There continued to be numerous instances where the alerts for deteriorating patients, determined by their MEWS or MET trigger, were seemingly ignored by the ward staff despite the multifaceted intervention.

Changes in behaviour are often seen at the outset of clinical research projects and can be maintained during the study through constant reminders (visual, verbal, and repercussions of the failure to behave appropriately) by the research staff. The harder challenge of sustaining behaviour is when research projects move into every day clinical practice as there is often no behavioural reminders or governance of the behaviours examined. In "The Sustainability Study" two key behaviours for managing patient deterioration remained two years following the initial introduction of the multifaceted intervention. However there was no sustained positive impact upon patient outcome, which could reflect an underpowered observational study or a regression back to the mean of prior to the installation of the intervention, a known limitation of the interpretation of the before and after intervention trials (Moran et al., 2005).

The findings that some of the behavioural changes that are pivotal for managing patient deterioration were sustained in every day practice are reassuring and could be built on to improve patient care further. Reasons for the sustained improvement are likely to be multi factorial. The deteriorating patient education program, COMPASS©, became mandatory at both the nursing and medical undergraduate and post graduate level. There was a hospital governance structure that oversaw and reviewed relevant policies. All cases of clinical deterioration were reviewed at a weekly multidisciplinary committee meeting and any issues occurring were taken back to the relevant clinical area for feedback and learning. However, there were still some important behaviours that had not improved (e.g. nursing communication to doctors) or had even deteriorated (e.g. calling for a MET review) despite the installation of the multifaceted intervention and the sustainability support structures.

9.2.4 Decision Making Determines Timely and Effective Clinical Management

Despite the issues with the definition of the deteriorating patient, the sensitivity of vital signs to detect deteriorating patients and the systems currently available to detect and manage patient deterioration, the greatest challenge remains the manner in which healthcare professionals respond to managing the deteriorating patient (Buist, 2008). The story from Alice's mother revealed that her daughter was observed with due diligence and was reviewed on multiple occasions by nurses and doctors and yet seemingly the right care was not being provided to Alice. Understanding human responses to a particular set of circumstances is only partly possible through quantitative data and better insights are revealed with exploring healthcare professionals' thoughts and perceptions through qualitative research.

Some of the shortcomings in human behaviour when managing patient deterioration were identified in "The Observational Study", "The Behavioural Study and "The Sustainability Study" and include the reluctance to seek expert guidance on further management. As such, it may mean that more "Alices'" are likely to occur. Better insights into the nursing and medical behaviour are essential to determine where the next steps need to occur in managing patient deterioration. Through talking to both doctors and nurses caring for deteriorating patients, it appears that the major decider on whether deteriorating patients are cared for appropriately is whether healthcare professionals make the right decision at the right time on the right patient. A major influence on decision making was the perceived or actual inability to communicate with a key decision maker, specifically trained consultants, to help both junior doctors and nurses make the right decisions. In order to facilitate this communication pathway, perceived and actual hierarchical barriers will need to be broken down to allow junior doctors and nurses to feel comfortable to communicate with their senior decision makers in the event of patient deterioration.

Other key influences on appropriate decision making were the extent of clinical experience and the communication structure between healthcare professionals. By addressing and improving these influences, it may be possible to provide better decision making affording earlier intervention to prevent further patient deterioration. What also may impact the care delivered to a deteriorating patient is the open acknowledgement by healthcare workers that their standard of care delivered has a bearing upon the patients themselves, something that none of the healthcare workers touched upon during the interviews or discussions.

9.3 Limitations

There are limitations to this thesis and they have been described in detail in relation to each study but given the case study nature of the thesis many of the studies involved either small patient or healthcare professional samples, which may not reflect other healthcare professionals or institutions. However, the findings of the observational, quantitative studies are very similar to those found in other healthcare settings and so it is likely that the deficiencies found and described are generalisable. What is less known is whether the qualitative findings can be generalisable as there has been very limited qualitative work in the arena of the deteriorating patient. So whilst the results from this particular work may not be generalisable, the method of investigation to understand the social context of the management of patient deterioration can be generalised. Other issues include the researcher being herself a member of the healthcare staff at the hospital where the studies were undertaken posed a limitation to the study it is proposed that in fact this involvement was a strong positive. With an intimate knowledge of the system and an understanding of the local environment, the researcher was able to bring insights that someone from outside would not have been able to provide.

9.4 The Impact of the Thesis Findings on the Candidate's Work at the Canberra Hospital

The thesis has generated significant changes in work practice both personally and in the intensive care unit that the candidate directs. There is now a much greater emphasis on patient and family centred care in the intensive care unit so that families are invited to take part in the intensive care ward rounds. This allows them opportunities to talk to the clinician caring for their loved ones attempting to maximise the input of their voice. Leading on from the work down on the multifaceted intervention and listening to the concerns of Alice's mother, a family escalation system (Call and Respond Early [CARE] for Patient Safety) has been piloted and will be rolled out in 2012. The candidate now appreciates the inability for junior doctors and nurses to make decisions particularly after hours when so few senior decision makers are physically present in the building. In understanding this limitation, more resources have been implemented including greater consultant and senior registrar cover for the intensive care unit. This provides a larger number of hours with senior decision makers in the hospital specifically for managing patient deterioration.

9.5 Further Studies

There is a number of studies that require further exploration including the investigation of which detection tool is likely to identify deteriorating patients prior to the onset of organ dysfunction. It may well be that using a combination of using vital signs or other parameters from the laboratory and stratifying for the presence of comorbidities can provide a more effective tool. Undoubtedly, if the tools are going to involve complex multi variable logistic regression equations, then to be applicable at the bedside, the tool will need to be digitised and used through a handheld computer system. Future studies will need to focus on overcoming hospital hierarchy to ensure that there is timely engagement of senior decision makers, this may well be through automated patient detection tools that automatically engage the senior decision maker without the ward staff needing to decide whether they should or should not call the consultant. All these systems need to be tested in large, probably cluster randomised, controlled trials to ensure that they are adequately powered to determine whether hospital mortality is improved.

9.6 Conclusion

The delayed management of a deteriorating patient can lead to unexpected and potentially preventable deaths and it is, therefore, critical that the all the necessary steps are put in place to minimise harm to deteriorating patients. However, from the data, the question of why patients are allowed to deteriorate on hospital wards is complex and includes many traits of poor teamwork that increases the likelihood of harm being bestowed on deteriorating patients. Although healthcare teams are employed to care for patients, including deteriorating patients, it is evident that the team is fragmented both physically (shift work, attendance other than the hospital ward and being part of different peer groups) and mentally (perceived or actual hierarchal barriers). The fragmentation of the healthcare team neither fosters collaborative working relationships nor encourages the drawing upon of clinical expertise, which is particularly needed out of hours when the junior, inexperienced nurses and doctors are the mainstay of healthcare delivery including managing patient deterioration.

By understanding the clinical processes that are needed for exemplary team work for managing deteriorating patients, it is possible to install a deteriorating patient intervention that potentially improve patient outcome. These interventions are aimed at providing a common goal of timely and appropriate recognition and response to patient deterioration, an understanding of the roles and responsibilities of all doctors and nurses around patient deterioration and a clear structure for communication, which overcomes medical hierarchy. Additionally, patient deterioration interventions need to seriously consider involving patients and families, who are often more in tune as to whether anything is wrong, as part of the caring team.

However, if patient outcome following patient deterioration is to improve consistently, all academic health institutions need to focus on curricula that include education and training on patient deterioration, communication between healthcare workers and an open understanding that their management decisions significantly affect patient care. In the age of shift work and reduced clinical experience, enhanced decision making in the management of patient deterioration and teamwork will need the combination of intelligent systems that can detect accurately patients who are likely to be at risk of deterioration and achieving better access to senior decision makers by breaking down further the traditional perceived or actual medical hierarchy.

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APPENDICES

Appendix A: Comparative Ranges for Scoring the Individual Components of the Modified Early Warning Scores

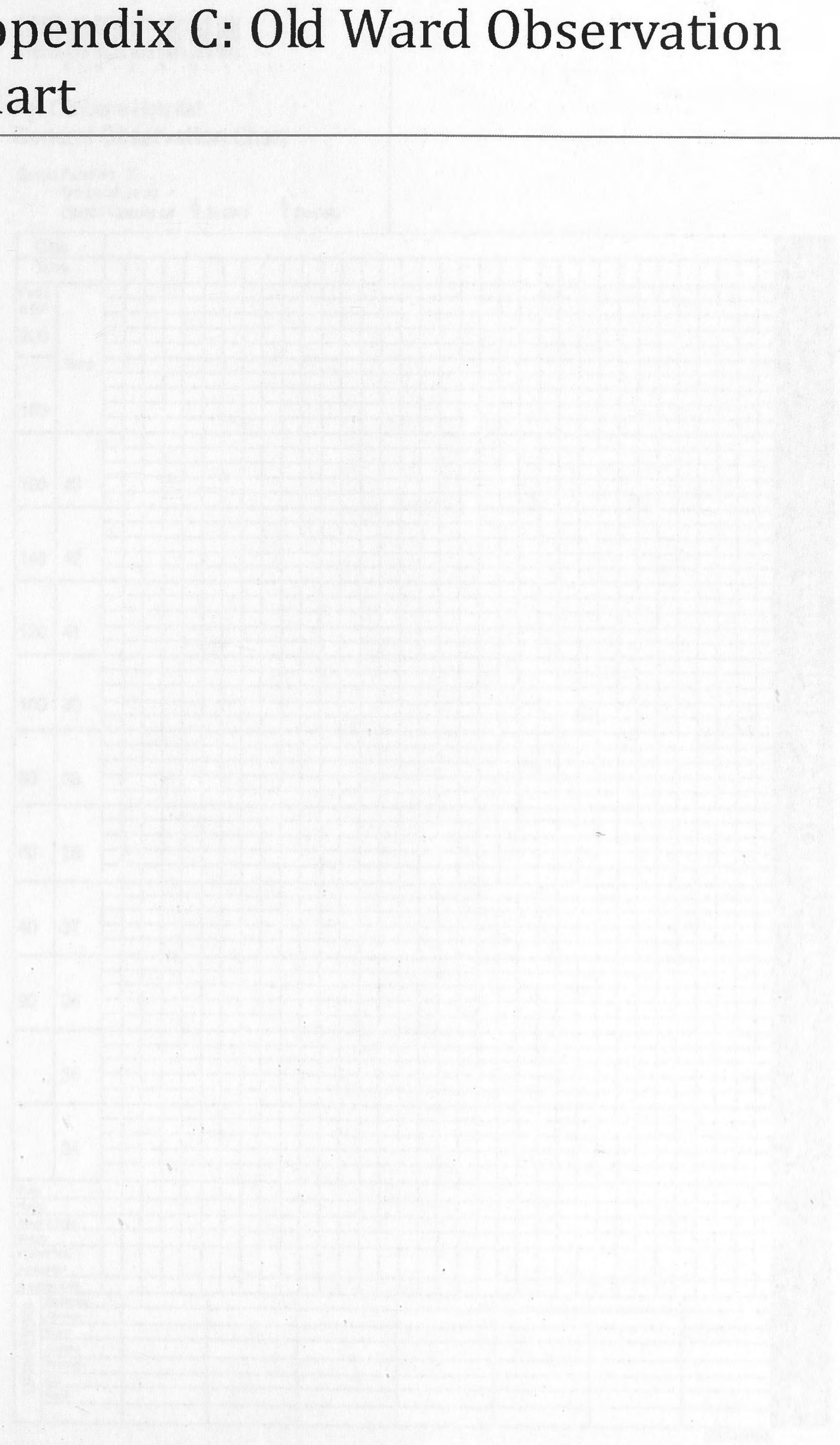
	MEWS	3	2	1	0	1	2	3
Heart Rate (bpm)	(Day, 2003)	<30	31-40	41-50	51-100	101-110	111-129	>=130
	(Morgan et al., 1997)		<40	41-50	51-100	101-110	>=130	
	(Subbe et al., 2003)		<40	41-50	51-100	101-110	>=130	
	(Odell et al., 2007)		<=40	41-50	51-100	101-110	111-129	>-130
	(Pittard, 2003)		<40	41-50	51-100	101-110	111-130	>130
	(Goldhill et al., 2005)	<40		40-49	50-99	100-114	115-129	>-130
Systolic BP (mmHg)	(Day, 2003)	Dependent on Usual BP						
	(Morgan et al., 1997)	<70	71-80	81-100	101-199		>200	
	(Subbe et al., 2003)	<70	71-80	81-100	101-199		>=200	
	(Odell et al., 2007)	<=70	71-80	81-100	101-199		>=200	
	(Pittard, 2003)	<70	71-80	81-100	101-179	180-199	200-220	>220
	(Goldhill et al., 2005)	<70	70-79	80-99	100-179		>=180	
Resp. Rate (breaths per minute)	(Day, 2003)	<6	6-8		9-14	15-20	21-29	>=30
	(Morgan et al., 1997)		<8		9-14	15-20	21-29	>30
	(Subbe et al., 2003)		<9		9-14	15-20	21-29	>=30
	(Odell et al., 2007)		<=8		9-14	15-20	21-29	>=30
	(Pittard, 2003)		<8	8-11	12-20	21-25	26-30	>30
	(Goldhill et al., 2005)		<10		10-19	20-29	30-39	>-40
Temp. (°C)	(Day, 2003)		<35	35.1-35.9	36-38	38.1-39	>39.5	
	(Morgan et al., 1997)		<35	35.1-36.5	36.6-37.4	>37.5		
	(Subbe et al., 2003)		<35		35-38.4		>=38.5	
	(Odell et al., 2007)	-	-	-	-	-	-	-
	(Pittard, 2003)	-	-	-	-	-	-	-

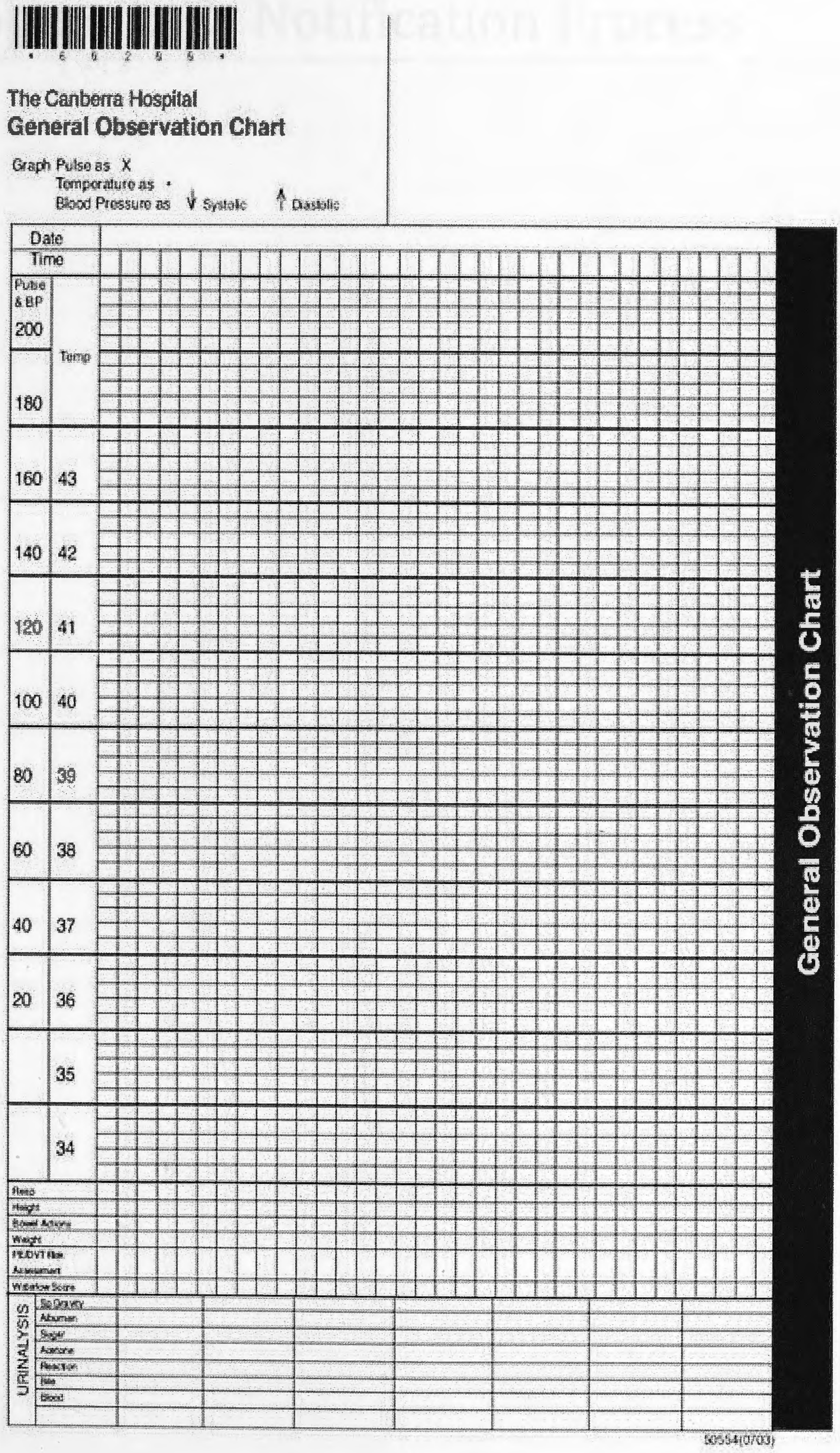
	(Goldhill et al., 2005)		<35	35-35.9	36-37.4	37.5-38.4	>=38.5	
Central Nervous System	(Day, 2003)				Alert and orientated	Responds only to voice	Responds only to pain	Unconscious
	(Morgan et al., 1997)				A	V	P	U
	(Subbe et al., 2003)				Alert	Reacting to voice	Reacting to Pain	Unresponsive
	(Odell et al., 2007)	Unresponsive	Pain	Voice/or new confusion	Alert			
	(Pittard, 2003)			Confused	Awake and Responsive	Responds to verbal commands	Responds to painful stimuli	Unresponsive
	(Goldhill et al., 2005)				Alert	Confused	Responds to voice	Responds to pain or unresponsive
Urine	(Day, 2003)	Anuric	<0.5ml.kg/h			>1.5ml/kg/h		
	(Morgan et al., 1997)	-	-	-	-	-	-	-
	(Subbe et al., 2003)	-	-	-	-	-	-	-
	(Odell et al., 2007), in 2 h	0	<=30ml/h	31-44ml/h	45ml/h or more			
	(Pittard, 2003),in 4 h	<80mls	80-120mls	120-200mls		>800mls		
	(Goldhill et al., 2005)	Nil	<0.5ml/kg/hr	Dialysis	0.5-3ml/kg/hr	>3ml/kg/hr		
SaO_2	(Day, 2003)	-	-	-	-	-	-	-
	(Morgan et al., 1997)	-	-	-	-	-	-	-
	(Subbe et al., 2003)	-	-	-	-	-	-	-
	(Odell et al., 2007)	-	-	-	-	-	-	-
	(Pittard, 2003)	<85%	86-89%	90-94%	>95%	-	-	-
	(Goldhill et al., 2005)	-	-	-	-	-	-	-
Respiratory Support	(Pittard, 2003)	BiPAP, CPAP	Hi Flow	Supplemental O_2.				

Appendix B: Examples of Rapid Response Teams (Triggers and Team Member

	HR	BP	RR	GCS	UO	SaO2	Combination	Other
PART(Goldhill et al., 1999)	≥110	≥90	≥25	Not fully alert	≤100ml/4 hours	<90	3 or more, or not fully alert and HR≥140 OR RR≥36	
MET (Parr et al., 2001)	CA, <40, >140	<90	RA, <5, >36	Sudden fall in GCS, GCS>2 point fall, seizures	-	-	-	Seriously worried , airway threatened
MET (Bellomo et al., 2003)	<40 or >130	<90	<8 or >30	Acute change in conscious state	<50ml /4hours	<90% despite O2 admin		Any staff member worried about a patient
MET (DeVita et al., 2004)	<40 or >140 with symptoms or >160	<80 or >200 or DBP>110 with symptoms	<8 or >36, new onset difficulty in breathing	Acute loss of consciousness, new lethargy, seizures, sudden movement loss face, arm, leg		<85% for more than 5 minutes		Colour change, chest pain, unexplained agitation
ME (MERIT Study Investigators, 2005)T	CA, <40, >140	<90	RA, <5, >36	Sudden fall in GCS, GCS>2 point fall, seizures	-	-	-	Anyone seriously worried about, airway threatened
ENIT (Daly et al., 2007)	<40 or >130	SBP <90	<8 or >30	Mental state changes, seizures		Below baseline while receiving supplemental O_2		Acute bleeding
MET (Calzavacca et al., 2008)	<40 or >120	<90	<8 or >25, dyspnoea	Acute change in neuro state, unarousable patient	<50ml/4 hours	<90		Airway obstruction , stridor, noisy breathing, problems with trache tube
MET (Konrad et al., 2010)	<40 or >130	<90	<8 or >30	Sudden altered level of consciousness		<90		Worried
(Santamaria et al., 2010) Santamaria:	CA, <40, >140	<90	RA, <5, >36	Sudden fall in GCS, GCS>2 point fall, seizures	-	-	-	Seriously worried , airway threatened

Appendix C: Old Ward Observation Chart





* 6 5 2 5 5 *

The Canberra Hospital
General Observation Chart

Graph Pulse as X
Temperature as •
Blood Pressure as ↓ Systolic ↑ Diastolic

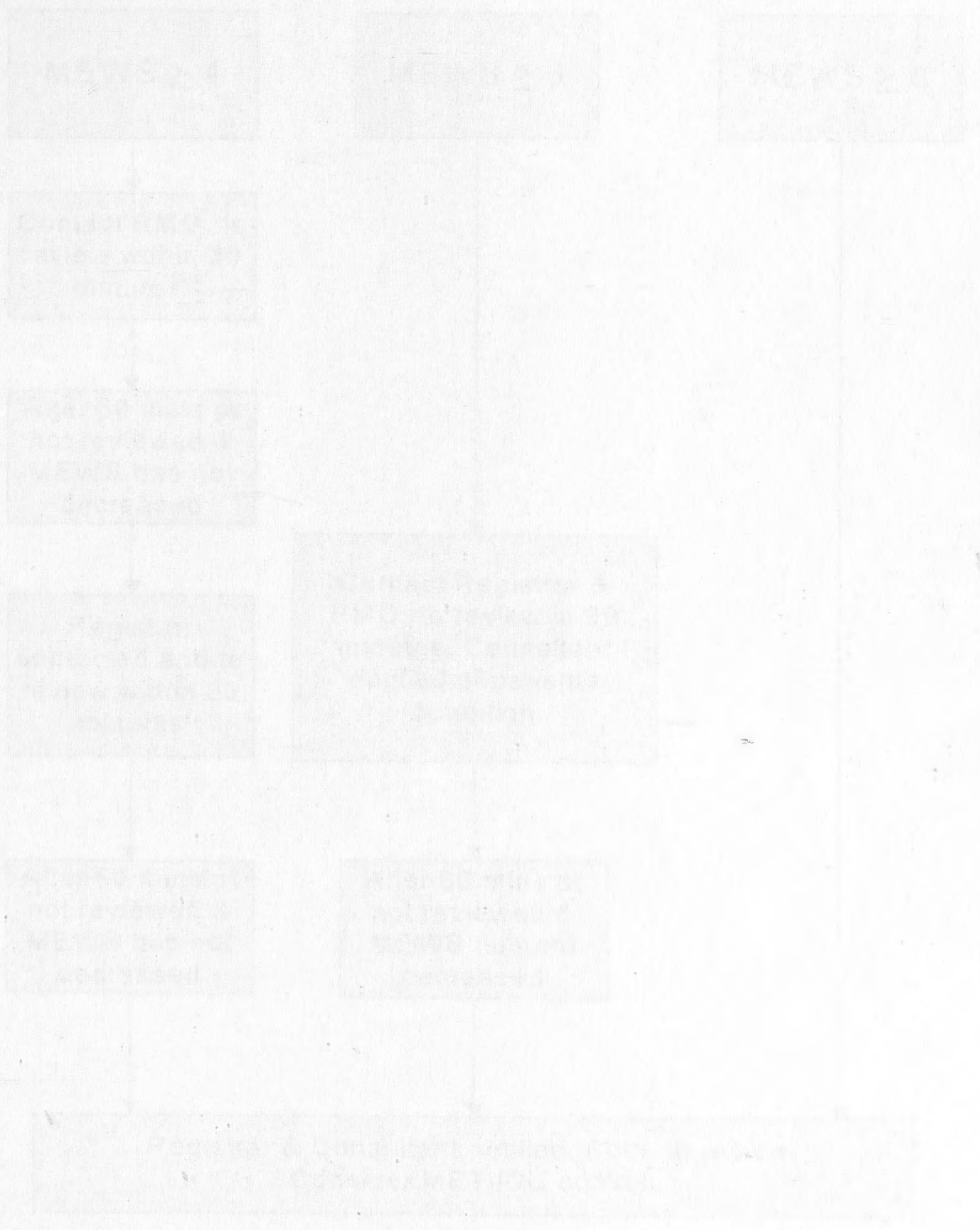
Date		
Time		
Pulse & BP 200	Temp	
180		
160	43	
140	42	
120	41	
100	40	
80	39	
60	38	
40	37	
20	36	
	35	
	34	
Resp		
Height		
Bowel Actions		
Weight		
PE/DVT Risk Assessment		
Waterlow Score		

URINALYSIS	Sp Gravity	
	Albumen	
	Sugar	
	Acetone	
	Reaction	
	Bile	
	Blood	

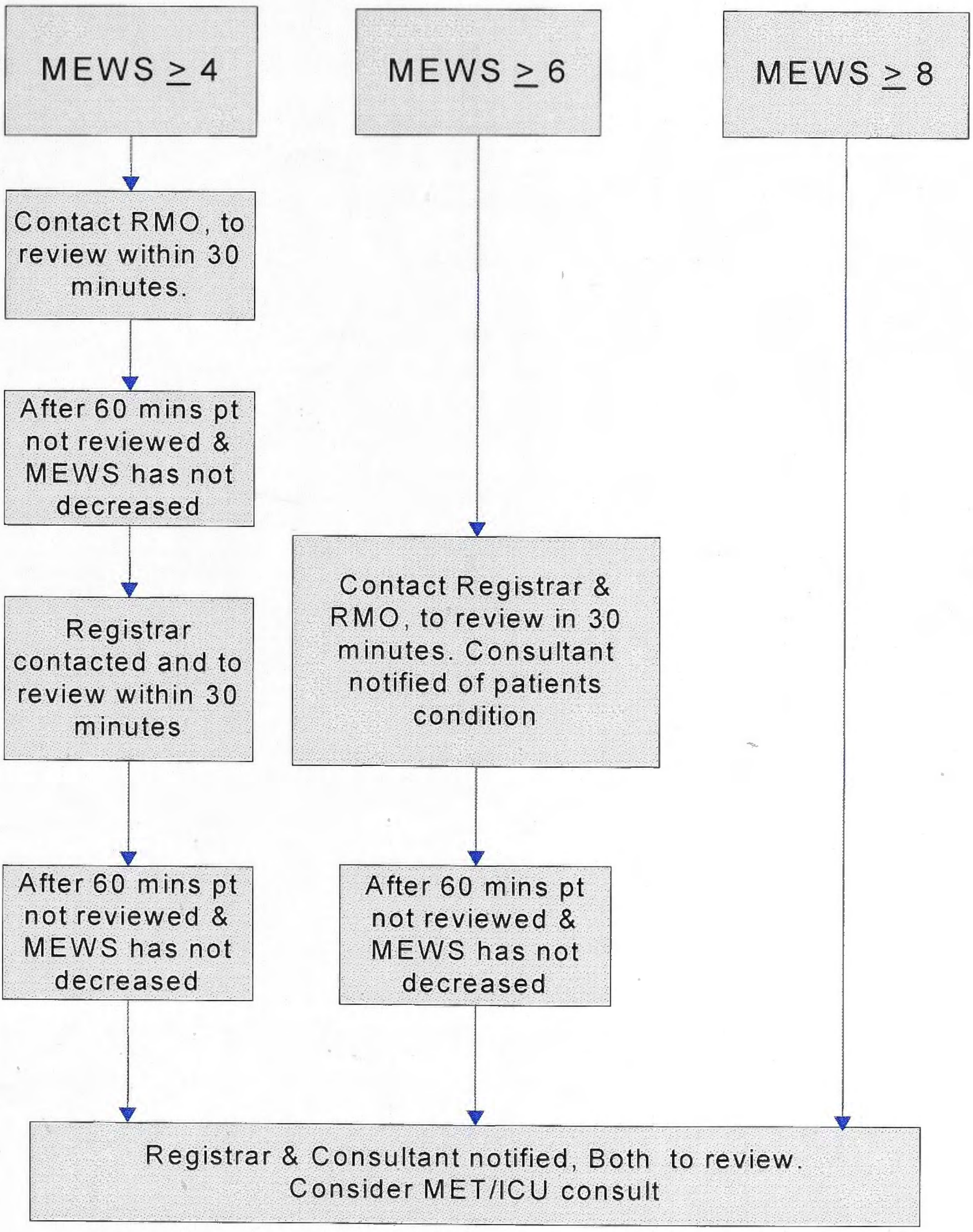
General Observation Chart

50554(0703)

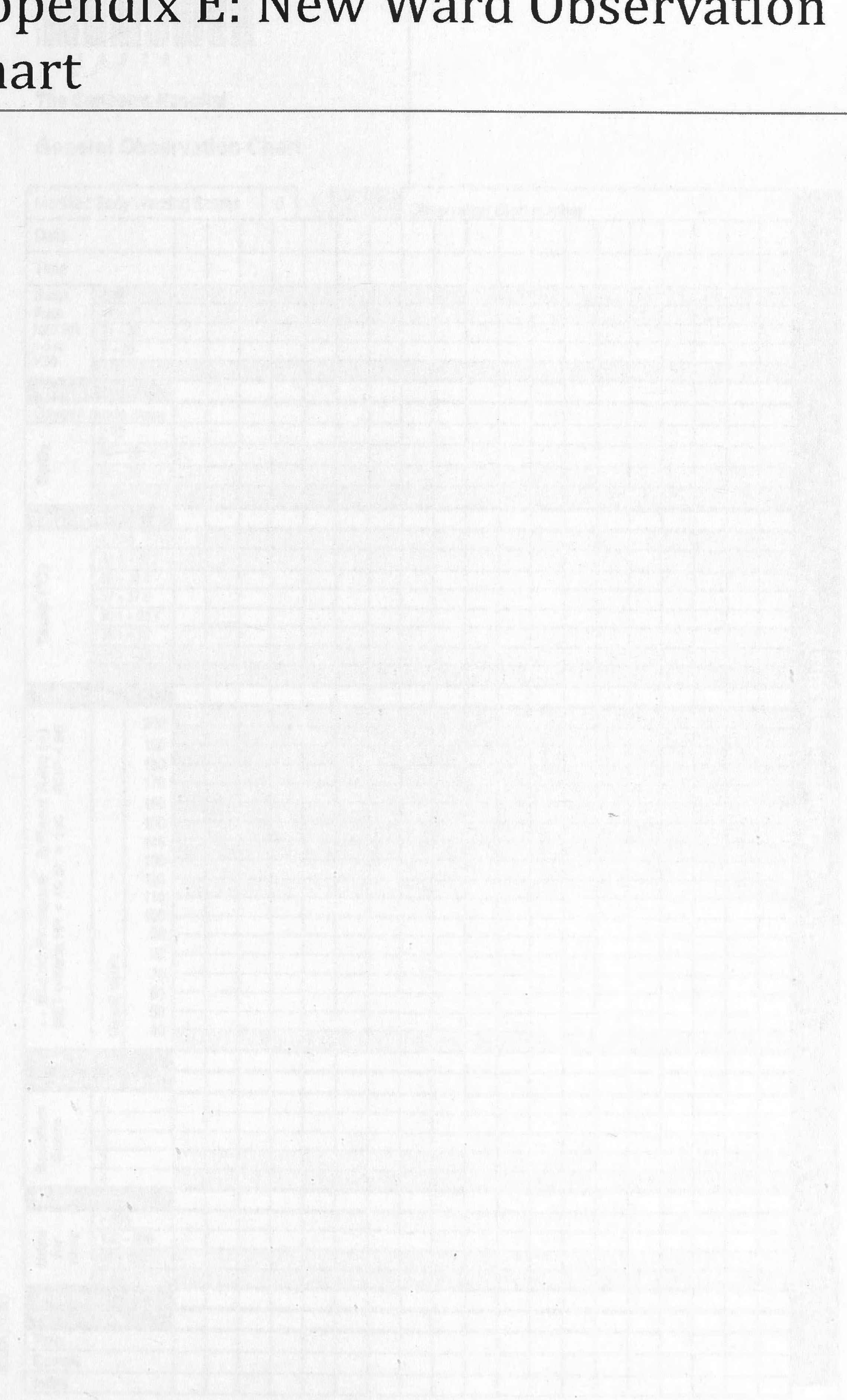
Appendix D: Notification Process



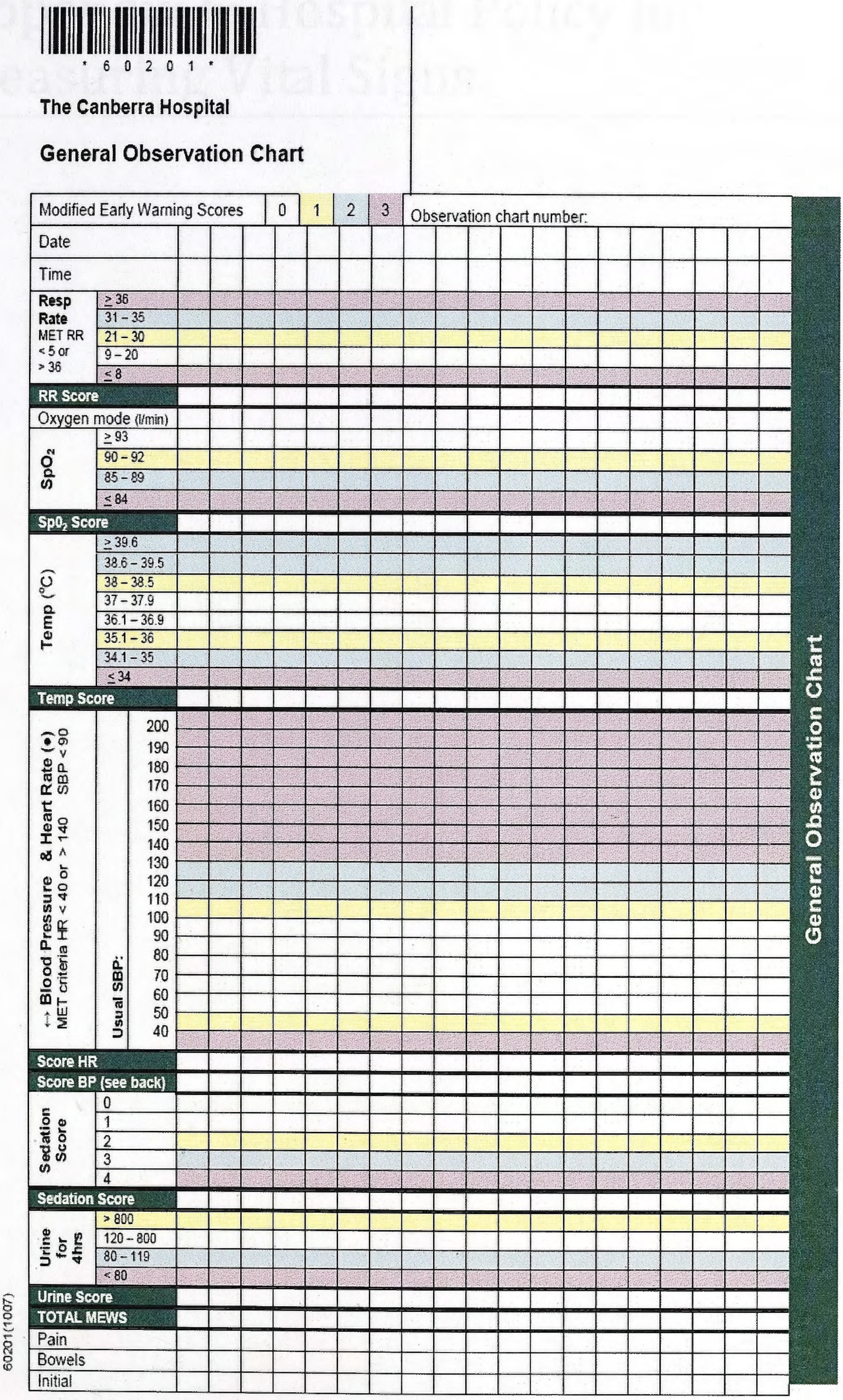
Appendix E: New Ward Observation Chart



Appendix E: New Ward Observation Chart



Appendix F: Hospital Policy for Measuring Vital Signs



* 6 0 2 0 1 *

The Canberra Hospital

General Observation Chart

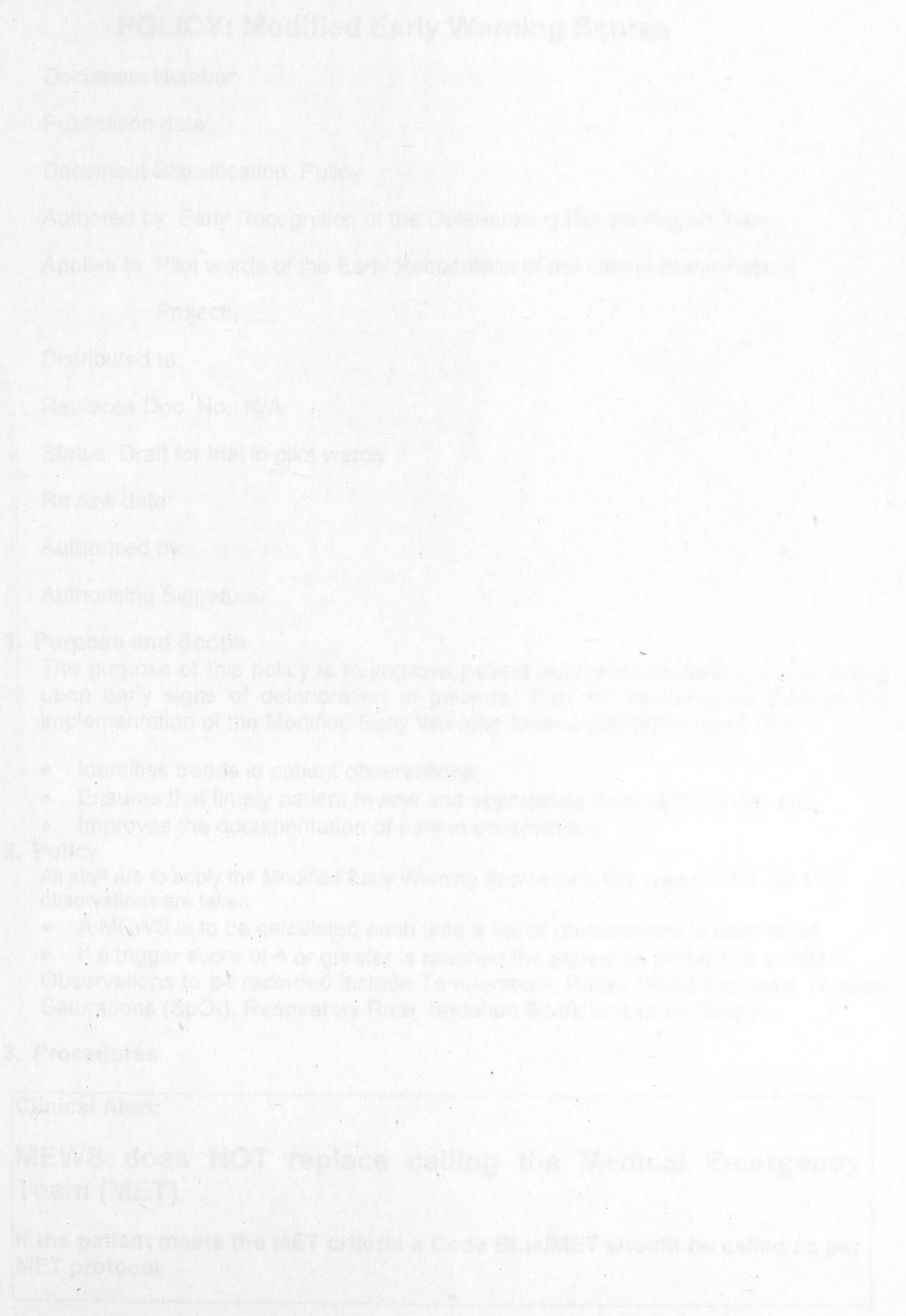
Modified Early Warning Scores | 0 | 1 | 2 | 3 | Observation chart number:

Date																				
Time																				
Resp Rate MET RR < 5 or > 36	≥ 36																			
	31 – 35																			
	21 – 30																			
	9 – 20																			
	≤ 8																			
RR Score																				
Oxygen mode (l/min)																				
SpO₂	≥ 93																			
	90 – 92																			
	85 – 89																			
	≤ 84																			
Sp0₂ Score																				
Temp (°C)	≥ 39.6																			
	38.6 – 39.5																			
	38 – 38.5																			
	37 – 37.9																			
	36.1 – 36.9																			
	35.1 – 36																			
	34.1 – 35																			
	≤ 34																			
Temp Score																				
↔ **Blood Pressure & Heart Rate (•)** MET criteria HR < 40 or > 140 SBP < 90	200																			
Usual SBP:	190																			
	180																			
	170																			
	160																			
	150																			
	140																			
	130																			
	120																			
	110																			
	100																			
	90																			
	80																			
	70																			
	60																			
	50																			
	40																			
Score HR																				
Score BP (see back)																				
Sedation Score	0																			
	1																			
	2																			
	3																			
	4																			
Sedation Score																				
Urine for 4hrs	> 800																			
	120 – 800																			
	80 – 119																			
	< 80																			
Urine Score																				
TOTAL MEWS																				
Pain																				
Bowels																				
Initial																				

General Observation Chart

60201(1007)

Appendix F: Hospital Policy for Measuring Vital Signs



POLICY: Modified Early Warning Scores

Document Number:

Publication date:

Document Classification: Policy

Authored by: Early Recognition of the Deteriorating Patient Project Team

Applies to: Pilot wards of the Early Recognition of the Deteriorating Patient

Project.

Distributed to:

Replaces Doc. No.: N/A

Status: Draft for trial in pilot wards

Review date:

Authorised by:

Authorising Signature:

1. **Purpose and Scope**

The purpose of this policy is to improve patient outcomes by detecting and acting upon early signs of deterioration in patients. This will be achieved through the implementation of the Modified Early Warning Scores (MEWS) which:

- Identifies trends in patient observations
- Ensures that timely patient review and appropriate escalation occurs
- Improves the documentation of patient observations

2. **Policy**

All staff are to apply the Modified Early Warning Scores (MEWS) (if appropriate) when observations are taken.

- A MEWS is to be calculated each time a set of observations is performed.
- If a trigger score of 4 or greater is reached the appropriate protocol is initiated.

Observations to be recorded include Temperature, Pulse, Blood Pressure, Oxygen Saturations (SpO_2), Respiratory Rate, Sedation Score and Urine Output.

3. **Procedures**

Clinical Alert:

MEWS does NOT replace calling the Medical Emergency Team (MET).

If the patient meets the MET criteria a Code Blue/MET should be called as per MET protocol.

ACT Health

POLICY: Modified Early Warning Scores

Document Number:

Publication date:

Document Classification: Policy

Authored by: Early Recognition of the Deteriorating Patient Project Team

Applies to: Pilot wards of the Early Recognition of the Deteriorating Patient Project

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Status: Draft for trial in pilot wards

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1. Purpose and Scope

The purpose of this policy is to improve patient outcomes by detecting and acting upon early signs of deterioration in patients. This will be achieved through the implementation of the Modified Early Warning Scores (MEWS) system that:

- Identifies trends in patient observations;
- Ensures that timely patient review and appropriate treatment occurs; and
- Improves the documentation of patient observations.

2. Policy

All staff are to apply the Modified Early Warning Scores (MEWS) system when patient observations are taken:

- A MEWS is to be calculated each time a set of observations is performed.
- If a trigger score of 4 or greater is reached the activation protocol is initiated.

Observations to be recorded include Temperature, Pulse, Blood Pressure, Oxygen Saturations (SpO_2), Respiratory Rate, Sedation Score and Urine Output.

3. Procedures

Clinical Alert:

MEWS does NOT replace calling the Medical Emergency Team (MET).

If the patient meets the MET criteria a Code Blue/MET should be called as per MET protocol.

Each individual observation is scored according to the criteria in Attachment A.

The blood pressure score is determined by calculating the difference between the current reading and the patient's usual blood pressure.

The MEWS is calculated and documented on the trial General Observation Chart, which incorporates the MEWS. If a different chart is being used then the MEWS score is still required to calculated and recorded.

The patient's **usual** systolic blood pressure is to be recorded on the blood pressure table on the observation chart in the space provided; the **medical officer must** be consulted in determining the usual systolic blood pressure for the patient.

Additional considerations relating to the MEWS for the individual patient can be documented in the space provided (i.e. chronic lung disease, dialysis patients).

If the total MEWS reaches an initial trigger point of **4** the activation protocol is to be initiated (see Attachment B).

Clinical Alert:

If the MEWS is 4 or greater the protocol is activated.

If the score is equal to or greater than 4, the frequency of observations is escalated to:

- ½ hourly for the first hour (or more frequently if the patient's condition dictates).
- Then hourly for the next four hours
- Then 4/24 for the next 24 hours

If the trigger score is reached, the following guide is to be used if the patient requires escort out of the ward area.

- MEWS ≥ 4 Registered Nurse
- MEWS ≥ 6 Registered Nurse & Intern
- MEWS ≥ 8 Registered Nurse & Registrar

Clinical Alert:

At the time of reaching a trigger score the nurse MUST also notify the team leader or CNC.

4. Attachments

Attachment A

MEWS Calculation:

MEWS Score	3	2	1	0	1	2	3
Resp Rate	≤ 8			9-20	21-30	31-35	≥36
SpO_2	≤ 84	85-89	90-92	≥93			
Temperature	≤ 34	34.1-35	35.1-36	36.1-37.9	38-38.5	≥ 38.6	
Heart Rate	≤ 40		41-50	51-99	100-110	111-130	>130
Blood pressure	See chart below						
Sedation Score				0-1	2	3	4
UOP for 4 hrs	<80	80-119		120-800	>800		

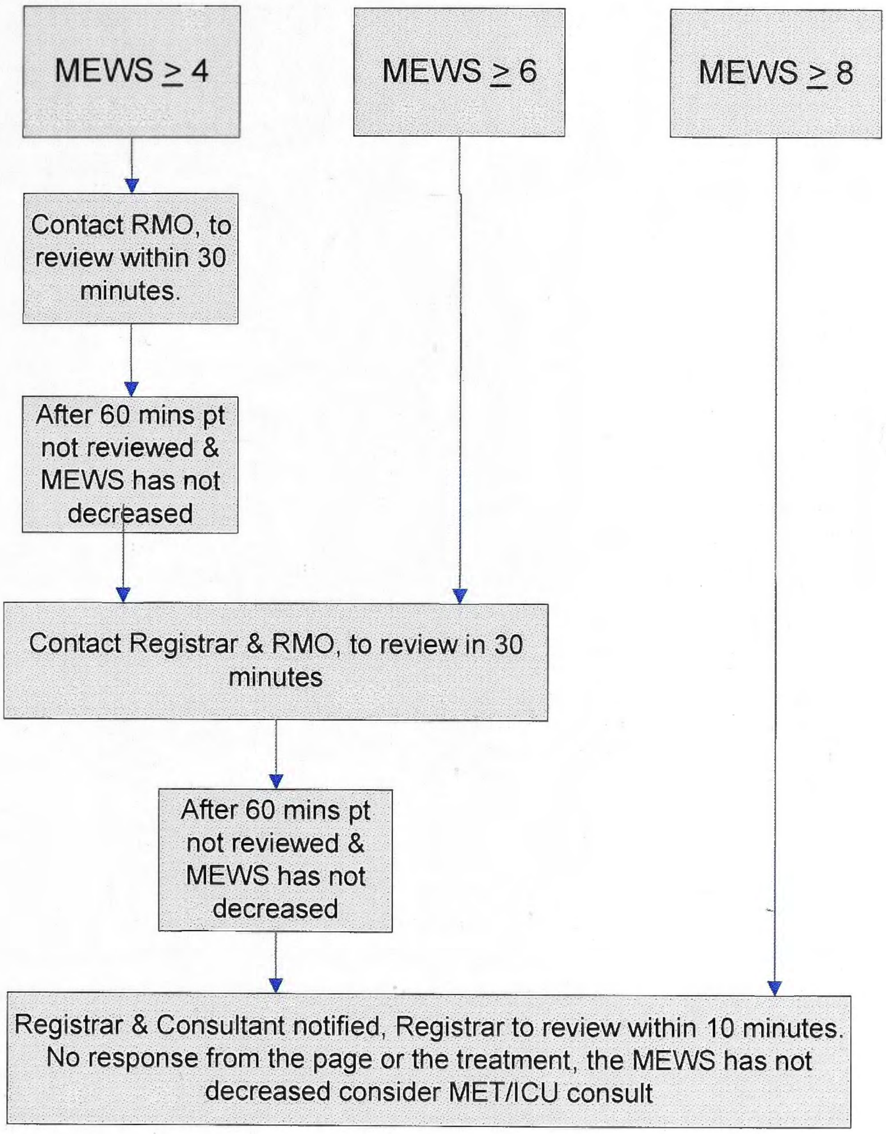
Patient's Usual Systolic BP =

Additional considerations:

	Usual SBP		180	170	160	150	140	130	120	110	100	90	80
Current Blood Pressure	200s		0	1	1	2	2	2	3	3	4	5	5
	190s		0	0	1	1	1	2	2	3	3	4	4
	180s		0	0	0	0	1	1	2	2	3	3	4
	170s		0	0	0	0	1	1	2	2	3	3	3
	160s		1	0	0	0	0	0	1	1	2	2	2
	150s		1	1	0	0	0	0	0	1	1	2	2
	140s		1	1	1	0	0	0	0	0	1	1	1
	130s		2	1	1	0	0	0	0	0	0	0	1
	120s		2	2	1	1	0	0	0	0	0	0	0
	110s		2	2	2	1	1	0	0	0	0	0	0
	100s		3	3	2	2	2	1	1	0	0	0	0
	90s		3	3	3	2	2	2	2	1	1	0	0
	80s	MET 4				MET 3				MET 2		1	0
	70s									MET 1			

Attachment B

Notification is to occur using the following flow chart:



Appendix G: Participant Information Sheet for Behavioural Study

Intensive Care Unit
Phone: (02) 6244 2222 Fax: (02) 6285 2020
Website: www.health.act.gov.au
ABN: 82 049 056 234

Participant Information Sheet

"Perceptions of the Recognition of the Deteriorating Patient Intervention"

General Background Information

Patient adverse events occur in up to 17% of all hospital admissions. Of these, nearly 20% suffer death or permanent disability. One of the factors that has been identified in the causation of these patient adverse events is the failure to recognise and appropriately manage deteriorating patients on the general ward. The failure to recognise deteriorating patients is evidenced by delays in admission to the intensive care unit (ICU), unexpected referrals to intensive care and unexpected deaths that are often being preceded by significant, unrecognised physiological disturbances. The ability to detect early deterioration in patients allows early appropriate intervention, which may reduce unplanned admissions to the intensive care unit and unexpected deaths.

ACT Background Information

In 2006, ACT Health sponsored a project 'Early Recognition of the Deteriorating Patient' which was a prospective, controlled before and after intervention trial. The intervention included the employment of a new education package "COMPASS" available to all health care workers, the installment of a new observation chart and the utilisation of a track and trigger system in four general hospital wards at two hospitals (The Canberra Hospital and Calvary Hospital). The aim was to determine whether this intervention increased the early recognition of the deteriorating patient, which would be measured by the number of unplanned admissions to intensive care, the number of cardiac arrests and the overall hospital mortality. The study was completed in June 2007 and data analysis suggests that there was a significant improvement in patient outcome. There was a reduction in hospital mortality and a reduction in unplanned admissions to the intensive care unit. There was also an increase in the documentation of vital signs and an increase in the number of medical emergency team call outs.

What does it involve?

Approval has been given by the ACT Department of Health Ethics Committee to undertake a project that will allow the understanding of the overall impact of the intervention, a qualitative assessment of the thoughts and perceptions of health care workers needs to be undertaken. This will involve semi-structured interviews of a random, representative sample of the health care workers involved in the original intervention. There will also be semi-structured interviews pre and post intervention of a random, representative sample of the healthcare workers in areas where the intervention will occur in the coming months. The project will involve an interview lasting 30 minutes where questions will be asked relevant to the understanding of why the recognition of the deteriorating patient project may positively influence patient outcome.

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HOSPITAL
A division of ACT Health

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Yamba Drive, Garran ACT 2605
PO Box 11 Woden ACT 2606
Phone: (02) 6244 2222 Fax: (02) 6285 3020
Website: www.health.act.gov.au
ABN: 82 049 056 234

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General Background Information

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ACT Background Information

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What will be the outcome of the project?

The interviews will help determine whether the health care workers perceived the intervention as useful to patient care and try and elucidate which, if any, part of the intervention was deemed more useful. This will allow improvements to be made to the intervention to not only improve patient care but also patient outcome.

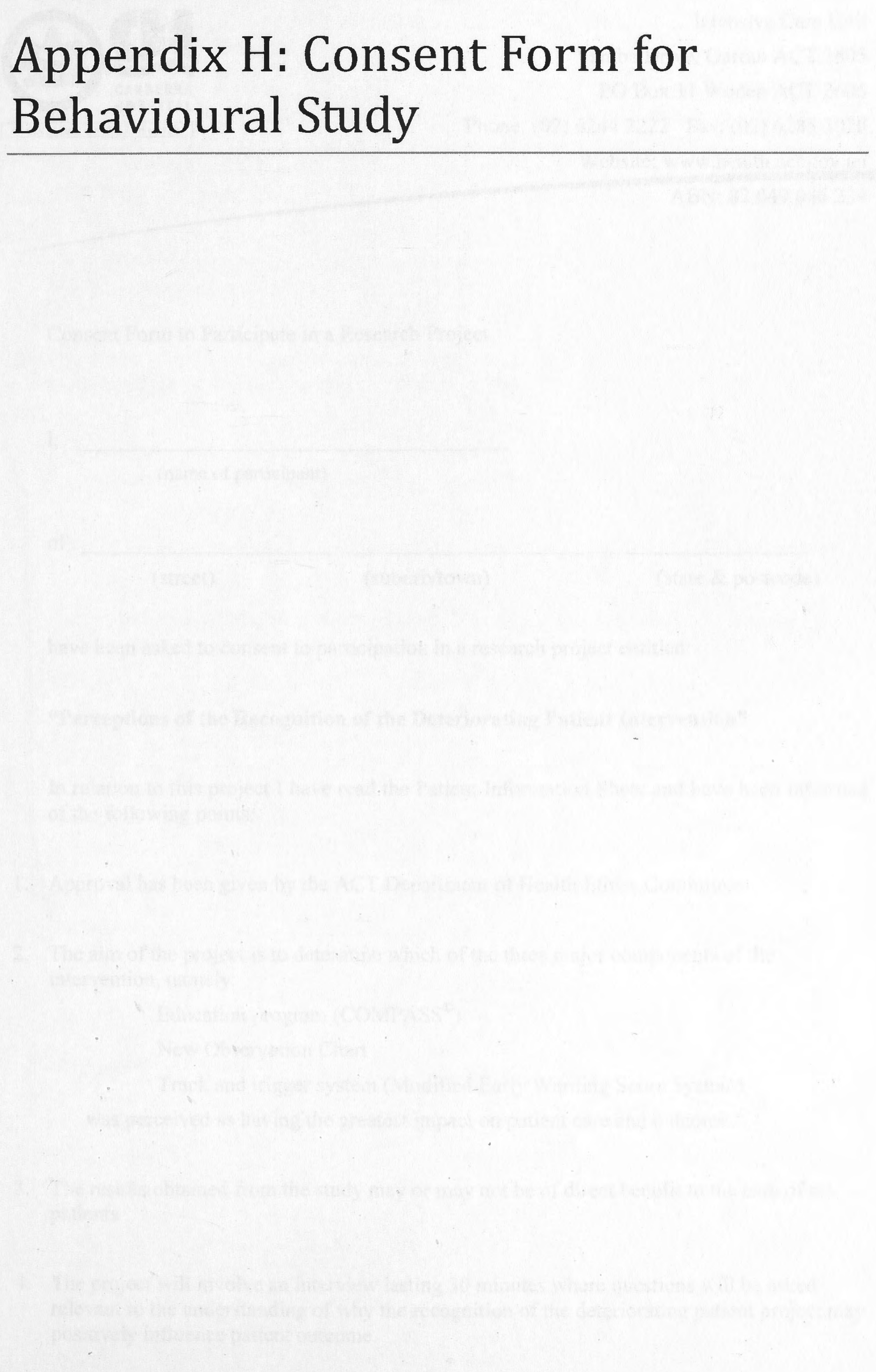
Who can I contact about the actual Study?

Should I develop a problem which I suspect may have resulted from my involvement in this project, I am aware that I may contact –Dr Imogen Mitchell, Director, Intensive Care, The Canberra Hospital, Garran ACT 2605, Tel: 02 6244 3305, email: Imogen.mitchell@act.gov.au

Who can I contact in General?

Should I have any problems or queries about the way in which the study was conducted, and I do not feel comfortable contacting the research staff, I am aware that I may contact the ACT Department of Health Ethics Committee Secretary, 11 Moore Street, Canberra City, ACT 2601, telephone (02) 62050846.

Appendix H: Consent Form for Behavioural Study



Intensive Care Unit
[illegible] Garran ACT 2605
PO Box 11 Woden ACT 2606
Phone: (02) 6244 2222 Fax: (02) 6244 [illegible]
Website: www.health.act.gov.au
ABN: 82 049 056 234

Consent Form to Participate in a Research Project

I, ______________________________
(name of participant)

of ______________________________
(street) (suburb/town) (state & postcode)

have been asked to consent to participation in a research project entitled

"Perceptions of the Recognition of the Deteriorating Patient Intervention"

In relation to this project I have read the Patient Information Sheet and have been informed of the following points:

1. Approval has been given by the ACT Department of Health Ethics Committee.

2. The aim of the project is to determine which of the three major components of the intervention, namely:
   - Education program (COMPASS®)
   - New Observation Chart
   - Track and trigger system (Modified Early Warning Score System)

   was perceived as having the greatest impact on patient care and outcomes.

3. The results obtained from the study may or may not be of direct benefit to the care of future patients.

4. The project will involve an interview lasting 30 minutes where questions will be asked relevant to the understanding of why the recognition of the deteriorating patient project may positively influence patient outcome.

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Consent Form to Participate in a Research Project

I, ______________________________
(name of participant)

of ____
(street) (suburb/town) (state & postcode)

have been asked to consent to participation in a research project entitled:

"Perceptions of the Recognition of the Deteriorating Patient Intervention"

In relation to this project I have read the Patient Information Sheet and have been informed of the following points:

1. Approval has been given by the ACT Department of Health Ethics Committee.

2. The aim of the project is to determine which of the three major components of the intervention, namely:

   Education program (COMPASS©)

   New Observation Chart

   Track and trigger system (Modified Early Warning Score System)

   was perceived as having the greatest impact on patient care and outcome.

3. The results obtained from the study may or may not be of direct benefit to the care of my patients

4. The project will involve an interview lasting 30 minutes where questions will be asked relevant to the understanding of why the recognition of the deteriorating patient project may positively influence patient outcome.

5. Should I develop a problem which I suspect may have resulted from my involvement in this project, I am aware that I may contact –Dr Imogen Mitchell, Director, Intensive Care, The Canberra Hospital, Garran ACT 2605, Tel: 02 6244 3305, email: Imogen.mitchell@act.gov.au

6. Should I have any problems or queries about the way in which the study was conducted, and I do not feel comfortable contacting the research staff, I am aware that I may contact the ACT Department of Health Ethics Committee Secretary, 11 Moore Street, Canberra City, ACT 2601, telephone (02) 62050846.

7. I can refuse to take part in this project or withdraw from it at any time without affecting my workplace environment.

8. Participation in this project will not result in any extra costs to me and can occur during working hours, at the discretion of my area supervisor

9. I understand that the results of the research will be made accessible and that my involvement and my identity will not be revealed.

After considering all these points, I accept the invitation to participate in this project.

I also state that I have/have not participated in any other research project in the past 3 months. If I have, the details are as follows:

____

Date: ___ **Witness:** ______________________________

(Please print name)

Signature: ____________________ ______________________

(of participant/volunteer) (of witness)

Investigator's Signature: ______________________________

Appendix I: Interview Guide for Behavioural Study

Semi Structured Interview

[illegible] of the Recognition of the Deteriorating Patient Intervention

A. General Questions

1. What ward are you currently working on?
2. What is your current role on the ward you are working?
3. When did you graduate?
4. Where did you graduate?

B. Questions Relevant to those participants that have yet to experience the Recognition of the Deteriorating Patient Intervention

1. Are you aware of the Early Recognition of the Deteriorating Intervention?
2. What details are you familiar with?
3. In your own mind, do you think we have a difficulty in recognising the deteriorating patient?
4. What aspects or areas of our patient care, if any, particularly concern you?
5. If you were able to change the way we care for our patients and particularly the recognition of the deteriorating patient, what would you change?
6. What do you think of the current general observation chart?
7. Do you feel that your university gave you a good grounding in why we record observations and the reasons why they might be abnormal?
8. Have you ever called a MET?
9. Do you feel comfortable calling a registrar/MET/Consultant?
10. Do you feel that your university gave you a good grounding in the way we communicate information to senior doctors?
11. Have you heard of a MEWS?

C. Questions Relevant to those participants that experienced the Recognition of the Deteriorating Patient Intervention during the pilot project in 2007

1. What was your role between February and June 2007 on SAU/MAU/[illegible]?
2. Do you know anything about the Early Recognition of the Deteriorating Patient project?
3. If you do know something, what do you know about the project?
4. Did you think that there was adequate information about the project during the lifetime of the pilot study?
5. How might you have improved the information and understanding of the project if you were [illegible] running a similar project?
6. Are you aware of the results?

D. Questions Relevant to those participants that experienced the Recognition of the Deteriorating Patient Intervention during the pilot project in 2007 and those participants that will have experienced the Intervention and will have been interviewed prior to the introduction of the Intervention

1. The project appeared to demonstrate an improvement in outcome for patients on these wards, reduced unplanned admissions to the intensive care unit and reduced patient complaints with regard to patient care and management, are you able to give me any personal insight why you think this may be the case?

Semi Structured Interview

"Perceptions of the Recognition of the Deteriorating Patient Intervention"

A. General Questions

1. What ward are you currently working on?
2. What is your current role on the ward you are working?
3. When did you graduate?
4. Where did you graduate?

B. Questions Relevant to those participants that have yet to experience the Recognition of the Deteriorating Patient Intervention

1. Are you aware of the Early Recognition of the Deteriorating intervention?
2. What details are you familiar with?
3. In your own mind, do you think we have a difficulty in recognising the deteriorating patient/
4. What aspects or areas of our patient care, if any, particularly concern you?
5. If you were able to change the way we care for our patients and particularly the recognition of the deteriorating patient, what would you change?
6. What do you think of the current general observation chart?
7. Do you feel that your university gave you a good grounding in why we record observations and the reasons why they might be abnormal?
8. Have you ever called a MET?
9. Do you feel comfortable calling a registrar/MET/Consultant?
10. Do you feel that your university gave you a good grounding in the way we communicate information to seniors/doctors?
11. Have you heard of a MEWS?

C. Questions Relevant to those participants that experienced the Recognition of the Deteriorating Patient Intervention during the pilot project in 2007

1. What was your role between February and June 2007 on 9A/10A/5W/4E?
2. Do you know anything about the Early Recognition of the Deteriorating Patient project?
3. If you do know something, what do you know about the project?
4. Did you think that there was adequate information about the project prior to the initiation of the pilot study?
5. How might you have improved the information and understanding of the project if you had been running a similar project?
6. Are you aware of the results?

D. Questions Relevant to those participants that experienced the Recognition of the Deteriorating Patient Intervention during the pilot project in 2007 and those participants that will have experienced the intervention and will have been interviewed prior to the introduction of the intervention

1. The project appeared to demonstrate an improvement in outcome for patients on these wards, reduced unplanned admissions to the intensive care unit and reduced patient complaints with regard to patient care and management, are you able to give me any personal insight why you think this may be the case?

2. What do you believe to be the biggest influence on the change of outcome?
3. Did you manage to attend one of the COMPASS© education sessions?
4. If did manage to get to one, did you have an opportunity to read and listen to the material beforehand?
5. Did you get an opportunity to do the quiz prior to going to the face to face session?
6. Was anything in the material before going to the face to face that was particularly useful? Any that was particularly difficult or confusing?
7. Did you think the face to face sessions related to what you do on the ward? Explore answer with regard to interpreting observations, ability to communicate, ability to prioritise seeing patients and better understanding of how to initiate patient care when they are deteriorating.

E. Direct Questions

Observations and Interpretation

- a. What did you think of the new observation chart?
- b. Has the way you have done observations changed since the intervention?
- c. If so, were there any in particular that were more interesting than others and why was this the case?
- d. Following the introduction of ERDP, did you notice if observations were recorded any differently?
- e. Did you take notice of observations any more yourself, did they get incorporated into your routine review of the patient particularly on ward rounds? Did anyone else in the team look at them before and after the pilot trial?
- f. Were there any observations in particular that interested you more than they used to? Why was this the case?
- g. Did the education program help improve your understanding and importance of observations?
- h. Did this help you manage the patient when they were deteriorating?
- i. In what way did it help you manage the patient?
- j. Did you think that the MET was called more often than it had been before?
- k. Do you think that this is helpful?
- l. If so, why do you think it was helpful?

Communication

- a. Had you heard of the SBAR method of communication?
- b. Do you remember what it was about?
- c. Do you think it has any merits and what do you think they are?
- d. Did you ever find yourself using it?
- e. Why do you think we use the SBAR so infrequently?
- f. What would help facilitate its dissemination?
- g. How do you think patient care might change if more nurses used SBAR?

Track and Trigger System

- a. Do you remember the MEWS system?
- b. What is your understanding of it?
- c. Did you ever call a doctor because of a high MEWs?
- d. Did you feel it gave you more confidence to call the doctor?
- e. Did you feel that it was taking away your ability to think for yourself?
- f. Did the MEWs often match what your thought was happening to the patient or were you surprised sometimes at the level of the score?
- g. If you called a doctor to describe that you had a patient had a MEWS of four or more, what response did you have?

    The doctor realised that they had a sick patient and came to see them quickly

    The doctor realised that they had a sick patient and gave a telephone order
    The doctor did not realise that they had a sick patient but came to see them quickly
    The doctor did not realised that they had a sick patient and did not come to see them quickly

h. Did it enable you to prioritise which patient to see next
i. Feel more confident to communicate more successfully with your registrar/consultant
j. Did you communicate more readily and more confidently with your seniors when calling about a patient deteriorating
k. Did you ever have to accompany a patient to Medical Imaging? Did you think it was appropriate that you should accompany the patient?
l. Would you like to see the MEWS on other wards?
m. If you think it is helpful, why do you think it I helpful?

F. Overall

How would you improve the process of:

Installation

Content of the education package

The day to day running of the process.

Appendix J: Participant Information Sheet for Human Element Study

[illegible]
[illegible]
PO Box 11 Woden ACT 2606
Phone: (02) 6244 2222 Fax: (02) [illegible]
Website: www.health.act.gov.au

Participant Information Sheet

"Perceptions of the Recognition of the Deteriorating Patient intervention"

General Background Information

Patient adverse events occur in up to 17% of all hospital admissions. Of these, nearly 20% suffer death or permanent disability. One of the factors that has been identified in the causation of these patient adverse events is the failure to recognise and appropriately manage deteriorating patients on the general ward. The failure to recognise deteriorating patients is evidenced by delays in admission to the intensive care unit (ICU), unexpected referrals to intensive care and unexpected deaths that are often being preceded by significant, unrecognised physiological disturbances. The ability to detect early deterioration in patients allows early appropriate intervention, which may reduce unplanned admissions to the intensive care unit and unexpected deaths.

ACT Background Information

In 2006, ACT Health sponsored a project "Early Recognition of the Deteriorating Patient" which was a prospective, controlled before and after intervention trial. The intervention included the development of a new education package "COMPASS" available to all healthcare workers, the introduction of a new observation chart and the utilisation of a track and trigger system in four general hospital wards at two hospitals (The Canberra Hospital and Calvary Hospital). The study was completed in June 2007 and data analysis suggests that there was a significant improvement in patient outcome and decrease in adverse events.

Since 2007, despite a robust system in place to recognise and respond to deteriorating patients, health care workers are still failing to recognise and respond to deteriorating patients. Using focus groups and critical incident methods insight will be gained into why healthcare workers feel that they fail to recognise and respond to deteriorating patients.

What does it involve?

Approval has been given by the ACT Department of Health Ethics Committee to undertake a project that will use modified focus groups. This will allow healthcare workers to consider and discuss their own experiences of caring for deteriorating patients and relate any similar incidents and discuss experiences as a collective to provide an opportunity to explore the understanding of why healthcare workers do not recognise and respond to deteriorating patients and provide rich perspectives. This method provides holistic views, unlimited by defined and discrete areas of inquiry and unencumbered by theoretically derived hypotheses. Six volunteers will be sought to develop the themes that have arisen out of the focus groups.

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Since 2007, despite a robust system in place to recognise and respond to deteriorating patients, health care workers are still failing to recognise and respond to deteriorating patients. Using focus groups and critical incident methods insight will be gained into why healthcare workers feel that they fail to recognise and respond to deteriorating patients.

What does it involve?

Approval has been given by the ACT Department of Health Ethics Committee to undertake a project that will use stratified focus groups. This will allow healthcare workers to consider and discuss their own experiences of caring for deteriorating patients and relate any similar incidents and discuss experiences as a collective to provide an opportunity to explore the understanding of why healthcare workers do not recognise and respond to deteriorating patients and provide novel perspectives. This method provides holistic views, unlimited by defined and discrete areas of inquiry and unencumbered by theoretically derived hypotheses. Six volunteers will be sought to develop any themes that have arisen out of the focus groups.

What will be the outcome of the project?

The focus groups will help gain insights into the experiences and beliefs of healthcare workers and development themes and concepts from this will inform further development of the multifaceted intervention, most particularly the 'human factor'.

Who can I contact about the actual Study?

Should I develop a problem which I suspect may have resulted from my involvement in this project, I am aware that I may contact –Dr Imogen Mitchell, Director, Intensive Care, The Canberra Hospital, Garran ACT 2605, Tel: 02 6244 3423, email: Imogen.mitchell@act.gov.au

Who can I contact in General?

10. Should I have any problems or queries about the way in which the study was conducted, and I do not feel comfortable contacting the research staff, I am aware that I may contact the ACT Human Research Ethics Committee Secretary, Building 10, Level 6 the Canberra Hospital, Garran ACT 2605 or on telephone (02) 6205 0846.

Appendix K: Consent Form for Human Element Study

Intensive Care Unit
Yamba Drive, Garran ACT 2605
PO Box 11 Woden ACT 2606
[illegible]
ABN 82 049 056 234

Consent Form to Participate in a Research Project

I, ______________________________
(name of participant)

of ______________________________
(street) (suburb/town) (state & postcode)

have been asked to consent to participation in a research project entitled:

'A qualitative assessment of the holistic perspective on understanding why healthcare workers fail to recognise and respond to deteriorating patients through workplace experience'

In relation to this project I have read the Participant Information Sheet and have been informed of the following points:

11. Approval has been given by the ACT Department of Health Ethics Committee.

1. The aim of the project is:

To gain insight into why healthcare workers feel that they fail to recognise and respond to deteriorating patients.
To re-design ACT Health's multifaceted intervention for the recognition and response to deteriorating patients based on the material received during the project.

12. The results obtained from the study may or may not be of direct benefit to the care of my patients.

13. The project will involve a focus group lasting 120 minutes where discussion and reflection will occur in an effort to try and develop ideas, critical incidents and why or why not intervention occurred as a means of understanding why the case story unfolded as it did. Six volunteers will sought to undertake further examination of the themes identified through the focus groups.

CANBERRA
HOSPITAL
A division of ACT Health

Intensive Care Unit
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PO Box 11 Woden ACT 2606
Phone: (02) 6244 2222 Fax: (02) 6285 3020
Website: www.health.act.gov.au
ABN: 82 049 056 234

Consent Form to Participate in a Research Project

I, ______________________________
(name of participant)

of ______________________ ______________________ ______________________
(street) (suburb/town) (state & postcode)

have been asked to consent to participation in a research project entitled:

"A qualitative assessment of the holistic perspective on understanding why healthcare workers fail to recognise and respond to deteriorating patients through workplace experience"

In relation to this project I have read the Participant Information Sheet and have been informed of the following points:

11. Approval has been given by the ACT Department of Health Ethics Committee.

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14. Should I develop a problem which I suspect may have resulted from my involvement in this project, I am aware that I may contact –Dr Imogen Mitchell, Director, Intensive Care, The Canberra Hospital, Garran ACT 2605, Tel: 02 6244 3423, email: Imogen.mitchell@act.gov.au

15. Should I have any problems or queries about the way in which the study was conducted, and I do not feel comfortable contacting the research staff, I am aware that I may contact the ACT Human Research Ethics Committee Secretary, Building 10, Level 6 the Canberra Hospital, Garran ACT 2605 or on telephone (02) 6205 0846.

16. I can refuse to take part in this project or withdraw from it at any time without affecting my workplace environment.

17. Participation in this project will not result in any extra costs to me and can occur during working hours, at the discretion of my area supervisor.

18. I understand that the results of the research will be made accessible and that my involvement and my identity will not be revealed.

After considering all these points, I accept the invitation to participate in this project.

I also state that I have/have not participated in any other research project in the past 3 months. If I have, the details are as follows:

Name: ______________________________

Witness: ______________________________________
(Please print name)

Signature: _________________________ ______________________________
(of participant/volunteer) (of witness)

Date: ______________

Investigator's Signature: ____

ALICE

Appendix L: Alice's Story

The following is a detailed history of my daughter's assessments by the GP and my account of the medical and nursing management in the Emergency Department (ED) and then in the ward of The Canberra Hospital (TCH).

I have included the GP assessments leading up to our referral to ED as, I believe, they demonstrate the appropriate use of the primary health care system. I am left wondering of what significance are the primary health care interventions and the individual assessment of the GP and subsequent referral to the ED on how the ED triages the patients? My experience tells me primary health care assessment and subsequent referral is of no importance ie makes absolutely no difference to the way a person is managed when presenting at the ED. And yet I am so aware that the ED should be used by those in the community who need timely and probably emergency access to the skill and expertise available in the ED.

Overview of Alice's Illness

Alice was assessed on;

- Wednesday March 18 2009 at 1330 by our GP with mild rash, had bloods taken. Noted that Alice had had a urinary tract infection January 30 2009;
- Thursday March 19 at approximately 0830 again by our GP, widespread erythema multiforme, low grade fever, referred to an immunologist;
- Thursday March 19 approximately 1130 seen by the immunologist, more bloods;
- Friday 20 March at 0830 seen by our GP, referred to ED of TCH;
- Friday March 20 arrive ED TCH with referring documentation. Confirmed Epstein Barr virus (EBV), glandular fever;
- Discharged TCH, March 20 1700;
- Saturday March 21, 1030, home visit by a close friend who is a GP, provisional diagnosis pneumonia, must be admitted, referred to admitting specialist of the day;
- Saturday March 21, 1130 arrive ED TCH, provisional diagnosis mycoplasma pneumonia;
- Saturday March 21, 2345 admitted, paediatric ward;
- Sunday March 22, 0800, transferred high dependency paediatrics;
- Sunday March 22, 1700, transferred Intensive Care Unit (ICU), intubated.

ALICE

Aged 16 years old

The following is a detailed history of my daughter's assessments by the GP and my account of the medical and nursing management in the Emergency Department (ED) and then in the ward of The Canberra Hospital (TCH).

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- Sunday March 22, 0600, transferred high dependency paediatrics;
- Sunday March 22, 1700, transferred Intensive Care Unit (ICU), intubated;

- Sunday March 29, extubated;
- Wednesday April 1, transferred to ward 6A;
- Saturday April 4, discharged home

Alice's provisional diagnosis made earlier in the ED on Saturday March 21 was mycoplasma pneumonia, noting positive EBV and the erythema multiforme. Her condition continued to deteriorate throughout Saturday and all of Sunday. As her mother I will never forget that Sunday. My daughter was so very ill and I felt completely powerless to have someone, anyone do anything other that simply look at the monitor and walk out of the room and leave me with her. I was anxious and fearful. It was not until I asked "does my daughter have to have a respiratory arrest before someone will do something?" that action was taken.

The ICU specialist came to Alice's bedside in the high dependency unit introduced herself, saying that she had been requested to review Alice and, without laying a hand on her, informed me that my daughter was critically ill and must be transferred to the ICU and that my family should be notified and come immediately. My heart sank...............I knew that this was very serious for my daughter.

I still believe that either someone or something failed my daughter on that weekend. In looking back later on the Saturday and Sunday as the hours passed, I should have insisted that she be reviewed with a view to intervention and much sooner as I most certainly had presided over copious monitoring and review but a seemingly total lack of clinical assessment and decision making affording early intervention in order that her deterioration was halted.

Early signs of Alice's developing illness

- Woke on **Monday March 12**, following a restless sleep, and noticed a fine pin point rash on the palms of her hands and on the abdomen, though very faint;
- Attended school as usual;
- did not sleep well Monday night, though not really complaining, as school activities very demanding and at her own admission "I'm just tired";
- Slept poorly Tuesday night;
- Wednesday morning rash more visible, red and raised in places and had spread up forearms and across abdomen. Alice stated that "I only feel really tired". No temperature, no itching, not hungry;
- Alice attended school as usual (she had a math exam);
- I decided to phone the GP and see if someone could see her, just in case;

- Attended the GP at 1330, **Wednesday 18 March**. On seeing Alice it was obvious to me that the rash had spread and was generalized over her body. Our GP described the rash as erythema multiforme. Only complaint was tiredness, not febrile, no itching. Prescribed antihistamine and referred for range of bloods. **NB** Alice was diagnosed with a Urinary Tract Infection on 30 January 2009. She has never had UTI and her only symptom was a low back ache, no temperature, no frequency, no burning, no fatigue, pathology E-coli, treated with antibiotics. (Alice is not sexually active). She made what to me seemed a full and uneventful recovery.
- Distressing night, rash widespread much denser in places and raised, uncomfortable and fever 38, no sleep at all;
- I took Alice back to our GP on **Thursday (March 19)** morning. Our GP consulted and both agreed that she should see an immunologist, whom we saw in the pathology dept of TCH. His assessment was she probably has "infectious mono", agreed that the rash indicative of infection and use the polaramine as prescribed. He ordered repeat bloods and told me to phone tomorrow for the results;
- I took photos of the rash (from Thursday to Saturday morning) as I was not convinced that I would be able to describe it adequately, should it somehow disappear!
- I was slightly anxious as the afternoon wore on and I decided to contact the immunologist, unsuccessfully. I was still concerned so decided to try for "the registrar", whom I did not know nor did he know me. I explained my situation to the registrar, who did his best to assist me. He confirmed that the blood results would not be available until tomorrow, and that he would make sure that he called me with the results.
- Thursday night was distressing for me as I could not alleviate her discomfort. Alice visibly distressed, unable to tolerate standing, not cooperative with fluids, febrile 38-39, tepid showers, cold packs to try to sooth the heat generated from the rash. I noted her rapid pulse 100 and she had started coughing;
- I arrived unannounced at GP, **Friday March 20**. Following assessment by our GP, Alice was referred to the Emergency Department of Canberra Hospital. Our GP provided me with a referral letter and phoned the "admitting Officer" regarding our attendance.

Emergency Department (ED) activity, Friday March 20.

I am now very concerned for my daughter as she is clearly much worse.

As we waited at the glass partition to be triaged, Alice was unable to sit on the seat, so I laid her down while my letter and our details were being processed. The person, an RN I assumed, behind the glass screen called out that she "should sit up as you have that rash." I was taken back by the remark and immediately responded that she was too ill to sit, by which time my husband was back from parking the car and he cradled her as I asked please could we lay her down on a bed somewhere?

We were shown to a bed behind the front reception, where Alice could lie down. Her general observations were taken and the nurse asked Alice how long she had been sick. She responded with "a few days I think, is that right Mum?" she asked. At which point the nurse asked Alice, "How old are you?" To which Alice replied "I'm still 16", "well in that case you are old enough to tell your own story", said the nurse. This comment was uncalled for and unprofessional in my view. Alice is an intelligent young woman; the circumstances were obvious, just looking at her indicated that she was very sick. I noted for the nurse that there is a letter from the GP that I had handed through the glass partition (not sure to whom I gave it), but she wanted me to proceed and provide the history for Alice to date, which I did. I did not observe the GP referral being read.

We were then moved to a single "room" in the ED. The resident and RN came and asked the same questions regarding her history and I re-iterated the story again. I asked could the immunology registrar please be paged, explaining that I had spoken with him and been seen by an immunology consultant the day before. I was told that he would be paged when necessary to which I replied that I thought it appropriate and I would be happy to call the registrar using my phone, to which the nurse replied that that would not be necessary.

There was general agreement that Alice was dehydrated, should have IV fluids and further bloods and she was given maxalon. The immunology registrar came, confirmed Epstein Bar Virus, Glandular fever. This was a relief, we had a diagnosis. One of my sons, like many other adolescents, had had glandular fever............but I was uneasy as he did not ever look like Alice did now......covered head to toe in a fiery rash, lethargic, hot, coughing, unwilling to weight-bear, and asking "can't I just go to sleep, am I going to be alright Mum?"

We were discharged home at approximately 5pm.

Later that night I read the discharge summary that the resident had provided for our GP. That summary of the day's events describing my daughter as having a rash and unwell to me was a total understatement and in no way gave the reader a true picture of the patient and how unwell she was.

Friday night, through to Saturday morning was another simply terrible night. Alice was febrile 39+, very uncomfortable with the heat from the rash. I continued with showers, cold compresses, and fan all night.

Her coughing was increasing, her pulse was 110 -120 and her breathing was "more shallow" and she kept telling me "I just want to sleep". Both of us were now very fatigued as we had not slept since Wednesday night.

Emergency Department (ED) activity, Saturday March 21.

Saturday morning and I am very alarmed. Alice is worse, erythema multiforme very pronounced, respirations rapid, she has had very little to drink. I did not want to simply re-appear at the ED as I did not want to have to go through the whole saga of her illness/history again. I called a personal friend, a GP, who came to the house (1030) and took one look at Alice and said she has pneumonia and must be admitted. I requested could we somehow avoid having to sit in the waiting area as this was so distressing to Alice yesterday. The GP contacted the admitting officer, who said to send her in and was I happy with the physician on for the day and I confirmed I was.

We arrived at the ED at approximately 1130. Alice was unable to walk, let alone hold her head up, I put her in a wheelchair presented at the glass grill, and almost immediately asked "could I please lay her down". To my complete amazement the whole triage process began again. I advised that the GP had referred us and that the admitting officer knew we were coming and that we had been here all day yesterday and please can we come inside and lay her down. The nurse said "OK. Come through" which meant that I pushed Alice through the door but she then had to remain sitting in that chair with me trying to support her, while the nurse found her on the system. My husband had returned from parking the car and I asked could he come in and the nurse actually said "no, there's not enough room."

I cannot adequately articulate how that initial interaction with the triage nurse felt. Completely gob smacked by the lack of professionalism of the nurse and her seemingly complete inability to use her eyes to make an assessment that this young girl was very ill, very hot, shocking rash and with laboured breathing. We had to wait in the wheelchair while her details of yesterday were confirmed and her vital signs were recorded.

We were taken back to the single room in the ED we had occupied the previous day. We then had a resident (very pleasant young woman) who went through the whole history taking again. I asked her where the file notes of yesterday were as they would provide the overview ....but she insisted on me re-telling the entire story for her to be able to make document her own assessment. A registrar in ED, came in, had a chat said more bloods would be required, that Alice was 'dry' and needed fluids and that the resident would attend to this. Alice looked at me with alarm as the previous day the IV line and the bloods had been difficult in her dehydrated state and distressing to her. I said to the resident, after two failed attempts and my daughter visibly distressed, please could some-one else try. She agreed. The ED registrar returned and said he would do it, but there was an ankle that needed re-alignment and some other orthopaedic type casualty and he would be back soon.

I noted that she wanted to sit up a bit more, her coughing was getting worse, temp still up, heart rate fast. I can't re-call if the nasal oxygen had started at this stage, but oxygen via nasal prongs was started.

In the meantime the consultant physician came in and consulted with us. His assessment was that Alice had mycoplasma pneumonia. She needed IV fluids, antibiotics and would need to be admitted to hospital. I was relieved and commented that I didn't think that she could only have glandular fever and be this sick. We thanked him and he left.

It took a few more hours before the IV line went in. My daughter was exhausted, continually coughing, febrile, tachycardic, not saturating well. The rash was flaming hot, itchy and very uncomfortable and further complicated by the fact that she had reacted instantly to the bolus dose of antibiotics she had been given earlier. Her hands and feet in particular required ice packs for the blisters and general comfort. We spent 12 hours in ED "under observation." People came and went, they didn't say much, some did obs others just looked and slowly my daughter deteriorated. The night RN came on at 9pm. She asked me how I thought Alice was, asked Alice how she was, to which she said "I've never felt so bad ever," I said I was very worried as she is really struggling to breath and asked, perhaps naively, why is she having to work so hard and shoudn't she be improving a little?. She was most professional in explaining and talking frankly with me about how sick Alice was, that there was not a bed available at the moment, but that she would be with us until she could be moved to a ward or somewhere suitable. She got me a comfortable chair and blankets showed me the tea making facilities and offered me a sandwich. Her kindness and thoughtfulness was much appreciated as I was truly feeling the strain of what was now 3 full days of watching my daughter slide downhill.

At about 10pm it was decided that Alice should move to the paeds area in ED. The RN who took over her care, whose name I cannot remember was most professional and attentive to observations, but had other smaller children to provide care to. I was becoming more fragile (very teary) as my daughter was not improving and seemed more agitated, given the constant coughing and I am not exaggerating when I say constant. By this stage I think she had had about 10 litres of fluid. I discussed with the RN that I thought she was getting worse. She was now sitting upright most of the time, draped over the bed side table or over my shoulder, saying to me "I can't do this anymore Mum" and then started talking about random, disconnected thoughts, she was delirious........I consoled her by saying that you sometimes say 'funny' things when you are really tired, try not to worry.

A doctor came up to the bed, I have no idea who he was and he did not introduce himself nor tell me what he was doing. It became evident he was assessing her for a move, and assessed that she would go to paediatrics as she was still 16. I asked “is she going to be monitored?” to which he replied "there are monitors by the bed." And that was the extent of the "consultation." He did not ask me one single question. let alone acknowledge how sick my daughter was, or how I might be feeling about the situation!

Hospital admission

Sunday March 22

We were in the ED until nearly midnight when Alice was transferred to a paediatric bed. My husband insisted that I go home have some sleep and he would stay with our daughter. I left, reluctantly, at approx 0045. I knew that I would be of no use if I did not have some sleep and I re-assured myself that she was now in the hospital and in good hands. As I drove home it crossed my mind that Alice had not had a chest x-ray......... and that I had not seen anyone Dr or nurse listen to her chest......or talk to me about her. When I got home I rang the ward, spoke to the night nurse re my concerns (I could hear Alice coughing) and was assured that she would be reviewed regularly.

My husband's account of the night was disturbing. At about 2.30 a female doctor (no name or introduction) came in response to my husband asking about cough suppressant. This doctor again asked for a full history (i.e. start at the start) which he provided and ordered nebulized oxygen. At 4am another doctor appeared, no name given, though he was pleasant. He took bloods and did that skillfully and asked again for a full account of Alice's history. About 04.30 - 0500 another doctor came, neither introduction nor purpose for visit offered, but more history wanted. My husband told him he had told the story enough for one night and that he could read the notes afterall isn’t that what they are for and then my husband assured him he would be happy to answer any queries or provide clarification. From the description my husband gave me my guess is that it was the same doctor who saw Alice in paeds ED at approx 11pm.

My husbands report to me (by phone) the next morning was "She's coughed all night, she's so tired, she looks awful. Three doctors have seen her, but they didn't say anything to me, they've taken blood and put a nebuliser on her which seems to have made her a bit more comfortable and now (0500 - 0600, Sunday March 22) she is being transferred to high dependency in paeds, so they can watch her more closely”.

High Dependency, Paediatrics

As I drove back to the hospital early on Sunday I remember thinking what is happening, why is Alice so sick, what is missing? What am I going to do to help my daughter?

Looking at Alice that morning, I noticed several things:

- Face very red and swollen;
- Eyes very puffy and bloodshot;
- Rash more noticeable on ears and ears swollen;
- Fluid very noticeable in arms and legs
- Rash on arms and legs red ++
- Sitting bolt up-right in the bed;
- Coughing every few minutes;
- Grimacing while coughing;
- Nebulised oxygen in place; and
- IV fluids still running.

Alice was so very happy to see me and said how she was so tired and could I help her sleep. I tried to prop her over the bedside table, but she was unable to breath and the coughing…….. She asked me "am I going to get better?" to which I replied very firmly "of course you are."

I introduced myself to the RN and asked her "how do you think she's going?" "She's very sick………..." was the reply. I asked about the medical team and when would she be reviewed. The consultant paediatrician came in with his team sometime in the morning, I cannot remember exactly when. He confirmed that Alice was being treated for pneumonia. I do not remember much more of note in that consultation and perhaps I thought that I would see him again that day, but I have never seen him since, not even in the ICU.

Later, around lunch time my observations were:

- Heart rate 120+, resps up to 45 sometimes more when coughing, BP 80/60, sats 75-80;
- Not cooperative with oral fluids;
- Whole body appeared bloated;
- I could re-call that she used the pan once;
- Very dry around the mouth;
- Complaining of very sore ears, they were very swollen;
- Saying that she could not see well and her eyes were sore, they were very bloodshot;

- Continual cough that at times was productive, but always very distressing to her; and

- Moving in and out of rational and coherent discussion and sometimes asking me, "what am I talking about mum?"

One of my sons came and remarked "gee mum Alice is all swollen, even her eyes are, and that fluid would make you cough wouldn't it?" My mother-in law and sister-in law were reduced to tears as they saw her "she looks so sick….." My 85 year old mother-in law then slowly but clearly said to me "what is going on, can't you see she's dying." That moment is also clear in my mind…….and I continued to care for my daughter.

About lunch time the RN shift change occurred and a very pleasant young woman, I cannot recall her name, was assigned to care for Alice.

I asked the RN for more normal saline for the nebulizer. She immediately gave me one and also provided a supply at the edge of the desk at the nurse's station that I could get as required. While this gave me instant access to the normal saline, I was concerned that she didn't think it necessary to monitor the number of times I needed to re-fill the saline and it was often.

Alice's rash was hot to touch, raised and itchy. The itchiness was compounded by the fact that as a result of the antibiotic that was given in ED she had blisters on her hands and feet and burning sensation all over her body which was driving her mad. I asked the same nurse for ice which she provided and I rotated those bags around my daughter's very red, itchy and swollen body and I cried as she rambled about school and various bits and pieces of her life. She was delirious…. The nurse did not stay in that room for more that a few minutes at a time, long enough to provide the ice bags or look at the monitor. At no stage was I ever engaged in a discussion with the nursing staff about Alice's status, nor did I ever see a more senior nurse come and either clinically review her or at least look at her. This was in an area called paeds high dependency, where the nurse has either I or 2 patients to monitor and provide care to and yet I spent most of the time in that room alone with my daughter. I was uneasy.

My husband had a public open day work commitment that Sunday and I had assured him that we would be ok and he should go to work. I had spoken to him several times on the phone during the morning, raising my concern at her lack of improvement and how difficult it was for her to breathe. He re-assured me "they know what they're doing, they are the experts, and she is in hospital and will be ok."

Alice was finding it increasingly difficult to get comfortable, her bottom was sore and her lower back was aching, not to mention the discomfort from the hot, itchy rash. This was not at all surprising given that she had basically been resting on her back and/or sitting almost upright since Friday. I decided that I should try calm and comfort her with hand and back wash, clean her teeth and change her pyjama's and re-position her. I maneuvered her to her right side. She lasted seconds, panicked she said "no no mum I can't breathe." I sat for about the next half hour with her draped (rather awkwardly) over my shoulder. It was during this time that I noticed her coughing had reduced. I asked her was she ok, she said "I've worked it out; if I sort of don't breathe I don't cough." I held her for a few more minutes, she was calm and then I panicked.

I laid her back, went out to the nurse's station and said abruptly,

"Does my daughter have to have a respiratory arrest before anyone does anything?"

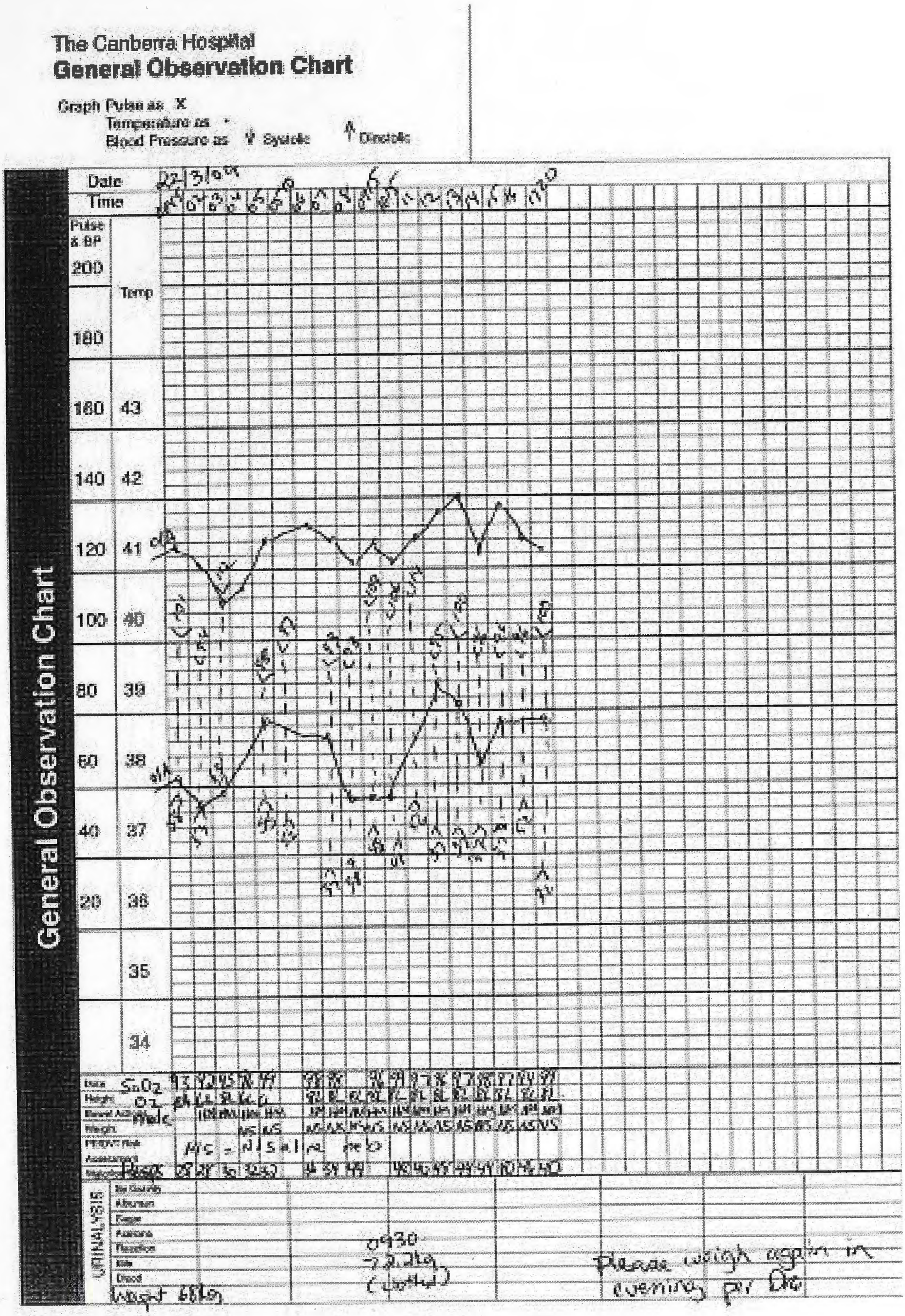
A person appeared and introduced herself to Alice and me as the intensivist, who had come to review Alice. Almost immediately she beckoned me to follow her. She informed me that my daughter was critically ill and that she would need to be transferred to ICU to have her breathing assisted. She further stated that I should contact other family members immediately. I was emotional to say the least, on one hand I was so relieved that someone had made a decision that would see Alice treated on the other I knew that this was confirmation of what I knew to be true, her continued deterioration. After all you don't take a 16 year old healthy girl to ICU simply to assist them to breathe!

Alice was transferred to the ICU from the paediatric high dependency area on Sunday March 22, 2009 at approximately 5pm, from which time her treatment was exemplary. By 7pm she was intubated. At this time my family, my husband and two sons, met the intensive care specialist and the ICU staff for the first time. She told us to prepare for the fact that our daughter may die. We were shocked to hear these words. Little did we know that this was to be the beginning of life altering experience for us as a family and for my daughter in particular?

That Sunday is stamped in my memory for many reasons, the most significant of which is that I was unable to get adequate and timely clinical intervention for my daughter when she needed it and that may have prevented her admission to the ICU. The trauma for our family and for me in particular, leading to her admission to ICU, and during the week that followed and the enormous impact the events have had on Alice's health and schooling cannot be overstated.

Alice's recall of events from the Wednesday 18 March through to extubation on the 29 March 2009 is at best sketchy. This has caused her great difficulty in understanding what happened to her and of course why. She has proven however to be a most determined and resilient young woman and she is beginning to accept and understand what occurred, what effect that has had on her mental and physical health and that, in time, she should return to her strong capable healthy self.

Appendix M: Alice's Observation Chart



The Canberra Hospital

General Observation Chart

Graph Pulse as X

Temperature as •

Blood Pressure as ∨ Systolic ∧ Diastolic

Weight 68kg

0930
72.2kg
(Wetted)

Please weigh again in evening per Dr